READING ACQUISITION OF ADULTS
WITH SEVERE CONGENITAL
SPEECH AND PHYSICAL IMPAIRMENTS:
THEORETICAL INFRASTRUCTURE,
EMPIRICAL INVESTIGATION,
EDUCATIONAL APPLICATION

by

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A thesis submitted in conformity with the requirements
for the Degree of Doctor of Philosophy
Department of Human Development and Applied Psychology
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Abstract

Reading Acquisition of Adults
with Severe Congenital Speech and Physical Impairments:
Theoretical Infrastructure, Empirical Investigation,
Educational Application

Degree of Doctor of Philosophy, 1998

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Theoretical issues pertaining to both ecological and reading acquisition factors were addressed. Two empirical descriptive studies were conducted. In Study 1, a battery of reading acquisition skill tests was given to 107 Kindergarten students in order to obtain performance measurements of nondisabled children at the onset of reading. In Study 2, communication competencies were evaluated, ecological information was obtained and an expanded battery of tests was given to 32 adults with SC SPI, of whom 31 had used Blissymbolics as their initial primary communication system. A multi-tiered model of analysis was used for examining the data.

The results showed (1) an overall lower reading performance of adult subjects with SC SPI in comparisons on standardized tests with the norms of nondisabled adults, (2) a similar pattern of performance on informal reading related tasks in comparisons between adults with SC SPI and children at comparable phonological recoding levels, (3) statistically significant performance differences between SC SPI subjects with phonological recoding skills and those without, and (4) a pattern of higher
reading achievement associated with stronger environmental support *irregardless of articulatory ability*.

An argument is presented that the failure to find a different pattern of reading acquisition skills between the SCSPi and nondisabled groups at similar phonological recoding levels precludes a primarily endogenous explanation for the generally lower reading level of persons with SCSPi. Rather, the higher ecological ratings associated with higher reading achievement and higher performance in language and cognitive measures provide support for an exogenous etiology. Limitations relating to print access, literacy instruction and literacy expectations are proposed as primary causal factors of lower reading performance of learners with SCSPi rather than their severe speech limitations to which reading difficulties are typically attributed. Lower performance in tasks measuring nonverbal intelligence, receptive language and working memory are attributed to a reciprocal relationship between reading ability and the efficiency of these cognitive processes.

A Profile for Reading Acquisition and an Ecological Checklist are proposed for use within *Writing and Reading with the Internet and Bliss (WRIB)* — a new Educational Application emphasizing explicit, analytic teaching of spelling-sound correspondences and using the learner's experience with Blissymbolics as a language resource.
Acknowledgements

This thesis is dedicated to the many persons with a severe congenital speech and physical impairment (SCSPI) whom I have had the privilege of knowing since the late sixties. Each person I asked to participate in this study, responded positively and enthusiastically! I am indebted to every one of them — Dennis Barrow, Chantal Bedard, Cam Calfas, Ron Carrie, Russell Cecchini, Justin Clark, Roberto Colautti, Valerie Cruse, David Dawson, John Dowling, Darlene Gallant, Gregory Gittings, Treena Guy, Kari Harrington, Barbara Hertel, Carolyn Henry, Martyn Humm, Nancy Irvine, Christine Jimenez, David Jones, Larry Kekish, Robert Loree, Paul Marshall, Terry Martin, Nola Millin, Trudy Peters, Ann Running, Deborah Scott, Aaron Shelbourne, Paul Sullivan, Alan Sunislooe, Victor Valentic, David Watson. They have taught me much!

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To my supervisor, Peter Lindsay goes my deepest appreciation. This project would never have been completed without his encouragement to address issues as I saw them. He always urged me to explore ideas from my particular vantage point as a long time educator and friend of AAC users. I thank him for his support and empathy as I struggled to analyze the results of group comparisons while maintaining my interest in the development of each individual, for his many worthwhile questions and suggestions, and for his patience as I grappled with statistical issues. His sincere excitement when I promised to give him the final draft the week he went on holiday was genuine, and typical of his attitude at every stage of this project. His continued support even as he suffered serious health problems will always be remembered.

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Most of all, I thank my family for making it possible for me to enjoy a career in education and ongoing academic study, as well as the joy of family life. The people who have been closest to me were always in my thoughts as I worked on this project: my mother who was without speech for eight years prior to her death, who believed strongly in
the value of education and who sacrificed much to ensure that I would have the opportunities she missed; my father, who came to understand why teaching and studying were important to me as he volunteered and began to meet many of my friends with SCSP in his later years; my son David and his wife, Janice Light, whose AAC perspectives always generate new thinking on my part and whose enquiries and discussion regarding my thesis, tucked into the busy days of family visits, meant much to me; my grandchildren, Christopher, Kathryn and Matthew who are always reminding me how language and literacy is acquired by speaking children in a home filled with love and with learning adventures; my son, Kevin, who has discovered the same joy as me in having a career that includes helping persons with special life challenges and because of this, with whom there is so much to share.

I save the most important person to the last — my husband Bob. Although this thesis is dedicated to those who participated as subjects in Study 2, it owes its existence to Bob. I will always treasure his unquestioning confidence in the worthiness of this project and his belief in the importance of what I have chosen as my life work. He ensured that none of the important things in our life together — family, friends, our home and our caring for each other — would be sacrificed while I devoted extensive time and thought to this endeavour. He was always there, a wonderful partner each step of the way! For that and everything else we share, I will be forever grateful.

Permission has been granted for the inclusion of the following material in this thesis:
1. Model of Reading, Figure, appearing on page 38:
2. Diagnostic Model, Figure, appearing on page 44:
3. Model of symbolic representational system learning, Figure/explanatory text, pp. 21-24:
4. Evaluation of Spontaneous Communication with Focus on Blissymbols, Rating scale, appearing in Appendix 3-2-C: from Margareta Jennische, Dept. of Phoniatrics, Uppsala Academic Hospital, Uppsala, Sweden.
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SECTION I
GENERAL INTRODUCTION

Writing has a method and a purpose; to read, one must master both....
More than ever before, methods of teaching reading must be the best they can possibly be.

Adams, 1990, p. 26

Adults who lack functional speech have a vested interest in improved methods of teaching reading. Few have attained a literacy level that enables them to read with ease and enjoyment. They recognize that their learning needs are confounded by their speech and physical impairments and that reading seems to require greater effort from them than from their nondisabled peers. Nonetheless, most adults with severe congenital speech and physical impairments (SCSPI) are highly motivated to improve their reading skills. They realize that as they were growing up, professionals lacked the knowledge necessary to provide relevant reading instruction. Individuals with SCSPI who wish to continue their literacy learning as adults deserve methods of teaching reading to be the best they can possibly be.

The Operationalized Task

This thesis addresses the immediate need for an assessment and mediation-based instructional methodology for adults with SCSPI to further develop their reading skills. The investigation is motivated by the desire to better understand the factors relating to persons with SCSPI learning to read and to apply this knowledge in a manner that enables each adult with SCSPI, who is so inclined, to become a controlling partner in his or her reading acquisition program. The underlying premise is that increased understanding of the issues involved can lead to many more persons with SCSPI acquiring reading.
To relate to the well-recognized and formidable research challenges posed by this scattered and diverse population (Beukelman, 1992; Lindsay, 1990; McNaughton, 1990a; Mirenda, 1990; Rowland, 1992; Todman, 1994), a multi-level approach has been used.

First, a theoretical infrastructure was developed in which reading acquisition is positioned within a broad representation of language development (Snow, 1991), adapted by McNaughton (1992c). A model of symbolic representational system learning, developed by McNaughton and Lindsay (1995) to portray the unique life situation of persons with SCSPi, provides the context. From this base, a scaffolding for an empirical investigation was constructed, drawing upon (a) the literature pertaining to reading acquisition by nondisabled children, (b) findings arising from studies pertaining to reading acquisition by persons with SCSPi, and (c) the author's experience and writings from over 25 years of interacting with and learning from persons who use augmentative and alternative communication (AAC).

Second, two empirical studies were undertaken, the first with 107 Kindergarten children, the second with 32 adults with SCSPi all of whom used AAC systems. The reading acquisition and reading related tasks within each of the studies and the ecological factors examined for subjects with SCSPi were linked to the constructs identified in the theoretical infrastructure.

Third, an Instructional Reading Program was proposed, grounded on the theoretical infrastructure and the findings of the two empirical studies. Throughout the investigation, the attempt was made to be sensitive to the life experiences of adults with SCSPi, while integrating the extensive literature relating to reading acquisition by nondisabled children with the available empirical and experiential knowledge concerning persons with SCSPi.

The term "acquisition", as used throughout the text entitled Reading Acquisition, edited by Gough, Ehri and Treiman (1992), has been used in this thesis. It denotes that the ability to read must be learned or acquired and cannot be viewed solely as a result of development within a literacy rich interactive environment. In developing the theoretical rationale for the Educational Application phase of this investigation, reference will be made to the importance of learning that is constructivist in nature. At an early stage of acquisition the constructivist learning is exogenous (learning that requires explicit instruction). At a later stage of literacy acquisition it becomes endogenous (learning that is self generated) (Stanovich, 1994).
The Current Status of AAC Literacy Research

Reading acquisition has long been recognized as an area of difficulty for persons with SCSP (Koppenhaver, 1991; Schonell, 1956; Silverman, McNaughton & Kates, 1978). It is only in the last decade, however, that professionals within the field of augmentative and alternative communication (AAC) have begun to direct their attention to this topic. Most of the initial papers have been speculative or have focussed primarily on clinical concerns, e.g., instructional and environmental considerations (Foley, 1993; Koppenhaver, Evans & Yoder, 1991; Kopenhaver & Yoder, 1993; Light & D. McNaughton, 1993; Pierce & McWilliam, 1993) and the role of computers in promoting literacy (Steelman, Pierce & Kopenhaver, 1993). There have been discussion papers relating to factors contributing to literacy development (Koppenhaver & Yoder, 1992), phonological processing and spelling abilities (Bishop, Rankin & Mirenda, 1994; Blischak, 1994; Vandervelden, 1990), the relationship between graphic representational systems (GRSs) and literacy (Bishop, Rankin & Mirenda, 1994; S. McNaughton, 1993; S. McNaughton & Lindsay, 1995), and the role of metalinguistic skills in learning to read (Hjelmquist, Dahlgren Sandberg & Hedelin, 1994).

In spite of the increasing frequency in current AAC publications and conferences, of references to reading and writing deficits among individuals with SCSP, research investigations have not kept pace with clinical concerns (Koppenhaver, 1991). Support to this observation was evident recently at the 7th Biennial Conference of the International Society for Augmentative and Alternative Communication, held in Vancouver, August, 1996. Of the 20 papers pertaining to literacy, 6 were research related and the remaining 14 were clinical, product-oriented or discussion papers. Concern regarding the lack of empirical studies in all areas of AAC was evident at the Fourth ISAAC Research Symposium, co-chaired by Lindsay and Bjorck-Åkesson, that followed the 1996 Vancouver conference. This smaller meeting provided a forum for the discussion of AAC research-related issues and the establishment of collaborative links between conferences. Literacy research, while not on the 1996 agenda, was identified as a topic for inclusion in future research seminars.

Although empirical AAC literacy studies have been few, there are noteworthy examples reported in the current AAC literature. Two surveys offer valuable information — one, a retrospective survey by Koppenhaver, Evans and Yoder (1991) of 22 literate adults and the second, a survey of parents and teachers regarding the
home and school literacy experiences of students who use AAC systems, by Light, Koppenhaver, Lee & Riffle in 1992 (unpublished manuscript, results described in Light & D. McNaughton, 1993). In addition, the early literacy experiences of preschoolers who use AAC have been investigated through two studies, one that compares their experiences with that of their nondisabled peers (Light & Kelford Smith, 1993) and one that analyzes the story reading interactions between preschoolers and their mothers (Light, Binger, & Kelford Smith, 1994). Two literacy-related studies have been undertaken at the University of Toronto, one by Koke and Neilson (1987) investigating the effect of auditory feedback on the spelling of persons with SCSPI, and the second, a study by Kelford Smith, Thurston, Light, Parnes, & O'Keefe (1989) that examined the written communication of persons with SCSPI.

Within the sparse AAC literacy research literature, only a few papers relate specifically to the skills required for reading acquisition. Case studies by Berninger & Gans (1986a) and Smith (1992) in which reading related test performances were reported have been published. Foley has conducted two studies examining phonological recoding, first with 8 subjects and then adding 4 subjects to conduct analyses with 12 congenitally anarthric and dysarthric subjects (Foley, 1989, 1993). Bishop and her colleagues at the University of Manchester, in their study of subvocal articulation, have undertaken three experiments with subjects with cerebral palsy, relating to short-term memory and rhyme judgement, phoneme-grapheme conversion and phoneme discrimination (Bishop & Robson, 1989a; Bishop & Robson, 1989b; Bishop, Brown & Robson, 1990). The most comprehensive investigation to date has just been completed by Dahlgren Sandberg (1996). It examined the reading and spelling skills of 42 Swedish children and adolescents, 5 to 20 years of age and with severe motor and speech disorders.

A large percentage of the clinical and research papers published to date have been driven by the ideas of the emergent literacy (Katims, 1991) and whole language (Goodman, 1976, 1986; Smith, 1971, 1973, 1979) learning paradigms. This direction is being given strong leadership by Koppenhaver and Yoder and their colleagues at the

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1 Anarthria and dysarthria refer to motor speech disorders caused by a disruption of the neurological connections to and from the muscles involved in the production of speech. Anarthria denotes a total loss of speech function; dysarthria denotes a partial loss of speech function. The criteria used within this investigation to assess each subject with regard to this disorder are presented in Study 2, Methods section.
Center for Literacy and Disability Studies, formerly of the University of North Carolina at Chapel Hill and now located at the Duke University Medical Center. Within the emergent literacy paradigm, attention is given to the social, linguistic and psychological aspects of early literacy learning (Sulzby & Teale, 1991) and the young child's active involvement in reading activities within a supportive environment (Pierce & McWilliam, 1993). Within the whole language paradigm, an emphasis is placed on the functional dimensions of text and child-centered instruction (Bergeron, 1990). These central precepts offer valuable support to parents and teachers of children with SC SPI. Two attributes of the whole language philosophy have been identified by Adams (1991), however, as meriting serious concern — "a disavowal of the value of teaching or learning phonics" and "subscription to the view that children are naturally predisposed toward written language acquisition" (p. 41). A strong body of literature to refute both these positions has been established during the eighties (Adams, 1990, 1991; Gough & Hillinger, 1980; Just & Carpenter, 1987; Rayner & Pollatsek, 1989; Stanovich, 1984, 1986, 1991, 1994). The need for explicit instruction related to phonological decoding is dealt with at length in this thesis. Support for this view is drawn from mainstream research relating to the early literacy acquisition of normally developing readers and reinforced by the experience of this author and other like-minded practitioners. The concerns expressed by Adams have particular relevance for learners with SC SPI.

Research in the reading acquisition of nondisabled children offers a rich resource to apply to the investigation of literacy acquisition by persons with SC SPI. To date, the findings relating to skill acquisition in normally developing readers have had limited impact on the AAC professional body or upon the educational programs of children and adults with SC SPI.

**Current AAC Educational Practice**

While admittedly small and in its formative stage, it is nonetheless unfortunate that the knowledge base relating to literacy development for persons with SC SPI is known primarily by the decreasing number of teachers working in specialized classes for children with physical disabilities. Within the broader educational system, where many North American children with SC SPI are now integrated, Light and colleagues (1992) have found a significant number of teachers (and parents) who have minimal
expectations for their children with SCSPPI to make any progress in literacy. Some of their reservations may relate to the teacher's increased workload. There is no doubt that the additional demands placed upon the teacher in implementing and maintaining individualized adapted programs in large integrated classes are extensive. Several different and overlapping reasons have been offered for the persistence of teachers' low literacy expectations for children with SCSPPI. Koppenhaver and Yoder (1993) attribute the lack of teacher initiative in adapting literacy instruction for students with SCSPPI to lack of teacher training programs, the absence of specific curriculum and the lack of valid and reliable literacy assessments to monitor student progress. To this, Light & D. McNaughton (1993) have added limited access of teachers to other children who have similar disabilities and who provide examples of successful literacy outcomes.

Paradoxically, while the limited training and resources available to teachers in integrated programs is placing children with SCSPPI at risk for appropriate literacy instruction, the importance of literacy achievement for persons with SCSPPI is gaining wider recognition within the AAC professional community. Not only are literacy skills considered "integral to a child's success in school, a young adult's transition into the workforce, and an adult's ability to live freely and independently" (Koppenhaver & Yoder, 1993, p. vi), but it is acknowledged that literacy competency provides especially vital and unique advantages for the child with SCSPPI. Literacy provides access to language and to text-based technology for expressing ideas clearly both in face-to-face and written communication (Blackstone, 1989; Koppenhaver & Yoder, 1993). In addition, it offers full participation in the emerging information highway and access to the many enriching experiences afforded by telecommunications.

The Role of This Thesis

This thesis responds to the need for better instructional practice so that persons with SCSPPI will have increased opportunities to realize their literacy potential. The investigation exemplifies an attempt to help bridge the gap between mainstream reading acquisition research and AAC clinical and educational practice. It presents a rationale for the approach taken, provides a descriptive analysis of the literacy levels of adult AAC users, offers multi-tiered statistical analyses considered relevant to the population being examined, discusses theoretical issues related to assumptions underlying current AAC literacy research and intervention, and proposes theoretical, empirical and
practical support for an instructional reading program. Following the Introduction, the investigation is reported in three major sections, each corresponding to a phase of the project: Theoretical Infrastructure, Empirical Investigation and Educational Application. The final section, General Discussion, addresses the limitations of the approach taken and discusses the results obtained and the issues raised.
SECTION II
THEORETICAL INFRASTRUCTURE

Acknowledging the complexity of the process under investigation [reading acquisition] and of the investigative processes defies the time-honored principle of parsimony... We must choose between a false sense of simplicity and the pursuit of understanding the complexities of how a biological brain achieves the amazing feat of translating retinal stimulation from squiggles on a page into meaning,


To develop a theoretical infrastructure relating to literacy acquisition for persons with severe congenital speech and physical impairments (SCSPI), information must be selected and integrated from a variety of sources (Beukelman, 1992). This process inevitably requires broad brush strokes. The approach of a "lumper" who deals mainly with general issues (Stanovich, 1992) has been chosen, believing it is warranted at this formative stage in the study of literacy for persons with SCSPI.

This infrastructure contains background information relating to the field of AAC and within it the communication system of Blissymbolics which has been used by all but one of the subjects included in Study 2. To better understand the subjects of the second study, information is provided concerning cerebral palsy and the incidence of persons who use AAC. As well, a model is offered relating to the cognitive, language, motor and social development of persons with SCSPI. A proposal by McNaughton and Lindsay (1995) relating to the visual processing associated with different types of graphic representation is introduced to emphasize what the author believes to be an important consideration in studying persons who use AAC. The research literature relating to mainstream reading acquisition and to reading acquisition for persons with SCSPI is reviewed. By examining the factors involved in reading acquisition, a context is presented for the test selection within the empirical studies. Models of reading and theoretical positions related to instructional methodology are

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Stanovich (1992) distinguishes between "lumpers" and "splitters". He describes lumpers as taking a broad-brushed approach and splitters "tending to see the idiosyncrasies, lack of fit, and discrepancies in new empirical findings" (p. 307).
included in order to provide a rationale for the Educational Application (Section IV). Throughout this theoretical infrastructure, a scaffolding is offered for examining the theoretical issues that underly both research and intervention relating to persons with SCSPPI acquiring reading.

Returning to the lumpert/splitter analogy, the fine tuning of the "splitters" with their refining distinctions must surely follow the lumping that is evident in this investigation. During this formative stage of scientific enquiry, however, the risk of "classifying together phenomena, tasks, and patterns that really call for theoretical differentiation" (Stanovich, 1992, p. 308) is worth the taking, for the vantage position it affords. Having said this, there is need, as well, to examine closely the few studies that have been undertaken relating to the skills involved in the reading acquisition of AAC users. In so doing, this thesis will initiate a few instances of "splitting". The author, in these instances, is aware of a new risk, that of isolating phenomena, tasks and patterns that should have been included within a broader theoretical framework.

The AAC Domain

The term "augmentative and alternative communication (AAC)" has been used since 1983 to specify the interdisciplinary and international field that relates to persons who lack functional speech and who require either a supplement or a substitute for speech. Prior to 1983, a range of terms were used to describe members of this population, including "nonspeaking, nonvocal, nonverbal, nonoral", all of which are now discouraged by those in the field. These terms lack accuracy and, as well, they refer to the inability to speak rather than denote the ability to communicate. The preferred term for individuals who lack functional speech and who compensate with AAC is "AAC user". In this thesis, the descriptive term "severe congenital speech and physical impairment (SCSPI)" has been introduced in order to clearly specify that the persons being studied have lacked functional speech since birth and their severe speech impairment is accompanied by a severe physical impairment.

Augmentative and alternative communication (AAC) is a young field with but a small number of researchers coming from many different disciplines — speech language pathology, special education, linguistics, occupational therapy, rehabilitation engineering, psychology. Until recently, attention has been directed primarily to the
variables related to effective interpersonal communication. Moreover, the population of persons with severe congenital speech and physical impairments (SCSPI) represents a small proportion of persons with disabilities and comprises many different etiologies. As a result, the AAC studies that have been conducted are small in number, relate to different subgroups within the AAC population and for the most part, lack replication. With regard to literacy for AAC users, research can be described as just beginning to move from the speculative "pioneering stage" into the "building stage". As explained by DeMey (1982) in his representation of the growth cycle of specialized areas of science, the "building stage" is one in which "activity is directed toward productive investigations that turn the first stage programmatic statements into solid knowledge supported by empirical evidence" (p. 149).

The Emergence of Augmentative and Alternative Communication

The field of augmentative and alternative communication (AAC) traces its roots back to the 1950s and early 1960s when innovative professionals found substitutes for the traditional speech therapy methods for persons who could not develop functional oral communication (Zangari, Lloyd, & Vicker, 1994). During the 1970s, AAC began to emerge as a recognized area of specialization within the range of services provided to persons with severe speech impairments. In many instances, the speech limitation was the outcome of a congenital or acquired physical impairment rather than a cognitive limitation. As a young field, AAC has attempted to address the needs of many different populations. Persons with cerebral palsy, the population studied in this thesis, are a group within AAC whose communication needs have driven much of the graphic and technical development during the field's first 25 years (McDonald & Schultz, 1973; Silverman, McNaughton, & Kates, 1978; Vicker, 1974; Vanderheiden & Grilley, 1976).

In 1981, the American Speech-Language-Hearing Association (ASHA) issued a formal position paper on AAC (ASHA, 1981) and in 1983 a new professional organization, the International Society for Augmentative and Alternative Communication (ISAAC), was formed. It was not until 1985 that a peer-reviewed journal, *Augmentative and Alternative Communication*, was established. Although there were several important books published during the 70s (Lloyd, 1976; Schiefelbusch, 1977, 1980; Schiefelbusch & Lloyd, 1974; Silverman, 1980), the specialized literature base on which AAC rests is a limited one. In 1986, the first text book devoted to AAC
was published — *Augmentative Communication: An Introduction* (Blackstone, 1986). The relatively small body of literature has made it imperative that AAC researchers draw upon their own and their colleagues' clinical and educational experience to ask appropriate questions and then, carefully, draw upon the knowledge and subject resources of other domains for parts of the answers (Bedrosian, 1995; Higginbotham, 1995; Higginbotham & Bedrosian, 1995; McNaughton, 1990a).

While a large number of clinical programs were developed during the 1970s and 1980s, there was little formal research until the mid to late 1980s. The studies that were undertaken related primarily to communicative interaction, technology techniques, synthetic speech intelligibility, demographic investigations, iconicity and learnability of graphics, intervention strategies and vocabulary selection issues. Much of the research has had practical goals, seeking pragmatic answers (McNaughton, 1990a). In 1986, the keynote speaker at the ISAAC Biennial Conference held in Cardiff, Wales (Crystal, 1986), advocated the gathering of systematically documented case studies as a beginning strategy toward developing an AAC research base. The field responded and a growing number of case studies have since appeared in *Augmentative and Alternative Communication*, focusing mostly upon the issues listed above. As outlined in the Introduction, the present investigation has been undertaken to contribute to the much smaller data base of studies conducted to date that have focussed on literacy development for AAC users.

In the 1970s, Blissymbolics was adapted for use as an AAC system for persons who lack functional speech. It was the first of several graphic representational systems/sets (GRSs) that were introduced during the 70s and into the 80s (Vanderheiden & Lloyd, 1986). By the late 80s, while there were many small groups of persons with SCSP using the different GRSs that became available commercially, Picture Communication Symbols (PCS) became the dominant picture set in North America. This trend has resulted in North American AAC users under age 20 or so having pictures on their communication boards and devices, and Blissymbols being used primarily by adults. In Europe, on the other hand, Blissymbols are still being introduced to young children and hence they are used by persons of all age levels.
Blissymbolics

Blissymbolics is a communication system developed by Charles K. Bliss (1897-1985), first published in Semantography-Blissymbolics (Bliss, 1949, 1965). It was originally created as a system for international communication. With its application in 1971 as a communication system for children with physical disabilities at the Ontario Crippled Children's Centre (OCCC), Blissymbolics became one of the first AAC graphic systems. All but one of the subjects in the present descriptive study were introduced to Blissymbols through this Toronto-based program, either directly as students in the OCCC School or indirectly through their instructors being trained by members of the OCCC professional team (Silverman, McNaughton, & Kates, 1978). Today, Blissymbolics is used as an AAC system in 33 countries and Blissymbol materials have been translated into 17 languages.

The system of Blissymbolics is composed of over 2,000 graphic symbols which can be combined and recombined in endless ways to create new symbols (Hehner, 1980; McDonald, 1980; McNaughton, 1985; Wood, Storr & Reich, 1992). Simple shapes are used, making the symbols easy and fast to draw. Because both abstract and concrete levels of concepts can be represented, the system can be used by both children and adults with a wide range of intellectual abilities. (See Figure 2-1.) Blissymbols are displayed on simple communication boards mounted on wheelchairs, on dedicated electronic devices with synthetic speech, and within computer software and computer mediated communications (CMC) programs, the latest and most advanced of which is BlissInternet.

Blissymbols used herein derived from the symbols described in the work, Semantography, original copyright © C.K. Bliss. In September, 1982, C.K. Bliss granted an exclusive, non-cancellable and perpetual, world-wide license to the Blissymbolics Communication Institute, for the application of Blissymbols, for use by handicapped persons and persons having communication, language and learning difficulties.

3This Centre is now known as the Bloorview-MacMillan Centre.
Compound symbols are composed of key symbols, e.g.,

\[ \downarrow = \text{person} \quad \downarrow = \text{person} \]

\[ \heartsuit = \text{feeling} \quad \bigcirc = \text{container} \quad \uparrow = \text{up} \]

\[ + = \text{positive} \quad \cup = \text{give} \]

\[ ! = \text{intensity} \quad \circ = \text{knowledge} \]

\[ \downarrow \heartsuit + ! = \text{person you feel positive about with intensity} \]

\[ = \text{friend} \]

\[ \downarrow \cup \circ = \text{person who gives knowledge} \]

\[ = \text{teacher} \]

With the addition of indicators, the grammatical class and meaning of a key symbol changes. e.g.,

\[ \bigcirc = \text{mind} \]

becomes

\[ \wedge = \text{think}, \quad \checkmark = \text{thought}, \quad \check = \text{will think,} \]

\[ \text{brain}, \quad \times = \text{minds}, \quad \mathbb{X} = \text{brains}, \quad \wedge = \text{thoughtful} \]
Blissymbolics has a relatively wide basic vocabulary (over 2,400 entries in the Blissymbol Reference Guide, 1992), a grammar which allows for sentences in past, future and present tenses, and markers for possession, plurality, questions and commands. There are many strategies within the system which enable the user to create new symbols. These are interpreted by experienced partners by analyzing the component parts that have been combined to form a new symbol. In the same way that letters represent sounds that are used to create words in print, meaning-based Bliss units (of which there are approximately 100) are combined and recombined to define the meaning of each compound symbol. Bliss' objective in designing Blissymbolics — to transcend the spoken language barrier — has had the fortunate side-effect of providing persons with SCSPI with a potential communication system, the units of which, by being semantically-based, bypass phonological requirements. While this can be perceived as a disadvantage in preparing a Bliss user to read print, it offers an alternative, language-based, reading medium for individuals who may have difficulty processing a phonologically-based system.

The number of Blissymbols on the displays of experienced Bliss users range from 50 to 800. As Bliss users select, create and decode Blissymbols and produce and read Blissymbol messages using their voice output device or computer, they can be described as Bliss "readers", "spellers" and "writers". Sentences range in length, often including up to 10 or more symbols. (See Figure 2-2.) The term Bliss Reader is used within this study for those who have not mastered the reading of print, as a reminder that these persons are indeed "reading", albeit their orthography is non-phonologically-based.

Examples of sentences produced by Bliss users:

I want to know why house mother is upset this morning.

\[ \downarrow \hat{O} \hat{O} \hat{O} \uparrow \downarrow \text{?} \hat{O} \} \hat{O} \hat{O} \downarrow \] \[ \hat{O}_{12} \]

Question what thing is that on the blackboard?

\[ \text{?} \hat{O} \hat{O} \hat{O} \hat{O} \]

You are right because you say that we are thick.

\[ \downarrow _2 \hat{O} \hat{O} \hat{O} \text{?} \downarrow _2 \hat{O} \hat{O} \downarrow _1 \hat{O} \hat{K} \hat{K} \]

Figure 2-2  Examples of Blissymbol sentences (James, 1984).
For some Bliss users, the system of Blissymbolics provides an introductory and transitional graphic representational system (GRS), serving solely as a substitute for speech until they gain fluency with print for communication, reading, spelling and writing. For others, Blissymbolics becomes their lifetime GRS, using it for communication, "reading", "spelling" and "writing".

The Learner with SCSPI

The challenge and complexity of learning to read for persons with severe congenital speech and physical impairments (SCSPI) is well recognized. The small size, the diversity both in terms of cognitive and physical abilities, and the geographic spread of this population make this group difficult to study, understand and teach. The strong desire to learn to read on the part of most persons with SC SPI known to the author, however, and the life-enriching opportunities literacy provides, makes it imperative that this topic be addressed.

To describe the population of persons with severe congenital speech and physical impairments, the incidence and etiology of the population will be discussed first and then (a) a model of cognitive, language, motor and social development and (b) a structure for examining the ecological influences that shape and respond to each individual's unique personal growth will be presented.

Incidence of Persons Lacking Functional Speech

The population of primary interest in this thesis are adults who lack functional speech, who have a severe speech and physical impairment (SCSPI) and either still use or have used Blissymbols prior to learning to read. Findings from demographic studies have reported a low incidence of such individuals and have identified cerebral palsy as the major etiology for severe congenital speech and physical impairment. Reliable incidence figures, however, are not available.

It is unfortunate that there is no definitive study providing statistics regarding the incidence of individuals of all ages who lack functional speech. The most reliable incidence information comes from demographic studies of school populations. In 1986, the educational needs of speech and physically impaired students and their teachers within the province of Ontario, the geographic area of the subjects of this
study, were investigated (Lindsay, Cambria, McNaughton & Warrick, 1986). This study found 2,300 school-aged children with severe congenital speech and communication impairment (SCSPI). The professionals who interacted with them reported a strong need for training and resource materials.

Other demographic studies relating to the incidence of speech and physically impaired children in schools have been undertaken in California, British Columbia and Washington. The incidence of individuals (as a percentage of the total school population) who would benefit from augmentative and alternative communication (AAC) were estimated as .20% in Orange County, California (Aiello, 1980), .30% in Washington State, rural and .60% in Washington State, urban (Matas, Mathy-Laikko, Beukelman & Legresley, 1985), .20% in British Columbia (Moffatt, Anderson & O'Toole, 1982), and .15% in Ontario, from education administrative estimates and .22% totalling the 2300 students reported in Ontario (Lindsay, Cambria, McNaughton & Warrick, 1986).

Table 2-1

<table>
<thead>
<tr>
<th>California</th>
<th>British Columbia</th>
<th>Washington State (rural)</th>
<th>Washington State (urban)</th>
<th>Ontario estimated</th>
<th>Ontario reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>.20%</td>
<td>.20%</td>
<td>.30%</td>
<td>.60%</td>
<td>.15%</td>
<td>.22%</td>
</tr>
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Individuals who would benefit from AAC as a percentage of the total school population

Two studies were conducted for the federal government to determine the telecommunication requirements of adults with SCSPI throughout Canada. Since neither study determined incidence information, the need for government action in this direction was emphasized in both studies. Of interest was the summary of needs in the Green and Hopkins study:

- early intervention and support to parents; sufficient and specially trained personnel; availability of information and resources; establishment of communication links to abolish isolation and to encourage the best possible use of the technology now available; greatly increased public awareness and action on many levels.

Green & Hopkins, 1984, p. viii
A further government study was undertaken by Finn (1990) for the Department of Communications, Government of Canada, to locate the speech impaired population of all ages, to identify the causes of their disabilities and their levels and modes of communication. Responses were received from 597 individuals in response to 3,263 distributed questionnaires. Of the 211 respondents with communication boards, 87 (41%) used Blissymbols. The results from the Finn study, considered along with figures from a widely quoted, informal survey conducted at a Conference on Communication Aids for the Non-Vocal Severely Physically Handicapped Persons, December 7-8, 1976, in Alexandria, Virginia, and published by the Bureau of Education for the Handicapped (BEH) (1976), would support an estimate of 40% of "non-vocal" persons with the etiology of cerebral palsy.

It had been hoped, from the recommendations made in the Pressman (1983), and Green and Hopkins (1984) studies that the Health and Activity Limitation Survey (Statistics Canada, 1991) would provide accurate and refined incidence figures for persons with communication impairments. The classification system in this report, however, did not differentiate degrees of impairment within the speaking impairment class (Table 2) and provided no breakdown for speech impairment in the severe disability class (Table 7). Thus, while it is accepted by those in the AAC field that the incidence of persons with a severe speech impairment is much smaller than that for severe hearing and vision impairments, accurate figures are not yet available. What seems to be relatively reliable are the figures that about one in 500 children (i.e., .20%) would benefit from AAC and that cerebral palsy is the diagnosis of about 40% of persons of all ages who lack functional speech.

Cerebral Palsy

The term, cerebral palsy, means "brain (cerebral) paralysis (palsy)" (Bleck, 1982, p.59). It is a non-progressive disorder characterized by lack of control and difficulty with body movements. It is a descriptive term rather than an etiological diagnosis and refers to motor dysfunction resulting from one of a variety of diseases and disturbances occurring during pregnancy, or from injury to the brain at the time of birth. Most instances of cerebral palsy are congenital. In some cases, however, a movement disorder resulting from a skull fracture or a brain hemorrhage is termed cerebral palsy. Berninger and Gans (1986a), in describing cerebral palsy, referenced
Low and Downey's postmortem studies (1982) which revealed that the neuropathology is microscopic and in two-thirds of the cases, occurs primarily in cortical and subcortical layers of the brain. They also reported that functional criteria of motor deficit does "not relate cleanly and neatly with patterns of structural damage" and similarly, "patterns of language function are unlikely to relate in simple ways to oromotor deficits and generalizations about the language abilities of persons with severe cerebral palsy should be avoided or qualified" (Beminger & Gans, 1986a, p. 46). This explains in part why there is such variability among persons with cerebral palsy and why studies that rely on matching individuals with cerebral palsy with nondisabled persons have many weaknesses.

Professional knowledge concerning cerebral palsy has progressed dramatically since the condition was first labelled "Little's Disease" in 1862. It was named after an English surgeon, Dr. William J. Little, who described the disorder (Bleck, 1982; McNaughton, 1991). As late as 1920, nothing was done for children with this condition. By and large, "doctors accepted the attitude of Little that cerebral palsy cases were probably of low-grade mentally and little or nothing could be done to improve their condition" (Schonell, 1956, p. 14). It was in 1937 that Dr. Winthrop Phelps, an orthopedic surgeon, adopted the term cerebral palsy for the condition and described its various manifestations. In the early forties, Earl Carlson, a medical practitioner, who had cerebral palsy himself, wrote a book about his own life and urged those working with children with cerebral palsy to study the child as a whole and make every effort to understand the development of the child's psychological life. In the fifties and sixties, the medical professionals working with children with cerebral palsy began to affirm that the correlation between motor and mental involvement was not as great as one might expect and that there might be total physical involvement with normal intelligence (Perlstein, 1952). In a book for teachers, Leaning (1958) commented on the swinging of the attitude pendulum. First all persons with cerebral palsy were regarded as having a mental defect. Then, there were efforts by isolated groups during the forties and fifties to eliminate any association between mental impairment and cerebral palsy.

The author of this thesis, from her experiences working with persons with cerebral palsy of the last 25 years and from referencing test results reported by Schonell (1956), Silverman, McNaughton & Kates (1978), and Bleck (1982) and results from the present study, would agree with Leaning, that:
However fervently we champion the rights of the cerebral palsied to education and treatment we must accept the fact that whether or not we can measure their intelligence as validly as we claim to measure that of the non-handicapped, a greater proportion function at a lower level than that of the ordinary population. This does not, in the case of the cerebral palsied, indicate what their potential level may or will be.

(Leaning, 1958, p.8)

The American Academy of Cerebral Palsy lists seven different types of manifestations of the motor disorder: (1) rigidity, which is characterized by a stiffness of the body and limbs; (2) spasticity, which results in the muscles becoming stiff with increased movement; (3) tremor, in which the limb quivers when a voluntary and co-ordinated movement is attempted; (4) ataxia, which is usually shown by a staggering gait or jerky arm movements; (5) athetosis, which is characterized by an overflow of muscle movements that makes the whole body move when the person attempts to move only one part; (6) atonia which is demonstrated by lack of sufficient muscle tone; and (7) mixed, a term used when an individual displays more than one of the above characteristics. For the purposes of this study, no medical diagnostic categories were used. In the experience of this writer, therapists who work most closely with persons with cerebral palsy find that more relevant information can be derived from an assessment of muscle tone, retention of primitive reflexes, hand function, head position, range of movement and pointing ability, than to a label for a subcategory of cerebral palsy. Since recent reports for this type of information were not available for the adult subjects in this thesis, the collection of physiological information was not attempted.

The same insult to the central nervous system that causes motor dysfunction also causes other handicaps. The figures for accompanying disabilities as estimated during the decades when the subjects in this study were born were as follows: mental retardation (50%), hearing loss (25%) and vision defects (50%) (Silverman, McNaughton & Kates, 1978). With regard to speech disorders, references in the literature of the same period indicate 60% to 70% of persons with cerebral palsy will have speech difficulties (Cruikshank & Raus, 1955; Illingworth, 1958; Keats, 1965). It was perceived difficult, however, to determine the percentage of persons with cerebral palsy who had a speech impairment so severe as to prevent functional speech. The only estimate available was derived from a study of the Easter Seal Society (ESS) District
Nurses' caseload (Kates & McNaughton, 1975). Of the children with cerebral palsy being served by the ESS in 1975, 8.7% were without functional speech.

In studies relating to persons with cerebral palsy who have severe speech and physical impairments, the lack of validity of any standardized measurement tool should be emphasized. The current study supported the findings of previous studies that persons with SC SPI test at levels lower than that of the nondisabled population. Intelligence as it is measured for the non-handicapped is inappropriate and of little relevance for persons with cerebral palsy. As will be demonstrated in the next section relating to the development and life experiences of persons with SC SPI, individuals who lack functional speech differ from those who are nondisabled in several critical areas. This makes it imperative that the results obtained from standardized assessment tools always be interpreted within the context of the unique life experiences of the person with SC SPI.

**Conceptual Model for Cognitive, Language, Motor and Social Development in Persons with SC SPI**

When thinking about the primary factors that might have significant influence on the development of reading in children with SC SPI, it is important to think about how their developmental environment for cognitive, language, motor and social development differs from that of the non-disabled child. That is, the context within which the individual with SC SPI develops language, can best be understood by contrasting the developmental experiences of the child with SC SPI with those of the nondisabled child. A model of symbolic representational learning for the child with SC SPI was originally developed and presented by McNaughton and Lindsay (McNaughton, 1993; McNaughton & Lindsay, 1995). These investigators sought to identify the primary experiential differences of those who must use AAC systems for communication and interaction with the world around them. The model, shown in Figure 2-3, and the accompanying explanatory text have been taken from the presentation by McNaughton and Lindsay (1995), with minor modifications:
Figure 2-3 Model of Symbolic Representational System Learning
(McNaughton & Lindsay, 1995, p. 214)

The top figure shows the general relationships among the person, the external world or environment in which the person lives, and a symbolic representational system (SRS) that mediates the person's experiences. In the bottom figure, these relationships are presented separately for the nondisabled child and the child with SCSPI, as each develops toward literacy. In addition, the general component parts within the "person" and "external world" components are identified.

In the general model, individuals are shown interacting with the external world directly (through motor explorations) and through the use of symbols representing referents and situations in the external world. As a result of this interaction, concepts are developed which constitute the child's internal cognitive view of the external world. The lines to and from the upper point of the model indicate that the child's learning can be mediated through his or her SRS and the
child in turn can influence the external world through his or her SRS. The direct line between the person and the external world indicates that the child can also affect and be affected by the external world directly through motor and perceptual experiences that do not involve the SRS.

**Symbolic representational system.**

For the nondisabled child, the SRS begins with speech developing from vocalization and for most children eventually expands to include traditional orthography. For most children with SC SPI, some form of augmentative and alternative communication (AAC) graphic representational system (GRS) serves as the child's SRS during the emergent literacy years. Signing is not included in this model given that it is not typically used as an early form of expressive communication by children with severe motor impairments. The encouragement of gestures and sign approximations for expressive communication and the introduction of signing as a means of broadening the young child's receptive communication, however, are certainly worthy additions to any AAC instructional program.

**External world and person.**

The "external world" in the general model is expanded in the two more specific models to identify particular components such as the referents or objects in the world, the various situations the person encounters, and the speech and conceptual frameworks of others in the environment, particularly those of significant others. Similarly the "person" component has been expanded to show the basic processes through which the child learns. The sensory-perceptual processes are responsible for the initial stages of processing incoming sensory information. This would include processing the visual and auditory information associated with objects, situations and the speech or signing of others in the child's environment. In addition, there are various higher level cognitive processes that are involved in interpreting the incoming information. The motor systems support a number of potential means for interacting with the external world. For the young child they include motor and vocal explorations with the objects and people in the environment.

As the nondisabled child develops, he or she moves beyond vocalizations and begins to use speech as a SRS to interact with the external
world. In the context of emergent literacy, print is part of the child's external world experiences and eventually it takes on the role of a SRS. The refinement of the child's motor behavior to include drawing and then writing develops as print, often referred to as traditional orthography (TO) in the AAC literature, becomes more established as a SRS and the child gains increasing skill as a reader, speller and writer. Speech, of course, continues as an interpersonal SRS after literacy develops.

The motor systems and the GRS for the child with SC SPI have been shaded to draw attention to these components as primary loci of difference from the nondisabled child. The different shape used for speech in contrast to the shape for GRS and print denotes the different modalities involved.

Although speech and the GRS perform similar functions, they are different in many respects. For the nondisabled child, speech typically emerges naturally and spontaneously out of his or her interactions with the external world. For the child with SC SPI, the aided GRS must be explicitly introduced and upgraded by significant others to meet the child's changing needs. Moreover, it will be limited in its capacity to relate to the child's experiences of the external world both in vocabulary size and in the generative linguistic capabilities it offers. The GRS is similar to speech, however, in that it can be used along with TO for as long as it can fulfill the child's interpersonal communication needs.

**Personal factors.**

The personal factors influencing the child's learning are portrayed in three broad areas. The first is the area of "cognitive processes" which would include such higher mental functions as the executive processes which allocate resources, detect errors and select strategies; selective attention; long-term memory including declarative, procedural, episodic, semantic and linguistic knowledge (Light & Lindsay, 1991). The second general area of "sensory perceptual processes" includes receptive language and lower cognitive functions such as hearing, seeing, perception, non-selective attention, motivation, short-term memory. The third general area of "motor systems and vocalizations" includes expressive language and motor behavior which serve a critical role in initiating a feedback loop through which the child will be able to derive information about his or her environment.
The primary differences.

Two important factors should be noted with regard to the use of a GRS rather than speech during the emergent literacy period. First, the GRS is an aided system. Thus it is accessed as a separate entity both motorically and cognitively by the child. Second, the GRS utilizes a graphic medium, drawing upon the same modality as traditional orthography. Thus the child gains experience in processing and using graphic representational information for expressive communication prior to TO. In comparison with speech, the use of an aided system places added processing requirements upon the child and requires more time to produce utterances. This reduces the number of utterances and the quantity of information that can be expressed. The slower rate of communication also places different demands on memory. Together, both factors illustrate differences in children's learning experiences arising from the indirect, *aided*, graphic path of expression of the child with SC SPI and the direct, *unaided* path of speaking of the nondisabled child.

Intervention.

The lines in the above model, as well as indicating connecting links for the child, illustrate some of the potential routes for adult intervention. Through either formal or informal instruction, the interactive effects of (1) the symbolic representational system and print, (2) the external environment to which the child is exposed and (3) the internal cognitive processing of the individual can be facilitated. Thus, for the GRS user, learning achieved through expressive communication is heavily dependent on the capabilities the GRS affords and the extent to which instruction exploits these capabilities.

*McNaughton & Lindsay, 1995, pp. 213-215.*

The above conceptualization highlights the restricted life experiences and learning opportunities of the person with SC SPI which could result possibly in limited processing abilities and reduced processing speed. On the other hand, the model also illustrates the experiences which may offer compensatory abilities, if utilized. A statement made by Shankweiler, Crain, Brady & Macaruso (1992) which reflects a commonly held view of authors contributing to the word acquisition literature for normally developing children has interesting implications when applied to persons with SC SPI. The authors commented that: "The child who is learning to read does not have
to acquire a new communication system, but can rely on preexisting language structures [italics added] that have long been exploited in spoken communication by the time instruction in reading begins" (p. 278). It is obvious from the above model that this is only partly the case for persons who rely receptively on oral communication, but who must use a graphically represented communication device of some form for their expressive communication. The implications and possible misperceptions arising from this unique language situation lie at the core of this thesis.

**Ecological Factors**

Internal "psychological" factors are one set of variables that contribute to the reading acquisition process. Another set of factors emerge from the environments in which the developing reader is immersed. That is, for an understanding of what the adult with SC SPI has been able to bring to reading acquisition, it is essential also to examine features of the "external world" component in the above model — features that play a role in shaping the development of any individual. Society's attitudes toward disability as they are operationalized in government policy and clinical and educational practice and expressed in family aspirations and expectations are examples of the broad influences from the external world that must be acknowledged in any study of the reading acquisition of persons with SC SPI. Within this wide context, educational opportunities and family attitudes are key factors to be considered.

**Bronfenbrenner's Ecological Model**

Warrick (1988) applied an ecological framework to the development of sociocommunicative skills in persons with SC SPI, using a model developed by Bronfenbrenner (1979). This framework serves equally as well for reading acquisition. Warrick began with a quote that aptly demonstrates the need to consider ecological influences upon learning: "The ecology of human development lies at a point of convergence among the disciplines of the biological, psychological, and social sciences as they bear on the evolution of the individual in society" (Bronfenbrenner, 1979, p. 13; cited in Warrick, 1988. p. 45). The literacy achievements of exceptionally endowed individuals with severe congenital speech and physical impairments have, for many decades demonstrated the potential that can be realized if there is a strong family or
substitute family support system, in partnership with knowledgeable educators, to "do battle" against the prevailing lack of awareness in society at large of the capabilities of persons with disabilities.

_The Trouble Bush_ by Earl Schenck Miers (1966), _Under the Eye of the Clock_ by Christopher Nolan (1987), _My Left Foot_ by Christy Brown (1954), the poetry and articles of Kari Harrington (1988), the Words+ Outstanding Consumer Lectures at ISAAC Conferences, (Joyce, 1992; Marshall, 1994; Williams, 1996) — all serve as outstanding examples of what can be achieved. This having been said, it is important to recognize, the strong inhibiting influence societal attitudes can have upon the learning opportunities of many persons with SC SPI when they are perceived as being incapable of learning to read.

Bronfenbrenner conceived of psychological processes as properties of the total set of systems in which the individual is embedded. These processes, however, are but one element of the total system. He related the system to a nesting toy, containing dolls within dolls. He theorized that there are four interacting systems underlying human development:

1. A microsystem — a pattern of activities, roles and interpersonal relations experienced by the developing person in a given setting with particular physical and material characteristics.
2. A mesosystem — the interrelations among two or more settings in which the developing person actively participates.
3. An exosystem — one or more settings that do not involve the developing person as an active participant, but in which events occur that affect, or are affected by, what happens in the setting containing the developing person.
4. The macrosystem — consistencies, in the form and content of lower-order systems (micro-, meso-, and exo-) that exist, or could exist, at the level of the subculture or the culture as a whole, along with any belief systems or ideology underlying such consistencies.

(Bronfenbrenner, 1979, pp. 22-26)

Overall, Bronfenbrenner offered a structure for:

the scientific study of the progressive, mutual accommodation between an active, growing human being and the changing properties of the immediate
settings in which the developing person lives, as this process is affected by relations between these settings, and by the larger contexts in which the settings are embedded.

This way of conceptualizing the influence of the environment on one's development is particularly relevant for persons with disabilities. In considering the reading acquisition of individual adults with SCSPI, for example, the features and participants of the microsystems in which they have interacted — their places of residence and their educational, vocational and avocational settings — must be understood if relevant learning programs are to be implemented. In the case of persons with SCSPI, the types of residential and educational situations during their formative years vary greatly. Subjects in this study spent their childhood years in family homes, residential hospitals and in large institutions for the retarded. Their early socializing experiences ranged from warm family support and strong encouragement at the upper end of the continuum to remaining confined to a cot and being deprived of any educational experiences at the lower end of the continuum. Many of those who had the opportunity to attend school during their primary years were in programs where the main focus was on communication, not learning to read. With but a few exceptions, as children with SCSPI, they were at a lower developmental level than their classroom peers with regard to reading skills. When students with SCSPI were able to reach high school, most of them still lacked many beginning reading skills. They were situated, however, in classes with teachers who had never been trained in early reading instruction and whose primary responsibility was meeting the curriculum requirements relating to the content of a specialized subject area.

The mesosystems involve links between the various micro-environments of the individual — residences, educational programs, community services and significant persons who participate in more than one of these settings. In addition, communication between settings, professionals' limited or expanded roles and the consistency and nature of knowledge and attitudes between settings must be considered. In a time of economic restraint and downsizing of services, changes in the mesosystems can be profound. Persons with SCSPI are very vulnerable, relying much more heavily than nondisabled persons on support from their environments and on others initiating and maintaining vital links between their micro environments. Their literacy opportunities, like many other facets of their lives are affected by changes in societal services.
The components of the *exosystem* that involve all persons with disabilities — the many levels of government services, charitable organizations, volunteer support agencies, educational programs, medical intervention — have a profound influence upon all aspects of their lives. Typically persons with SCSPI are fortunate if there is any adult literacy program available to them. If one is closed due to cutbacks there is frequently no other option. Government downsizing and shifting responsibilities for various levels of government have special significance for this population. The possibility of changes to support services and adult educational programs has influenced the design of the Assessment and Instructional Protocol within the Educational Application section. A format has been used that recognizes the need for persons with SCSPI to have control of their own reading acquisition program and to provide a structure for volunteer assistants.

The *macrosystem* as it relates to persons with SCSPI is a complicated construct. For these individuals, the macrosystem has been interpreted as organizations, groups and sub-cultural belief systems associated with persons with speech and physical impairments. There are few informal groups and no agency to serve and lobby on behalf of persons in Ontario who use AAC. Organizations such as the CNIB for persons with a visual impairment and the Canadian Hearing Society for persons with a hearing impairment focus on a single sensory impairment and serve and lobby on behalf of much larger populations. Persons with SCSPI have both a speech and mobility limitations. There are professional services, albeit with case load limitations, that prescribe communication devices through a network of clinics authorized by the Assistive Devices Program (ADP), Government of Ontario. As well, there are informational services available through the Ontario Federation of Cerebral Palsy and the International Society for Augmentative and Alternative Communication. There are some children’s programs available through The Easter Seal Society. There are adult programs available through the Ontario March of Dimes, as well as individualized assistance as funding permits through Blissymbolics Communication International. By and large, however, each adult with SCSPI is dependent on the support of his or her own family and community and on whatever is currently available through government services.

The effect of exosystem factors has been vividly demonstrated in recent years in Ontario as swings in voting patterns and policy changes at both the provincial and federal levels result in reduced services for persons with disabilities of all types. Nested within these changes there is an impact on reading acquisition, as access to
transportation is reduced, adult educational programs are downsized and volunteer services are redirected toward providing basic necessities. While beyond the scope of this thesis, it is important to remember that societal attitudes are reflected in government policy. When both the society and government are uninformed, the result can be reduced "external world" opportunities for persons with SCSP. Limited opportunities to acquire reading can be one of the many consequences resulting from an underestimation of the potential of persons with SCSP. From this follows an under realization of their abilities and the assumption that they cannot learn to read is perpetuated. Those who do achieve a high level of literacy are viewed as the exception.

While little can be done within an instructional program to address events at the exosystem and macrosystem levels, it is important that the instructor be aware of the societal attitudes and government policies that have contributed to the individual's reading level. Limited learning opportunities in the past and the resulting attitudes on the part of the individuals with SCSP and their families and caregivers must be considered as a learning program is initiated. Of course, the same considerations hold true for the researcher who is investigating causal factors relating to the reading level achievement of persons with SCSP.

**Lundberg's Ecological Perspective**

In considering reading to be both an individual and a social skill, Lundberg (1991) has brought another ecologically oriented perspective to the study of reading acquisition. In describing reading as a cultural practice as well as a personal skill, he has drawn attention to the reading skills that are learned outside of school. Like proponents of the emergent literacy approach, Lundberg focussed on the early childhood family experiences that support reading acquisition — positive models, and access and exposure to written language. In addition Lundberg pointed out the many social experiences that foster literacy, such as reading bus tables, filling in forms, locating information in brief documents, etc. For the person with SCSP who may be very delayed in achieving any degree of mobility or physical independence, many of these social learning opportunities are outside their restricted range of experiences. Often their reliance on others because of their physical dependency creates an expectation that others will do the reading for the person with SCSP as well. It is interesting to note, however, that in the last decade the emergence of increased computer usage has often created a reversal of roles, where the dependency has shifted to the caregiver. In many
instances, the person with SCSPI knows and reads more relating to the functioning of the technology than others in the environment.

Lundberg also mentioned the importance of literacy acquisition in the workplace that results from collaborative work on special projects. Whereas total failure would be predicted on the basis of test results, often the focus on a specific task and the social expectations from colleagues resulted in the individual showing actual progress in reading as a result of participating in a group endeavor. Most persons with SCSPI are deprived of such experiences. Rarely would they have summer or part-time jobs as they approach adulthood and even more rarely would they gain full-time employment.

Access to a computer in order to participate in an exchange of written information, whether it be in text or in Blissymbols, can be a compensating experience for lack of work experience outside the home. Lundberg looked ahead to future social opportunities for learning literacy and suggested that the increased use of technology could bring about a profound change. In the case of persons with SCSPI who learn Blissymbols before acquiring print literacy, the future will indeed bring new learning experiences. BlissInternet software for sending email messages either in Blissymbols or in print has been developed that offers the user a new medium through which to develop reading competencies in both Bliss and in print, outside school (Lindsay, Galvin, & McNaughton, 1996; McNaughton et al., 1996).

Ecological Factors within the AAC Literature

The prevailing attitude that persons whose speech is dysfunctional and whose physical abilities are severely impaired lack the ability to think and to learn to read has exerted a pervasive influence even inside the classroom. Koppenhaver and Yoder (1993) summarized five studies, conducted during the eighties and early nineties, that they were able to locate in the literature relating to classroom instruction and interactions for children with severe physical disabilities. Their findings were that these children received less literacy instruction than their nondisabled peers, participated in more passive ways, seldom interacted with their nondisabled peers during instruction, and experienced frequent and regular interruptions. As a teacher in the early seventies and observer of "educational" programs for similar children in the eighties and nineties, this author can attest to the scheduling challenges facing every teacher of children with SCSPI. Frequent therapy sessions, hospitalizations, extended time required for toileting, meals and transportation are part of these children's lives. Unless the teacher
and family are strongly motivated to provide a purposeful and substantive educational program, the child's academic experiences can be mere interludes between biological and medical routines. Knowledge, not only of how many years were spent in school, but also of family and teacher attitudes and quality of the individual's educational program is critical in interpreting test performance.

As a basis for better understanding the factors that may influence literacy for AAC users, Light and D. McNaughton (1993) discuss several factors influencing literacy achievement for nondisabled individuals: expectations for literacy development, opportunities for participation, student expectations of success. Light, Koppenhaver, Lee and Riffle (1992) surveyed 69 students ranging in age from 3 to 21 years, 73% of whom had cerebral palsy. Less than half (48%) of the parents expected their children to achieve functional literacy, and almost one in ten (8%) expected their children would never learn to read. Thirty-one percent expected their children would learn to read and write only a limited number of words. In terms of teacher expectations, sixty-four percent expected their students to achieve functional literacy skills by age 25. It should be noted that the students included in this survey were clients of two leading AAC service programs, one in Ontario (the Augmentative Communication Service at the Bloorview MacMillan Centre, Toronto) and one in Pennsylvania (the Pennsylvania Assistive Technology Center, Harrisburg). As such, the parents and teachers in this study would have been provided with information regarding communication and literacy. These reading expectation rates, while still lower than one would wish for, are likely higher than could be considered typical.

In a demographic study and survey relating to the educational needs of nonspeaking students throughout the schools in Ontario (Lindsay, Cambria, McNaughton and Warrick, 1986), a much less positive indicator of expectations was obtained. In analysing the returns for 972 students ranging in age from 4 to 21, teacher specified goals in order of frequency of occurrences placed "an individual program plan" in 24th place, with only 5 responses. The primary "educational" goals were "self help skills", with 333 responses, "improved communication" with 334 responses, "motor skills" with 247 responses, "functional curriculum" with 150 responses and "independence" with 103 responses. Even "readiness", in 6th place, gained only 96 responses.

The findings of Koppenhaver and Yoder (1993), Light, Koppenhaver, Lee and Riffle (1992) and Lindsay, Cambria, McNaughton and Warrick (1986), make it clear that "expectations for achievement" and "quality of instruction" are two of many
ecological variables demanding attention in any study of reading acquisition in individuals with SCSP1. This consideration is critical to the valid interpretation of data from the empirical studies and to the planning of the Educational Application. Specific factors can also be identified that warrant attention within the assessment process.

Ecological Approach to Reading Assessment

Smith (1988) offers a model of learner, task, and setting factors that is useful in guiding the assessment of the individual and in making instructional recommendations. Her emphasis is upon the interaction between the individual's strengths and weaknesses and the environmental factors influencing the individual's reading acquisition. Smith describes the process as turning "the looking glass both inward and outward" (p. 36) and identifying how the task and setting can be matched to the learner and hence facilitate his or her development. Smith's model includes a set of contributors to learning that are related to physiological capabilities; individual characteristics; task-characteristics and task matching to learner's cognitive style, attending and learning strategies, information processing speed, practice needs and stronger modalities; family-based factors and school-based factors. Smith's model was developed for a teacher to apply in a classroom with reading disabled students and would be helpful to any teacher with a child with SCSP1 in his or her class. Many of her recommendations are appropriate as well in the individualized instruction of adults. Her model serves as a valuable resource to Writing and Reading with the Internet and Bliss (WRIB), presented in the Educational Application, Section IV.

Ecological Considerations within This Investigation

Several dimensions of the microsystem were considered in the data collection and were addressed in the data analyses. Only those factors considered as salient could be included, however, given the broad scope of this investigation. Two factors restricted the ecological information that could be collected — the paucity of early records and the subjects' limited memory of childhood events. Of high interest were the ecological factors relating to early reading instruction. Since this author was involved in the instruction of a number of the subjects as children, whenever there was direct knowledge of the reading intervention provided for a subject, this information was included in the ecological data.
The ecological systems and the characteristics of the learner with SCSPi provide two important strata contributing to our understanding of reading acquisition. Further knowledge can be derived from studying the variables found to be predictive of reading achievement and the models used in mainstream reading acquisition research.

Mainstream Reading Acquisition Literature

Examining Reading Acquisition

The primary approach that has been taken in this thesis is to view reading acquisition as a complex mental act with many subskills within the broad area of language development. The approach can best be described through a parable told by Higginbotham at the First ISAAC Research Symposium, held in Stockholm, August, 1990. Higginbotham used a "fish story" to argue for different approaches related to different objectives. He told of the fishing patterns of two imaginary tribes. One tribe fished for the small fish at the top of the lagoon, casting finely meshed nets near the surface of the water. They gained a regular supply of food for the tribe but found fishing to be a pretty repetitive and routine activity. The other tribe fished with strong nets made of large mesh and trolled the bottom of the lagoon. They never knew when they would catch fish, but when they did the fish were huge and were described as monsters that tore the nets apart! These tribesmen found their work dangerous but exciting and loved to tell tales of their heroic achievements (Higginbotham, as reported by McNaughton, 1990b).

As many knowledge domains are tapped within this theoretical infrastructure, the primary approach taken can best be described as deep water fishing. On the other hand, the descriptive study undertaken with 32 adults with severe congenital speech and physical impairments (SCSPi) demonstrates a moderately meshed net cast near the surface. This yielded empirical data that could be used to refine some of the speculations arising from the "catch" of the broad nets used in the deep water fishing. In two instances, new tests were developed by the author — (1) the testing of consonant-vowel-consonant recognition skill using a nonconventional approach and (2) the testing of visual analysis retrieval recognition skill — in order to have nets with fine mesh that could be lowered into deep waters. Even though there are dangers inherent in using a new tool to take a close look at a small component of a multi-faceted process, it was felt that it was important to see what was there, nonetheless.
Reading as a Component of Language Development

The first large-meshed net was cast deep into the theoretical waters to study some of the broad dimensions of language development. Reading is viewed as one component within the language learning process which develops gradually as nondisabled individuals, from infancy onward, interact with others and with their environment. At first they use crying, vocalizing, body movement, eye signalling and gestures and gradually they come to rely on speech for much of their interpersonal communication. It is recognized that there are well documented processing differences between oral and written language (Gough & Hillinger, 1980; Liberman & Liberman, 1990; Stanovich, 1994; Wallach, 1990) and that these differences have implications for reading instruction. Nonetheless, there is a need to examine the language continuum typically developed through speech within which reading acquisition occurs. The provision that must always be made for persons with SC SPI, however, is that they may well take a different development pathway as a result of their use of AAC.

Snow's (1991) model of separable paths of development comprising the components of language skill was adapted and combined with Keating's (1990) reformulation of performance testing in terms of charting "pathways to the development of expertise". The resulting model provided the theoretical underpinning for this investigation. As described in a recently published paper by McNaughton & Lindsay (1995):

Snow's model (1991) focuses upon the specific components within the language pathway, and language proficiency is viewed as performance in a complex of separate components. The components are defined in terms of the tasks being performed and the particular demand characteristics of those tasks. Snow's model presumes that "the various components of language are theoretically separable for all children and empirically separable for some, and that developmental progression through the various components might occur at very different rates for a single child" (p. 110). Thus, although the components interact with each other as the child grows, each component has its own path of development and its own set of social and linguistic facilitators. Linguistic performance is the product of the phonology, lexicon, syntax, morphology, speech acts, conversation and discourse components of language as well as cognitive, affective and social competencies. Nelson (1992) has applied Snow's
model of language to assess the language proficiency of individuals who are nonspeaking and who use AAC.

(p. 215)

As reading acquisition is examined throughout this investigation, Snow's model needs to be considered within the context of the unique cognitive, language, motor and social development of the individual with SCSP, as depicted in Figure 2-3. To accommodate the unique language and communication experiences of the child with SCSP, a visual strand has been added to the pathway. Because Snow's model was for the speaking child and related to oral language, the visual strand was not included by her as a component of language skill. In adapting her model to reading and in considering persons with SCSP, the visual strand becomes an essential component. While all children begin with visual focussing and progress to attending to pictures, the child with SCSP progresses from attending to visual stimuli to using symbols for communication and, eventually, to encoding and decoding graphics of various types and complexity levels. In the social, auditory and motor strands, the individual with SCSP experiences limitations compared to nondisabled persons. In the visual strand, it may well be that the increased attention given to symbols at an earlier age offers advantages as the child with SCSP approaches reading. A better understanding of the impact these differences may have upon reading acquisition is essential in the development of an effective instructional methodology.

As shown in Figure 2-4, the general essence of Snow's model has been maintained, however, the components have been re-structured to propose a Language and Literacy Pathway with five strands — visual, social, auditory, motor and symbolic (McNaughton, 1992a, 1992b; McNaughton & Lindsay, 1995).
Conceptualizations of the Reading Process

The second large net in this thesis was cast into the expansive and deep waters of reading acquisition as conceptualized in different models proposed in the mainstream reading literature. Four portrayals of the processing involved in reading have had a strong influence upon the direction taken in this thesis: (a) Adams' (1990) depiction of the four primary processors involved in reading; (b) the Interactive-Compensatory model proposed by Stanovich (1980, 1984, 1992, 1994); (c) the Stages or Developmental model, resulting from the work of many researchers (Byrne, 1992; Byrne & Carroll, 1989; Byrne & Fielding-Barnsley, 1989; Ehri, 1991; Ehri & Wilce, 1985, 1987; Frith, 1985; Gough & Hillinger, 1980; Juel, 1991; Mason, 1980; Vandervelden & Siegel, 1997) and (d) Kemp's (1987) diagnostic model of processing in reading. The influence of the emergent literacy philosophy must also be acknowledged. Reservations, however, will be presented with regard to some of the assumptions upon which it rests.

It must be noted that the basic theoretical rationale relating to reading acquisition that is presented here was derived solely from the literature concerning reading acquisition by *nondisabled children*. The approach was to start with our understanding
of the development of reading in the nondisabled child. Then the differences in life experiences and psychological processes of persons with SCSP1 were examined to see how they might impact on the development of literacy. This approach was taken in order to benefit from the wealth of information available in the research literature regarding reading acquisition by normal readers. Thus a judgement has been made that a knowledge base derived from normal reading acquisition, including references to able-bodied children experiencing difficulty learning to read, offers the best starting point to begin a study of reading acquisition by adults with SCSP1. There is one important caveat. The developmental and ecological differences between the two populations must be given considerable weight in interpreting the results and in planning and implementing intervention strategies.

The following assumptions influenced the selection and interpretation of the potential reading models:

- The individual who is able to hear but who is unable to speak acquires language and literacy in a unique way.
- The graphic representational system (GRS) used by an AAC user has an impact upon learning to read because of (1) its role as a substitute for expressive oral speech by encoding graphic symbol messages directly or by encoding synthetic speech utterances and (2) its influence upon the speech of communication partners, i.e. upon receptive language.
- A connectionist or parallel distributed processing (PDP) model, which accommodates the interplay of multiple sources of knowledge, (Rumelhart, McClelland and the PDP Research Group, 1989) offers a description of human cognitive processing which is helpful, supporting as it does new theoretical conceptualizations (Stanovich, 1991a).
- Mediation/instructional practices influence learning outcomes.
- An integrated instructional approach incorporating all the areas of language and literacy is the most effective.
Connectionist model.

As noted above, a contributing influence to the theoretical conceptualization of the reading processes in this thesis was the work of Marilyn Adams (1990). Her model of reading is derived from a comprehensive review of the reading research literature. It is strongly influenced by the connectionist framework for lexical processing of Seidenberg and McClelland (1989). In particular, she stressed the importance of the interrelation among the parts of the reading system: "As the parts of the system are refined and developed in proper relation to one another, each guides and reinforces the growth of the other" (p. 6)

Figure 2-5
Adams' Model of Reading, 1990, p. 158.

The model's connectionist basis was clearly presented: "Learning consists in the strengthening and refinement of associative links among the features of a pattern, and accrues through repeated experiences with the pattern" (Adams, 1990, p. 210). Adams summarized her position in the statement that "reading proficiency is strictly limited by the speed, accuracy, and effortlessness with which readers can respond to print as coherent orthographic, phonological, and semantic (meaning-bearing) patterns" (Adams, 1990, p. 8).
Adams accommodated both top-down and bottom-up processing theories and emphasized throughout her book that:

Skillful reading is not a unitary skill. It is a whole complex system of skills and knowledge. Within this system, the knowledge and activities involved in visually recognizing individual printed words are useless in and of themselves. They are valuable and, in a strong sense, possible only as they are guided and received by complementary knowledge and activities of language comprehension. On the other hand, unless the processes involved in individual word recognition operate properly, nothing else in the system can either.

Adams, 1990, p.3

Adams' model provides a good basis for speculating about how the limited motor, environmental, speech and language opportunities and experiences of children with SCSP1 might impact on basic components of the learning-to-read process. It could be supposed, for example, that these limitations might have a very detrimental effect upon the development and functioning of the Context, Meaning and Phonological processors for children with SCSP1 due to the ways in which their early learning differs from that of nondisabled children. Without a broad experiential background to bring to the reading process, the Context and Meaning processors would be unable to adequately play their role within the reading process. The Context processor must ensure that a coherent ongoing interpretation of the text is constructed. It decides how predictable a given meaning unit is and, in effect, provides increased energy to some word interpretations and less energy to others. To the extent that a meaning is already reinforced by the Context and Meaning processors, less input is needed from the letter recognition network to decide whether or not any given string of letters is a word. "The Context processor's job is to pick out and emphasize those aspects of a word's meaning that are most important to its evolving interpretation of the text" (Adams, 1990, p. 139).

With underdeveloped contextual and meaning resources available for the processing of the text, the individual with SCSP1 is at a great disadvantage. In addition, if the small loop in the Phonological processor is examined, a second handicap is apparent for the person who does not produce their own speech. This small loop is depicting that "the knowledge represented within the Phonological processor can be activated or reactivated at our own volition. Not only can we speak, we can also
subvocalize or generate speech images at will" (Adams, 1990, p. 158). Of course, Adams is referring to persons who have functional speech. Attention will be given in the empirical study with persons with SCSPS as to what implications this "generating of speech images at will" has for them.

With regard to the Orthographic processor in Adams' model, here a supportive effect from communicating with some graphic representational systems can be speculated. For those individuals who use symbols such as Blissymbols that contain sequenced components, experience is gained in analyzing semantic elements. In addition, symbol users have regular exposure to the word glosses that appear with all the symbols on each individual's communication board or computer screen. A critical characteristic of Adams' model has special significance for persons with SCSPS. "Both the immediate and long-term impact of reading depend critically on the speed [italics added] as well as the accuracy with which readers can identify the individual letters and words of the text" (Adams, 1990, p. 159). She explains that "the utility of the associative linkages, both within and between processors depends on the speed and completeness of the input they receive" (p. 160). Processing speed is a major issue for individuals with SCSPS and will be a factor considered in the discussion of the results.

Interactive-Compensatory model.

In the study of reading acquisition of persons with SCSPS, it is very helpful to add the idea of compensatory processing to Adams' basic model. Stanovich (1980, 1984) proposed an interactive-compensatory model of reading which reconceptualizes the nature of individual differences in reading. By proposing that skills at one processing level can help compensate for deficiencies at another level, Stanovich has provided a new perspective for examining the reading performance of persons who differ from the "normal". It also offers an approach to instruction that focuses on a utilization of strengths to, at least partially, compensate for weaknesses. This approach can be especially important both for individuals with limitations as well as with unique abilities, such as those possessed by persons with SCSPS. Stanovich's compensatory model focussed upon the compensatory relationship between higher and lower-processes in reading. There was nothing, however, in his model to prohibit considering the possibility that visual processing skills and cognitive strategies acquired through use of a graphic communication system might compensate for limited phonological processing skills (K. Stanovich, personal communication, January,
The additional dimensions of language processing made possible by the use of graphic AAC systems have been considered as possible compensatory sources within this thesis.

In any application of the interactive-compensatory model, the consequences of the individual's reading history and practice must play a prominent role. Stanovich (1986) describes the effect demonstrated by Ehri (1984, 1985), that experience with print has on knowledge of sound structure and metalinguistic functioning. He draws attention to memory performance differences between readers of varying skill levels, speculated by Torgesen (1985) as resulting from lack of reading practice leading to a less developed knowledge base. In addition, Stanovich emphasizes the importance of the more global consequences of reading resulting in cognitive differences, discussed by Donaldson (1978), Olson (1977) and Olson, Torrance and Hildegard (1985). Olson's (1997) theoretical argument for a connection between print experience and an awareness of the phonemic components of speech is described by the present author in the section relating to visual processing. The possibility that the reading level of persons with SCSPi may be restricted by limited practice warrants serious consideration. The societal expectation of low reading achievement by persons with SCSPi has resulted frequently in less attention being given to early reading instruction than for their speaking peers. The inclusion of ecological factors in this thesis was an attempt to assess the extent to which the subjects with SCSPi had the opportunity to become engaged in learning to read.

Within the context of reading history, Stanovich (1986) describes two constructs that could have special relevance in considering the reading performance of individuals with SCSPi — developmentally limited relationships and Matthew effects. They both relate to the early development or lack of development of the skills necessary for proficient reading. A developmentally limited relationship is one in which "the individual differences in a particular cognitive process may be a causal determinant of variation in reading achievement early in development, but at some point have no further effects on the level of reading efficiency" (Stanovich, 1986, p. 362). A Matthew effect refers to a reciprocal relationship between reading and a skill that is improved by reading. As the skill increases, it in turn improves reading. An example used by Stanovich was the relationship between vocabulary knowledge and reading proficiency. Reading volume increases vocabulary growth; increased vocabulary spawns further reading ability. In contrast, children with inadequate vocabularies read less and as a result have limited vocabulary development. This in turn reduces their reading growth.
The term "Matthew effects", first used by Merton (1968) and later by Walberg (Walberg et al, 1984; Walberg & Tsai, 1983) and then Stanovich (1986) was derived from the Gospel according to Matthew: "For unto every one that hath shall be given, and he shall have abundance: but from him that hath not shall be taken away even that which he hath" (XXV:29).

In considering Stanovich's Interactive-Compensatory model, it is important to examine the possible reasons for limited skill levels: (a) The cognitive processes essential to the early stages of reading acquisition may have been disregarded and developmentally limited relationships may have been prevented from occurring; (b) reading instruction may have been delayed indefinitely awaiting the individual's development of a high level of competency with his or her nonorthographic communication system; and (c) beginning reading instruction may have been attempted by teachers of grades beyond the primary level who were unaware of the skills associated with beginning reading and who lacked the training to provide adequate early reading instruction. The possible lack of adequate instruction resulting in reduced opportunities to acquire early reading skills at the time they are acquired by their peers, places children with SCSP1 at risk for acquiring the language foundation upon which further learning can be built. The Interactive-Compensatory model, enhanced by constructs related to the development of reading acquisition and reading related skills, provides a rich theoretical resource.

**Stages or Developmental model.**

The Stages or Developmental model offers the third frame of reference for the approach taken in this thesis. Within this framework, attention is focussed on the stage at which the young child first begins to relate to the segments or component parts of words as alphabetic cues (Ehri, 1987, 1989, 1992; Ehri & Wilse, 1985, 1987a, 1987b; Frith, 1985; Gough & Hillinger, 1980; Huba, 1984; Lundberg, 1992; Mason, 1980; Seymour & Elder, 1986). In building upon the stages proposed by Frith, Ehri (1991) provided a clear description of four phases of development that have helped in interpreting the results of the present investigation of adults with SCSP1. These stages are (a) the logographic stage in which the letters serve as visual cues and when the child recognizes words holistically as sight words or as a paired associate; (b) the transitional stage, when the letters begin to provide alphabetic cues linked to the sounds in spoken words; (c) the alphabetic stage when the child becomes able to
"phonologically recode spellings into pronunciations according to grapheme-phoneme correspondence rules" (Ehri, 1991); and (d) the orthographic stage, when children are familiar enough with the spelling patterns that recur, to apply this knowledge to reading words. Empirical studies based on Ehri’s formulation suggest that success in the transitional and alphabetic phases is one of the early indicators of which children will achieve literacy. Ehri’s stages were used as a guide to assess how far along the print developmental path each adult subject with SC SPI had progressed.

Within the context of the present thesis, reading groups were defined so that comparisons could be made between subjects who have arrived at different stages of reading acquisition. The primary division was between those subjects who demonstrated performance at the alphabetic stage and those who did not. Ability at the alphabetical stage was operationalized as performance on two phonological recoding tasks. In Study 1 (Kindergarten subjects), the subjects who demonstrated phonological recoding ability were labelled High Readers and those who did not were labelled Low Readers. In Study 2 (SCSPI subjects), the corresponding groups were labelled Print Readers and Bliss Readers. The further division of the SC SPI subjects into subgroups involved distinguishing within the Print Readers, (a) those subjects who were performing at the orthographic stage and demonstrating sufficient familiarity with the grapheme-phoneme rules that they could comprehend text above the grade 2.9 level (Independent Readers) and (b) those subjects who demonstrated performance at the alphabetic stage, but were not sufficiently fluent in phonological recoding to read above the grade 2.9 level (Primary Readers). The Bliss Readers were divided into two groups according to their development within the transitional stage, i.e., according to their ability to relate to letter-sound associations. The lower functioning subjects were labelled Pre-Readers and the higher functioning subjects were labelled Pre-Decoders.

The developmental model, as it was refined by Vandervelden and Siegel (1995), provided further distinctions within the alphabetic stage. The levels and the partial to full developmental pattern Vandervelden and Siegel identified are described in the section relating to phonological processing within the Rationale for Test Selection.

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4 phonological recoding, defined by Ehri (1991) as "translating letters into sounds by application of letter-sound rules and then recognizing the identities of words from their pronunciations" (p. 107).
Diagnostic model.

While Adams focused on the underlying cognitive mechanisms associated with the Context, Meaning, Orthographic and Phonological processing involved in beginning reading and Ehri proposed a set of basic stages in the development of reading, Kemp (1979, 1987) provided a diagnostic model for teachers which directed attention toward the assessment of processes involved in reading and the possible outcomes from various teaching methods.

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**Figure 2-6**

Kemp's Diagnostic Model

As can be seen in Figure 2-6, there were many similarities between Kemp's and Adams' models. The processing of Graphophonic Cues for Kemp was analogous to the Orthographic processor in Adams' model. The Semantic and Syntactic Cues identified by Kemp were represented by Adams as Context and Meaning processors. But Kemp, with his primary objective of teacher training, highlighted additional competencies. He notes, for example, that attention must play a central role. Strategies and processing levels were also listed by Kemp as skills that are required as the

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5 As the terms are used somewhat differently by Kemp than in most North American research, definitions for Processing Levels included in Kemp's model are provided in Appendix 2-A.
student progresses beyond the beginning stages of reading. The balance presented in Kemp's diagnostic model to both the higher processes and to word recognition skills provides an important reference for planning an intervention program.

**Emergent Literacy model.**

Due to the training and support being given by the Center for Literacy and Disability Studies, Duke University Medical Center, and conference presentations given by AAC professionals (Erickson, 1996; King-DeBaun, 1996; Musselwhite, 1996), the emergent literacy model of reading is having a strong impact upon clinicians and teachers working with AAC users. Emergent literacy has brought attention to the earliest phases of literacy development, what would have been called "pre-reading activities" and "reading readiness" in the seventies, and has offered another way of conceptualizing the development of reading and writing in young children. As with the Developmental Model of Ehri, the Emergent Literacy model relates to the reading acquisition of young children. In contrast with Ehri's focus on the development of specific reading acquisition skills, and Adams and Kemp's models of the processes involved in reading acquisition, the Emergent Literacy researchers focus on the child's knowledge about print. They are interested in the family and preschool environments, the literacy artifacts and events to which preschool children are exposed, the role of the adult in literacy events, the interaction of the adult and child in literacy events and the child's developing knowledge of the formal aspects of print (van Kleek, 1990).

Van Kleek describes the areas of knowledge about print that are developed by preliterate children under the categories of form, content and use. The five areas of knowledge relating to form are "(a) mastery of the conventions of print, (b) phonological awareness, (c) letter naming and writing, (d) realization of the formal relationship of print to speech, and (e) comprehension of macrostructures for organizing written language text" (1990, p. 32). Knowledge about content involves a realization that meaning resides in the printed words and is independent of the form or immediate social context. Knowledge about use includes learning the functions for print such as a way to acquire knowledge, a way to convey instructions, a way to take messages, etc.

Emergent literacy proponents have placed an emphasis upon the importance of the social, linguistic and psychological aspects of early reading acquisition and have
"taken the orientation toward the child as an active constructor of concepts further into the new domain of written language" (Sulzby & Teale, 1991, p. 728). In so doing, emergent literacy theorists such as Sulzby and Teale, have relied on a reciprocal causation interpretation with regard to phonemic awareness. They state, "Training in phonemic awareness for children with such experience [storybook reading and emergent writing], provides an organization of knowledge, rather than an initial teaching of this knowledge" (Sulzby & Teale, 1991, p. 749). Sulzby (1985) described "aspectual reading" as a stage in which children rely on simple phonemic awareness as they temporarily focus on sounding out words. Sulzby acknowledged that simple phonemic awareness is necessary for inventive spelling, but she stressed the importance of two other focusses — word identification and comprehension — as precursors to early conventional reading. It should be noted that Stanovich (1994) makes an important distinction between endogenous constructivism which he applies to comprehension and exogenous constructivism which he applies to word recognition. In comprehension, the higher cognitive processes are involved and individuals can generate an understanding of text from their own knowledge base. In word recognition, on the other hand, the processing is modular and thus independent of the higher cognitive processes. Word recognition relies on specific information relating to letter-sound relationships which for many learners can most effectively be attained through direct instruction. This distinction does not seem to have been recognized within the emergent literacy paradigm.

The social and attitudinal precepts of emergent literacy make an important contribution to our thinking about literacy. The approach, however, that has been followed in this thesis has relied more heavily on the research findings that underly Adams' Connectionist Model of Reading, Stanovich's Interactive-Compensatory Model, Ehri's Developmental Model and Kemp's Assessment Model. While not always explicit, the direction of the research supporting these models is consistent with the need for instruction in the development of word recognition skills. The importance of ecological variables as they relate to reading acquisition, however, were recognized and thus the general principles associated with environmental issues within the emergent literacy model were considered in designing the present study. Since the subjects being investigated in this thesis were adults, the specific early literacy concepts and activities that relate to young children were not examined.
AAC Research Related to Literacy

Seminal Early Studies, 1956, 1978

It is interesting, yet discouraging, to note that little seems to have changed with regard to the need for more attention to literacy acquisition for persons with SCPSI. The motivating factors and performance results of early studies are reflected in similar findings in the small number of current studies that have been published. For example, Schonell, writing in 1956 emphasized the importance of reading in the life of persons with cerebral palsy and expressed concern at the low level of reading achievement in the students at the schools she visited. She conducted a study in which 20 students were given reading instruction for twelve months and their progress was compared with a control group matched for chronological age, mental age, reading ability and physical, sensory and speech handicaps to the extent possible. Interestingly, the "reading instruction" was not described. In the fifties, it was likely assumed by researchers that letter-sound associations would be taught. A significant difference in reading performance between the two groups was demonstrated and Schonell concluded from the study:

Although these results refer to only a small number of cases they indicate strongly that cerebral palsied children whose intelligence lies within the range of the ordinary school population and whose sensory defects do not prevent them from benefiting from class teaching can make very satisfactory progress in reading. It also suggests that such children are likely to benefit more from the special instruction given in a school for cerebral palsied children than in the larger and more varied group in an ordinary school or special school for physically handicapped children.

(Schonell, 1956, p. 150)

Schonell's second point relating to the benefits to be derived from special instruction has been influential in the approach taken in the Educational Application section of this thesis. Her position is in marked contrast with the policy of integration practiced widely to-day.

Similar findings to Schonell's were documented in The Formative Evaluation of the Ontario Crippled Children's Centre Symbol Communication Program (Silverman, McNaughton & Kates, 1978). The primary focus of the study was the
evaluation of progress in Blissymbols, but information was also collected regarding type of reading instruction and progress in both representational formats, Blissymbols and print. Of the 157 subjects included in the study, 120 received both reading and Blissymbol instruction. The population shift over a one-year period for those subjects whose programs included both Blissymbol and reading instruction indicated overall progress in reading, as shown in Table 2-2. The reading level, as defined by specific criteria (See Appendix 2-B), was evaluated by the teacher for each subject at the beginning of the study in 1974 and again at the end of the study in 1975. It is interesting to note that only 9% of the subjects were rated as reading above a grade one level, although the age range for the study was 2 to 30+ years, with 56% of the subjects being over age 9 (Silverman et al, 1978, part 2, p. 131).

Table 2-2

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>1974</th>
<th>1975</th>
</tr>
</thead>
<tbody>
<tr>
<td>preschool/kindergarten</td>
<td>35%</td>
<td>21%</td>
</tr>
<tr>
<td>early grade one (pre-primer)</td>
<td>51%</td>
<td>53%</td>
</tr>
<tr>
<td>grade one (primer)</td>
<td>7%</td>
<td>13%</td>
</tr>
<tr>
<td>grade two or higher</td>
<td>7%</td>
<td>9%</td>
</tr>
</tbody>
</table>

Reading Level:
Population distributions for 1974 and 1975
(Silverman, McNaughton & Kates, 1978, Part 2, p.79)

State of the Art, 1992

In an extensive review of the literature dating back to 1950 and relating to persons with SCSD and literacy, Koppenhaver, Coleman, Steelman and Yoder (1992) and Koppenhaver and Yoder (1992) of the Center for Literacy and Disability Studies, Duke University Medical Center, summarized both the source of articles and their subject matter, and offered an appraisal of the issues being addressed. The articles were spread throughout journals, books and theses often appearing in publications on disability issues. As Koppenhaver et al (1992) commented, papers relating to the topic
of literacy for nonspeaking persons seemed to be "anywhere except literacy journals" (p. 136). This limited the likelihood of an adequate peer review process. They found a much stronger emphasis on descriptive studies over experimental research and a disproportionate number of studies involving single subjects. Of the 66 studies reported in the past four decades, 22 were case studies and another 10 were single subject experimental designs. Koppenhaver and Yoder noted a heavy emphasis on abilities relating to reading and writing subskills found in 51 of the 66 studies. Of the 51 research questions, 25 focused solely on literacy subskills such as word identification, reading rate, spelling and handwriting. The authors expressed concern that sociocultural context was the least studied aspect, attended to in only 4 studies. They called for a broader model of literacy. Their recommendations included a more adequate operationalization of reading and writing constructs, the measurement of both reading and writing, recognition of the weaknesses of using standardized tests for persons with SCSP, a better documentation of procedures, and more research driven by theory. Their call for higher research standards was timely. Most importantly, from this author's perspective, Koppenhaver and Yoder expressed the possibility that an AAC user's poor phonemic awareness might be attributable, not to an individual's speech impairment, but to the limited language learning experiences available in his or her environments. The relationship of ecological factors to reading acquisition has already been introduced in this thesis and will be further developed in the Discussion following Study 2.

Investigations in the Past Decade, 1986-1996

Although all but one investigation involved single case studies or very small numbers of subjects with SCSP, several papers published in the last ten years have relevance to this thesis. These comprise two papers by Berninger and Gans (1986a, 1986b) — one a descriptive study of three persons at different age levels and one a discussion paper; two papers by Smith (1989, 1992) — the first a descriptive study of ten nonspeaking children and the second a report of two case studies; a discussion paper examining phonological awareness task adaptations by Blischak (1994); an in-depth descriptive study of 12 adolescents and adults with SCSP by Foley (1989, 1993); and a series of studies by Dahlgren Sandberg (1996). All of these papers have contributed important information to the AAC literature on literacy acquisition. Each one drew attention to the complexity of learning to read and presented and applied the
reading literature for nondisabled children and/or adults within the context of AAC users.

**Study of three subjects by Berninger and Gans.**

Two papers by Berninger and Gans (1986a, 1986b) supported the direction taken in this thesis, that of assessing different levels of language and organizing the results into explicit levels of language processing. Though their numbers were small, their identification of common performance patterns across the three subjects of different ages (adult, adolescent and nine-year-old) demonstrated a valuable approach (Berninger & Gans, 1986a). This procedure was followed in the interpretation of the data in this thesis. The subjects studied by Berninger and Gans (1986a) had grade equivalent levels of 2.2, 3.5 and 3.7 in comprehending sentences, the Reading Comprehension subtest of the Peabody Individual Achievement Test (PIAT). The authors found that the three subjects (a) achieved average performance on tasks requiring recall for information in normal discourse, (b) showed age appropriate oral receptive language at discourse level (paragraph comprehension), (c) displayed better spelling performance than decoding, and (d) performed better on tasks requiring cognitive and semantic knowledge than on those requiring syntactic knowledge.

Berninger and Gans (1986b) discussed the particular significance of visual processing in their consideration of various assessment procedures. This is relevant to a distinction between the processing of pictographic and nonpictographic symbols that has been made by McNaughton and Lindsay (1995) which will be described in the section entitled *Visual Processing Associated with "Reading" Different Types of Graphic Representational Systems (GRSs)*. As will be discussed further, in the section entitled *Visual Processing*, Berninger and Gans acknowledged that existing research suggests that general measures of visual perception are only weakly related or not at all related to reading acquisition. They concur, however, with the present author, that attention is needed on processes specific to extracting visual information from printed words and with translating this visual information into linguistic representations in memory. They found that "selective attention to a letter (component processing) and memory for a whole written word (global processing) were related to reading achievement prior to formal reading instruction when most of the children were nonreaders or had very limited sight vocabularies" (Berninger & Gans, 1986b, p.59). They went on to speculate that:
global processing may be a capability needed for acquiring a beginning sight vocabulary and component processing may be a capability needed for learning phonics rules, but serial processing may be a capability that emerges as a consequence of learning to read and of practice in processing the orthography of the language.

(Berninger & Gans, 1986b, p.59)

Finally, they referred to a study being undertaken by Berninger (1987) in which letter by letter presentation of words on computer-regulated word displays was facilitating the application of phonics rules of grapheme-phoneme correspondence. This line of thinking has much in common with that presented by McNaughton and Lindsay (1995), described earlier in this thesis in the section entitled Visual Processing Associated with "Reading" Different Types of Graphic Representational Systems (GRSs). This speculation also has important implications for the selection of a graphic representational system for AAC users.

Descriptive study and two case studies by Smith.

Smith (1989) conducted a study with ten nonspeaking children with cerebral palsy, aged 7-10 years. In the year prior to the study, all subjects had been assessed as functioning in the average range of intelligence by the psychologists in the Central Remedial Clinic, Dublin, Ireland. The tests that had been used to measure intelligence varied and included the WISC-R, the Hiskey Nebraska Test of Learning Aptitude, and the Leiter International Performance Scale and the Colombia Mental Maturity Scale. Smith assessed the children on a battery of tests measuring visual and auditory-perceptual skills, memory and synthesis, and reading ability. The mean scores on all perceptual tests were well below population norms and 9 of the 10 children achieved Reading Quotients below 85. Smith found that speech production ability correlated significantly with sound blending skills and reading difficulties correlated most strongly with visual perceptual deficits. This occurred only in relation to performance on the visual matching task, however, not on the tasks relating to visual memory of letters and shapes or picture memory. Smith concluded that the nature of the visual perceptual deficits required more careful evaluation. She commented on the need to consider test factors, noting (a) that none of the tests used had been standardized on a
population with cerebral palsy and (b) that the increased effort in a test situation resulted in increased muscle tone which could affect motor ability and artificially depress scores. Her recommendation was that a case study approach would be more appropriate for this population.

In her 1992 paper, Smith described two subjects, both turning 8 years of age during the two months of the study, in terms of their base level resources including perceptual skills and physical abilities and their higher level processes, including language abilities and world knowledge. This description is completely consistent with the model of the symbolic representational learning that has been presented earlier in this thesis in the Theoretical Infrastructure Section. Each of Smith’s two subjects had good hand function. They had no auditory or visual acuity problems, but they scored significantly below average on visual and auditory memory tasks. They both scored within the average range on the receptive language assessments. They both enjoyed reading, had reading quotients up to the average for their age level and were highly motivated to achieve. Smith noted that in her larger study of ten children (Smith, 1989), these two subjects were the only ones to reach age level in reading.

Smith (1992) gave special attention to Stanovich’s description of a developmentally limited relationship between cognitive skills in reading (Stanovich, 1986) and to the manner in which certain cognitive skills may be contingent upon reading efficiency, namely the "Matthew effect". (Both these constructs have been described in the previous section entitled Conceptualizations of the Reading Process, along with Stanovich’s Interactive-Compensatory Model.) Language abilities were reinforced by Smith as being important in the study of reading difficulties. Her concluding recommendations were for further research that would examine situations "where a system despite deficit areas, is still functionally adequate" (p. 65) and for examination of each individual’s pattern of skill resources — two approaches to analysis to be followed in this thesis.

Discussion of phonological awareness tasks by Blischak.

Blischak’s (1994) objective was not to present new empirical findings but rather to review, within the AAC context, the constructs from mainstream reading research of "word recognition" and "phonological awareness". She suggested AAC adaptations for tests that are typically used to measure various phonological skills. She pointed out however that the adaptations frequently increase the motoric, memory and visual task
demands. Use of indirect selection methods can increase selection time and increase the burden on working memory further. Thus, while tests can be adapted, valid comparisons with the performance of nondisabled subjects on similar tasks are problematic. In this thesis, the additional load on working memory for the tasks included in the present study was observed and the implications were noted in interpreting the results.

Study of phonological coding and reading by Foley.

Foley (1989, 1993) investigated the relationship of phonological coding and reading performance in a study with 12 adolescents and adults with SC SPI, all of whom had a reading comprehension grade level of 2.5 or higher. All of the subjects demonstrated normal intelligence and normal language comprehension at the discourse level. They ranged in age from 16 to 43 years. Six of the subjects were anarthric (i.e., they had a total loss of speech function) and six were dysarthric (i.e., they had a partial loss of speech function) with severity ratings ranging from mild-moderate to severe. Foley's primary intention was to gain a better understanding of the role of articulatory ability as it related to phonological coding and maintaining information in memory. While her investigation focussed on phonological recoding (Foley used both terms in the context of STM — coding and recoding), she was able to examine the performance of anarthric and dysarthric subjects on a number of other factors as well.

The test battery in Foley's study included general vocabulary knowledge, syntactic similarity, and paragraph reading subtests of the Test of Reading Comprehension (TORC) (Brown, Hammill, & Weiderholt, 1995) as well as the reading comprehension subtest of the Peabody Individual Achievement Test (PIAT) (Dunn & Markwardt, 1970) and the Test of Nonverbal Intelligence (TONI) (Brown, Sherbenou, & Johnsen, 1990) as a language-free measure of intelligence and reasoning.

In comparisons between the subjects with anarthria and dysarthria, significantly lower scores on the general vocabulary subtest of the TORC were found for the anarthric subjects. Foley concluded, however, that it was decoding skills rather than vocabulary knowledge that appeared to be the primary factor influencing the reading performance of subjects with anarthria. Three of the subjects with anarthria and all of the subjects with dysarthria scored in the low average on the syntactic similarities subtest. On the reading comprehension score for the TORC, all subjects with anarthria
scored below average and all subjects with dysarthria scored in the average range. While dysarthric subjects had better reading abilities in general than the anarthric subjects, both groups had depressed reading levels.

Foley mentions reading instruction as a possible factor in the poorer overall performance of the anarthric group. Most of the subjects with anarthria reported that their prior reading instruction had focused on learning sight words and few had received explicit training in phonological awareness or word analysis skills. Foley does not report any information regarding prior reading instruction for the dysarthric subjects; however she does emphasize the need to gain more information regarding the variable of reading instruction in future studies. Another interesting finding by Foley was that the only two of the six subjects with anarthria who scored in the average range on the test of phonological awareness had both had long-term exposure to AAC devices with synthetic speech output.

To study the relationship between absence of speech and phonological coding ability, Foley first tested the anarthric and dysarthric subjects on a series of tests related to judgement of homophony of words and nonwords. All 12 subjects were capable of judging the homophony of words and nonwords, indicating that phonological recoding can occur in the absence of speech. The second area of testing was phonological coding in short term memory as judged by (a) phonological similarity effect on retention of visually presented consonant sequences and (b) the use of phonological coding during rehearsal by means of word length effect. It should be noted that persons with normal speech abilities find sequences of similar-sounding letters more difficult to retain in short term memory than sequences of dissimilar-sounding letters (Baddeley, 1986). Foley found that subjects with dysarthria demonstrated significant phonological similarity effects like the speaking population, whereas four of the six subjects with anarthria did not. The two anarthric subjects who did demonstrate similarity effects were those who had had significant experience using voice output systems. The performance of the dysarthric subjects exhibited a word-length effect, however the results were not as strong as for the similarity effect. The word length effect was not significant for the anarthric group. Foley discussed the possibility that the need to include only words of modest length in order to remain within the reading vocabulary of all the subjects weakened the results and she suggested as well that some subjects might have adopted mnemonics that were abbreviations for the longer words, thus rehearsing auditory tokens of approximately the same length in both lists. This use of compensatory strategies by persons with SC S P I is of interest in interpreting the results.
of any AAC study and will be returned to in the Results and General Discussion sections.

Foley's results differed from an earlier study on this topic by Bishop and Robson (1989). The Bishop and Robson study included 12 anarthric, 12 dysarthric subjects and 24 controls individually matched to the speech-impaired subjects by age and nonverbal intellectual ability, as measured on the Raven's Standard Progressive Matrices (Raven, 1963) test. The authors had hoped to match the subjects and controls on severity of motor handicap but this turned out not to be possible. It should be noted as well that the subjects in the Bishop and Robson study ranged in age from 10 to 18. Their reading levels were not reported. Bishop and Robson found the same significant phonological similarity effects for both the anarthric and dysarthric subjects as for their non-speech-impaired controls. The tasks contained line drawings associated with the words sets (a) phonologically similar (man, van, pan, pram, fan, jam, lamb, hand) and (b) control (bath, pit, leaf, cake, doll, belt, glove, spoon). Foley found that only the dysarthric subjects and the anarthric subjects who had long-term experience with voice output devices showed evidence of the phonological similarity effect. Those anarthric subjects who did not show a similarity effect, had significant deficits in word identification. The test in Foley's study contained letter sequences selected from (a) a phonologically similar set of letters (BCDPTV) and (b) a dissimilar set of letters (FHIRWY). It is evident that further work is needed in this area to examine more fully and with larger numbers issues raised by the findings of Foley and of Bishop and Robson. That phonological coding can occur in the absence of speech is an important finding given the strong relationship between phonological processing and reading acquisition. The factors that might influence this processing are not yet clearly identified, however, and the relationship, if any, of performance on the different types of phonological coding tasks with reading acquisition is yet to be determined. The type of stimuli used (letters or line drawings) and the reading levels of the subjects are variables warranting attention.

The subjects in the present thesis were tested for a phonological similarity effect. The testing procedures had to be adapted greatly due to the variation in print knowledge of the current subjects. This limits the contribution that the results from this thesis can make to the theoretical issues that have been raised in the area of phonological coding. The results from this investigation will be compared, however, to the findings of Foley (1989, 1993), Bishop and Robson (1989), and Dahlgren Sandberg (1996) in the discussion of the results of Study 2.
Investigation of literacy abilities of children with cerebral palsy in Sweden.

Dahlgren Sandberg (1996) undertook a series of studies within her doctoral program in the Department of Psychology, Goteborg University, Sweden. Her research offers the most comprehensive descriptive information to date relating to children and adolescents with SCSPSI and the acquisition of literacy. The first three studies related to reading and spelling and included tasks to assess memory, language abilities and phonological awareness. The fourth study was a survey of the parents and teachers of 35 subjects from studies 2 and 3.

In Study 1 (Dahlgren Sandberg, 1996; Dahlgren Sandberg & Hjelmquist, 1996b), Dahlgren Sandberg compared a group of 7 adolescents with SCSPSI, aged 14-20, matched on mental age (MA), measured by Raven's progressive Matrices, coloured version (Raven, 1965) and phonological awareness (measured by a test of phoneme synthesis) with a group of nondisabled adolescents. Subjects were tested on eleven tasks of reading and spelling ability. The tests measured different aspects and different levels of reading and writing ability and were chosen according to the response techniques that were required and ease of administration. Included in the test battery were letter identification, spelling of single words and nonwords, and spelling of words in sentences, all from orally presented stimuli. Dahlgren Sandberg used the two spelling subtests with orally presented material to judge the subjects' ability to make a phonemic analysis and their knowledge of phoneme-grapheme correspondence. In addition, there was a test in spelling of visually presented photographs representing four monosyllabic and four polysyllabic words. The six subtests of reading ability included correction of spelling errors, a lexical decision test, a word chain test, a test of comprehension of connected text, word identification and reading comprehension.

Dahlgren Sandberg reported "good results at the metaphonological task" (1996, Study 1, p. 10), i.e. the test of phoneme synthesis that was used as a matching criteria for the subjects who were disabled. Their level on spelling and reading performance measures, however, did not correspond to their level of phonological awareness, as compared to the speaking subjects. The nonspeaking subjects also displayed great difficulty with visually presented spelling material. Subjects in both the nonspeaking and normal control groups performed better on the spelling than on the reading tests. This finding is consistent with the developmental pattern identified by Vandervelden (1992) and, as will be seen, is supported by the results in this thesis.
In Study 2 (Dahlgren Sandberg, 1996; Dahlgren Sandberg & Hjelmquist, 1996a), a group of 8 nonspeaking preschool children, 5-7 years of age, were matched for age and intellectual level (using Raven's Progressive Matrices, coloured version [Raven, 1965]) with 8 nondisabled children. The phonological tests were increased to include rhyme (choice of pairs of two out of ten pictures), phoneme synthesis (which one of seven photographs represents a spoken segmented word, as in Study 1), sound identification (yes/no-response to tell if a pronounced sound is present in a spoken word), and word length (choice of which one out of three pictures contains most sounds).

Dahlgren Sandberg reported no statistically significant differences in phonological ability between the disabled and the nondisabled groups. If the phonological tests that were used are considered developmentally as has been done by Vandervelden (1992) and Vandervelden and Siegel (1995), however, it is apparent that two of the tests are assessing phoneme awareness (sound identification, word length) and one test is assessing the first level (recognition) of phonological recoding. Since the more advanced level of phonological processing (decoding of pseudowords) was not assessed, it is not surprising that there was no difference in performance on these tasks between the disabled and nondisabled groups. The nondisabled group in comparison with the disabled group showed significantly better spelling abilities and reading abilities, and performed better on the semantic level of the verbal comprehension test. There was no statistically significant difference between the disabled and nondisabled groups on the syntactic level of the verbal comprehension.

In Study 3, 27 subjects ranging from preschoolers to adolescents were matched for chronological age, sex and mental age (using Raven's Progressive Matrices, coloured version [Raven, 1965]) with children with normal speech who were referred to in the study as mentally retarded. A second comparison group with normal speech was matched for sex and mental age (nondisabled group). The phonological tests included in the study were the same as in Study 2, and hence tested phonological awareness (rhyme recognition, sound identification, phoneme synthesis and word length analysis). Other tests included verbal comprehension measured by a semantic and a syntactic task, two tests of nonverbal memory, two visual sequential tasks and the Digit Span task from WISC. The differences among the three groups on all the measures were analysed. As in the two earlier studies, the disabled group performed more poorly on reading and spelling tests than the two comparison groups. The disabled group also showed lower results on tasks of visual memory and verbal
comprehension. The sound identification and word length tasks were more difficult than the phoneme synthesis and rhyme tasks in all three groups.

In Study 4, Dahlgren Sandberg (Study 4, 1996) obtained information through a questionnaire for 35 children with cerebral palsy and two comparison groups. The questions related to home literacy experiences, parents' priorities and literacy experiences in school. She found few differences between the Blissymbol group and the two comparison groups, one matched for mental age and sex (the nondisabled group) and the other for IQ (using Raven's Progressive Matrices) and sex (the mentally retarded group). From the parent responses, there were no differences between the groups in the parents' reading habits or in their values and the high priority given to literacy. In comparisons between the 10 Blissymbol users who she considered readers (scored on two of the four reading tests) and the 25 nonreaders, Dahlgren Sandberg again reported no differences in parental reports of children's interest in literacy activities and concluded "the home literacy situation can at best be marginally influential on reading development" (p. 13). Yet, she reported that the reading children "owned more books, had more often visited the school library, and asked more often for explanations of text read to them" (p.13).

Of particular interest were the results in Study 3 from a within-group analysis performed for the group of disabled subjects. There were no differences between the reader and nonreader subgroups regarding degree of motor disability, articulatory speech or IQ. The reading subjects performed better than the nonreaders on the visual and auditory memory, sound identification, phoneme synthesis, verbal comprehension and semantic tests. As well, the reading subjects used more symbols in their communication than the nonreaders. Of interest also, while there was no difference in access to synthetic speech for communication purposes between the two subgroups, synthetic speech was more often used in the reading and spelling education of the reading subgroup than for the nonreaders.

Dahlgren Sandberg, concluded that a spoken productive language is not necessary for developing phonological awareness as it was assessed in her studies. The nonvocal subjects, however, seemed to have problems with active manipulation of information at the phonemic level "demonstrated by greater difficulty to resolve tasks that were more complex and therefore would benefit from recoding by an overt or covert articulatory representation into some other form in memory" (p. 37). Her interpretation of the phonological results is consistent with the developmental position of Vandervelden and Siegel (1995). Dahlgren Sandberg was, in effect, identifying what
Vandervelden and Siegel would explain as the different levels of phoneme awareness and phonological recoding.

In summary, the children with SCSPPI tested by Dahlgren Sandberg performed at lower levels than the nondisabled comparison groups in reading tasks, spelling tasks and verbal comprehension tasks. There were smaller differences between the disabled and nondisabled groups, however, in performance on the phonological tests which were at the level of phoneme awareness. Second, there was a difference in performance on memory and language related tests between those nonvocal subjects who could read and those who could not read. Third, Dahlgren Sandberg felt the role of the family literacy environment was minimal in the results she obtained in her study.

Although the work of Dahlgren Sandberg is highly relevant, there are questions with regard to the statistical validity of several of the analyses. Parametric techniques were conducted in Studies 2, 3 and 4 in spite of the fact that there were strong floor effects, small numbers and heterogeneity of variance. This has led this author to rely more on an examination of individual subject's performance scores than on the statistical analyses involving differences between the disabled and nondisabled groups.

Another area that must be questioned is that of the criteria used for matching subjects. When investigating reading abilities, the logic of matching subjects on the basis of IQ or mental age, as was done by Dahlgren Sandberg in all three studies, is questionable on several counts, especially when a nonverbal test such as the Raven's Progressive Matrices is used. First, there is a fundamental and continuing dispute as to the nature of intelligence (Anderson, 1992; Case, 1985; Ceci, 1990; Gardner, 1985; Stanovich, 1991b; Sternberg, 1989). Whatever position relating to intelligence is taken to-day, it is likely to follow the direction taken by Ceci (1990) and incorporate "literatures from outside of psychology (anthropology, sociology and education)" and blend "developmental, biological, and information-processing strands into a single account" (p.219). Raven (1938), in introducing the Progressive Matrices emphasized that it was "not a test of general intelligence, and it is always a mistake to describe it as such (1938, p. 13). He described it "as a test of observation, or of a person's capacity to understand and apply a fresh method of thinking (p. 13). In his attempt to measure intelligent conduct, he proposed two tests that would trace changes in a person's capacity to reason by analogy and to recall information — Progressive Matrices and The Mill Hill Vocabulary Scale. Thus even the author of these tests, would consider it inappropriate to use either of them alone as a measure of intelligence or mental age.

Second, the nature of the relationship between "intelligence" and reading is yet
to be established (Siegel, 1989; Stanovich, 1991b). For example, in examining two types of abilities more currently associated with "IQ", Stanovich (1991b) argues that:

the nonverbal abilities associated with reading are more likely to be distinct and domain-specific (e.g., orthographic storage, processing of certain spatial frequencies) whereas the verbal abilities related to reading are more likely to have global influence (e.g., inferential comprehension, verbal STM, vocabulary, thereby affecting general verbal IQ. Therefore, dyslexics who are matched with nondyslexics on performance IQ will be likely to have broad-based deficits in the verbal domain because verbal IQ is allowed to become unmatched [italics added].

(Stanovich, 1991b, p.18).

Although the Raven's Progressive Matrices test was designed long before the variables referred to by Stanovich were being studied, the problem of allowing the verbal domain to remain unmatched nonetheless applies.

In addition "serious problems are presented to those attempting to objectively assess the level of intellectual functioning of physically handicapped non-speaking children through the use of standardized [on nondisabled populations] assessment devices" (Silverman, McNaughton & Kates, 1978, p. 223). Psychometrists experienced in testing persons with physical disabilities have raised particular concerns with regard to Raven's Progressive Matrices test. The strong visual perceptual and spatial organization components in Raven's Progressive Matrices test place subjects with severe physical disabilities at a disadvantage compared to nondisabled subjects on whom the test was standardized (B. Kates, personal communication, Feb. 22, 1997; G. Verburg, personal communication, Feb. 27, 1997). While this could place the disabled subjects in an advantageous position when the Raven's Progressive Matrices test serves as a matching criteria, it nonetheless renders the results questionable.

It was acknowledged by Dahlgren Sandberg that the Raven's Progressive Matrices has not been standardized on a Swedish disabled population and caution in interpreting the results was advised. Since matching is undertaken, however, in order to control for a variable "known or suspected to be related to performance on the dependent variable(s)" (Stevens, 1986, p. 128), it seems critical that the matching variable be clearly defined and reliably measured, and its relationship to the dependent variable be logically justified.
In addition to the problems in using IQ as a matching variable, the feasibility of matching subjects with cerebral palsy with nondisabled subjects on relevant variables warrants careful attention. E.T. McDonald, a psychologist and speech language pathologist with over four decades of experience working with children with cerebral palsy has described the problems inherent in the process. The large diversity within the small population of persons with cerebral palsy with regard to type and extent of impairment, the major developmental and experiential differences between those with cerebral palsy and nondisabled persons and the lack of tests standardized on both the disabled and able-bodied populations make most attempts to match ill-conceived (McDonald, personal communication, 1980). The problem of matching on the variable of chronological age, as was done by Dahlgren Sandberg in her second and third studies, serves as an example. The limited world experiences resulting from lack of independent mobility and the many interruptions to academic work due to the therapy and surgery required by many young children with cerebral palsy result frequently in the developmental level of the child with SCSP1 resembling that of younger nondisabled children.

It can be argued, therefore, since a nonverbal IQ and MA as well as an age match are open to question, the group comparisons reported by Dahlgren Sandberg lack statistical validity. They rest on the assumption that the individuals in the comparison groups are reliably matched on variables related to the dependent variables of reading and spelling and this cannot be supported either with regard to the validity of the measurement or an empirically supported relationship of intelligence and age with reading and spelling.

Nonetheless, having expressed the above concerns regarding the statistical analyses used in her investigation, the work of Dahlgren Sandberg makes an important contribution to the body of knowledge relating to reading acquisition and persons with SCSP1. The independent variables selected for testing, the tests used, the

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6 It should be acknowledged that in Study 1, Dahlgren Sandberg (1996) matched the subjects on both their Raven scores and their score on the phoneme synthesis test. The latter would seem a more appropriate matching variable and was the one in which the match was closest, with both groups having a mean of 5.71 and standard deviation of 1.38 (Table 3, p. 17, Study 1). It should also be noted that with the matching criteria of MA and phoneme synthesis score in Study 1, the age range of the disability group was 14 to 20 years and the nondisabled comparison group age range was 6 to 9 years (Table 1, page 16, Study 1). In Studies 2 and 3, comparison groups of children with normal speech were matched to the children with cerebral palsy for sex, chronological age and IQ.
comprehensive reporting of descriptive and performance data and the pattern of the results provide a valuable resource for comparisons with other studies and, hopefully, for future cross cultural collaboration. The complete reporting of individual children's scores on a battery of reading and reading related tasks affords a unique opportunity for comparisons with the adult subjects in this thesis.

Summary of findings from AAC research related to literacy.

The empirical studies from the past decade vary as to questions being asked, age of subjects, methodology, specific tests utilized and type of analysis. Recurring through most of the studies, however, were several strands of enquiry. Interest is apparent in the phonological processing capabilities of individuals who lack or have limited speech production and the need to differentiate between levels of phonological processing that demonstrate a phonological awareness and that which affords the decoding of words. There are mixed findings relating to the impact of total and partial lack of speech. Concern is raised regarding the limited knowledge we have with regard to visual processing as it relates to reading acquisition by this population. Differences in memory and language skills between those with SCSPS who have learned to read and those who have not raise questions regarding the nature of the relationship of these skills with reading acquisition. In comparisons with nondisabled subjects, the reading and language levels of those with SCSPS are consistently lower, however the subjects with SCSPS share with nondisabled subjects the developmental pattern in which results on spelling tasks are higher than results on decoding tasks. In parallel with testing to determine skill levels, questions are being asked about environmental support and instruction. The question underlying the investigations seems to be shifting away from "Are persons with SCSPS capable of learning to read?" to asking "What are the conditions in which persons with SCSPS learn the skills that support reading?".

The difficulties and limitations inherent in conducting studies with persons with SCSPS are apparent. Results must be interpreted with extreme caution due to the many constraints relating to number of subjects and the tests and analyses that can be used. There is a strong role for speculative and position papers in order to refine the questions and narrow the focus of investigations.
Position Papers Regarding Literacy Related Topics

A number of recent position papers have dealt with issues that are relevant to this thesis. The topics addressed include: (a) the influence of graphic symbol use on reading comprehension (Rankin, Harwood and Mirenda, 1994), (b) the impact of graphic symbol use on reading acquisition (Bishop, Rankin and Mirenda, 1994) and (c) the relationships between metalinguistic, cognitive and literacy variables (Hjelmquist, Dahlgren Sandberg, and Hedelin (1994).

(*Reading comprehension discussed by Rankin, Harwood and Mirenda.*)

A paper by Rankin et al. (1994) reviewed the literature pertaining to reading comprehension in relation to persons who lack functional speech. It made a valuable contribution to the AAC literature and proved helpful in interpreting the results of one of the groups in the present study — the Print Readers. Rankin et al. pointed out that:

to arrive at a meaningful understanding of printed text, individuals must understand the printed code or graphic symbols, have a functional use of the necessary language abilities and processes, have the cognitive ability to process the information, and have the background knowledge necessary to make sense of the content of the message conveyed through the text. Each time an individual "reads", these factors interact and affect the degree of meaning the reader is able to construct.

(p. 270)

Rankin et al. identified lexical retrieval, syntactic difficulties and oral discourse problems as being related to problems in reading comprehension. They referred to a two-year longitudinal study of beginning first-graders by Tunmer, Herriman, & Nesdale (1988) to discuss metalinguistic awareness and reading comprehension. Based on the work by Tunmer et al, Rankin et al. suggested that:

Metalinguistic ability develops separately from and later than speaking and listening skills, and that the ability to separate a word from its referent, dissociate the form of a sentence from its meaning, and the ability to focus attention on the intersentential relationships in a group of sentences require the
ability to "decenter" or to shift one's attention from the content of the message to the properties of the language used to convey that content.

(p. 275)

Tunmer et al. considered this ability as being developmentally dependent upon concrete operational thought. They interpreted their findings as meaning that children develop the capability for becoming metalinguistically aware when they are confronted with certain kinds of tasks provided that they have reached a certain threshold level of cognitive development. Rankin et al. commented on the lack of empirical evidence regarding how metalinguistic ability develops in individuals with SCSPID and recommend remaining open as to the role that GRSs might play in the development of word, syntactic and metalinguistic awareness. They concluded with the following:

(1) It is essential that we clearly define the literacy needs for individuals of varying abilities and investigate the multiple variables that may affect the development of skills and abilities necessary for different literacy goals [italics added].

(2) The most important contribution graphic symbols can make may be found in the development of a language base for young AAC users.

(Rankin et al., 1994, p.279.)

The present author's approach in this thesis reflects a position similar to that of Rankin et al. The assessment protocol and collaborative learning approach that is proposed in the Educational Application section is directed to both Bliss and Print Readers. It offers a practical example of a program that considers varying abilities, multiple variables and different literacy goals. Rankin et al's recognition of the importance of graphic symbols in building a language base has been supported by this author and others in the AAC field (Koppenhaver, Yoder, Pierce & Steelman, 1993; McNaughton, 1992a, 1993; McNaughton & Jennische, 1992; van Balkom & Welle Donker-Gimbrère, 1996).
The role of graphic symbols in literacy acquisition.

Bishop, Rankin, & Mirenda (1994), in a paper entitled, "Impact of Graphic Symbol Use on Reading Acquisition" argue that the overall impact of the graphic representational experience of persons with SCSPi prior to their exposure to print may be minimal. They base their position on the word recognition literature of nondisabled persons which assigns a primary role to phonemic manipulation and segmentation. One of the weaknesses of their argument is the failure to consider the possibility that persons with SCSPI, due to their different developmental path may acquire useful compensating skills. Nor did Bishop et al consider in their discussion regarding GRSs that there could be different processing involved in learning different types of graphic representational systems (GRSs). Their speculation is based on inferences from the literature on nondisabled individuals to persons with SCSPI without taking into account the unique developmental and ecological circumstances of persons with SCSPI.

Bishop et al (1994) went on to suggest that "the real contribution of graphic symbols may lie in their power to increase an AAC user's language through increased communication with others" (p. 123). This author agrees that language development through increased communication made possible by any GRS is important. This does not necessitate a claim, however, that there are no other contributions to be made by particular GRSs to one or another of the specific literacy subskills. Nor does it follow from an acceptance of a strong relationship between phonological processing and word recognition, that one should discount the possible contribution of other compensatory skills. The phonological recoding of words requires both visual and phonological processing. It would seem prudent, in addition to an examination of the phonological processing skills, to give attention to the different visual processing experiences AAC users bring with them to the processing of print. As Stanovich (1992) has cautioned, phonological processing is not necessarily "the end of the story" (p. 318).

Visual processing associated with "reading" different types of Graphic Representational Systems.

In their paper focusing on the possible relationship between literacy and the use of AAC graphics, McNaughton and Lindsay (1995) proposed that a distinction should be made between two types of structure in AAC graphics. As originally presented, the primary differences are:
In **Type One** symbols, each symbol's representation relates to the *visual appearance* of its referent. It is a *picture* which is derived from the spatial positioning of the parts relative to each other within the whole. A Type One symbol matches its referent's salient visual features.

**Type Two** symbols relate to domains other than visual appearance (phonological or semantic) and portray meaning by the sequencing of their component parts and the logic or rules by which the component parts are ordered both intra-symbols (components or letters) and inter-symbols (within phrases and sentences).

McNaughton & Lindsay, 1996, p. 219.

The distinctions made between these two types of symbols were compared by McNaughton and Lindsay to the differentiation between "geometric" and "algebraic" (Jackendoff, 1987), "analogy" and "propositional" (Shepard & Cooper, 1986), "depictive" and "descriptive" (Kosslyn, 1983), and "dot matrices, mental models" and "propositional representations" (Johnson-Laird, 1983) in the cognitive science literature.

Given that, prior to word acquisition each AAC user learns and processes primarily one of the two types of symbols, McNaughton and Lindsay stressed the importance of learning whether or not any benefit from the experience of "reading" different types of symbols can be applied to learning to read print. They referenced the work of Byrne and his associates that demonstrated that "breaking free of the logographic stage depends on achieving phonemic awareness" (Byrne, 1992, p.6) McNaughton and Lindsay went on to describe the processing of Type One symbols and compared this to the holistic processing of words in the first stage of the developmental model of reading. They then speculated as to the possible effects of extensive experience in the processing of Type Two symbols within an AAC graphic representational system (GRS). They questioned whether this experience might impact upon the speed and accuracy of the visual analysis processing component of the subsequent phonological decoding involved in word recognition.

Metalinguistic skills discussed by Hjelmquist, Dahlgren Sandberg & Hedelin.

The paper by Hjelmquist, Dahlgren Sandberg and Hedelin (1994) related to the development of metalinguistic skills in adolescents with SCSP. It included both a
review of the metalinguistic literature and a report on an application of a metalinguistic approach. All of the subjects in the application study were Bliss users. These authors pointed out that learning to read and write an alphabetical language presupposes conscious attention both to the surface level, or form, and the content of a message. Since Blissymbolics is semantically based and relies to some extent on iconic features, it does not represent the same distinction between form and content as print.

Hjelmquist et al. recognized the situation of Bliss users, therefore as being of special interest and providing an opportunity to study the distinction between reference (form) and referent (content) at both the word and discourse levels. From their examination of the metalinguistic skills of eight Bliss users using (a) a Bliss encoding task (a referential communication game in which the subjects described and asking for information regarding a picture in order to ascertain all the dimensions that differentiated the stimulus picture from the distractors) and (b) a paraphrase judgment task (translating an oral message into Blissymbols, followed by selection of the verbatim repetition of the original message from 4 distractors), they concluded that the subjects demonstrated metalinguistic awareness at both the word and discourse levels.

The Hjelmquist et al. study (1994) is valuable in the attention it brings to metalinguistic knowledge being expressed through use of an AAC system. The conclusions that were drawn, based on the correlational analyses, are weak due to the the small number of subjects (N=8) and the existence of floor effects for several tests. This study, however, provides a bridge to the metalinguistic literature and makes a preliminary attempt to examine this area with AAC users.

**Rationale for Test Selection**

It has been necessary to cast a coarse "fishing" net into the "deep waters" of both the mainstream reading research and the AAC research to provide a theoretical base for this thesis. There is an important complementary role, however, for medium-meshed (and in some instances, fine-meshed) nets, positioned near the surface in both bodies of research. These are needed to assist in operationalizing the constructs that have been identified in the deep fishing.
Test Selection

The extensive reading acquisition literature from the last two decades provides the primary context for determining the tests by which to probe the reading acquisition of adult subjects with SCSPI. In addition, some tests have been selected from the AAC studies of Foley (1989, 1993) in order to compare the subjects of this study with adults with SCSPI who have been studied within a different context. The factors predicted to be of high relevance to the subject of this thesis are those related to phonological processing, visual processing, language processing and memory.

Phonological Processing

A large body of research has supported the centrality of word recognition in initial reading acquisition and the key role of phonological processing within word recognition (Adams, 1990; Gough, 1984; Gough & Hillinger, 1980; Juel, 1991; Perfetti, 1992; Stanovich, 1991a). The first test selected for inclusion in the test battery for this investigation was that of *letter names and sounds* due to the importance of recognizing individual letters accurately before word recognition instruction can be undertaken (Adams, 1990).

Many studies have examined the variety of sound analysis abilities that are referred to as *phonological awareness* and found to relate to early reading acquisition (e.g., Adams, 1990; Hoien, Lundberg, Stanovich & Bjaalid, 1995; Lundberg, Frost & Petersen, 1988, Stanovich, 1992; Yopp, 1988). Stanovich (1992) has suggested use of the term "sensitivity" to differentiate between tasks requiring explicit analysis of small-sized phonological units such as phonemes (deep level of sensitivity) and tasks requiring analysis of rhyme units (shallow level of sensitivity), with the analysis of syllables being considered as the intermediate level. The phonological processing abilities assessed within the test battery of this thesis required a further distinction. The tasks were derived from the Developmental Model (Ehri, 1991; Frith, 1985) as it has been refined by Vandervelden (1992) and Vandervelden and Siegel (1995, 1997). Vandervelden and Siegel make a distinction between *phoneme awareness*, the ability to analyze spoken words and syllables into their constituent phonemes, and *phonological recoding*, a superordinate term which they use to encompass a set of gradually developing skills related to making use of the systematic relationship between letters and phonemes, the most advanced of which is the decoding of pseudowords. The
ability referred to by Dahlgren Sandberg (1996) as "active manipulation of information at the phonemic level" is considered phonological recoding by this author.

The speech limitations of the adult subjects being examined in this thesis prevented the administration of the phoneme awareness tests or of the conventional retrieval form of the decoding pseudoword test that would enable comparisons to be made with speaking subjects. Typically phoneme awareness tests require the subject to produce accurate sounds and perform such tasks as segmenting the phonemes in a pseudoword (e.g., "Break the word apart and say each sound in the word in order; if I say old, you say /o/ /l/ /d/"), manipulating phonemes (e.g., "Say hill without the /hl"), and blending tasks ("Say the word when you put /m/ /a/ /p/ together") (Adams, 1990). Conventional decoding pseudoword tests require the subject to orally read a set of pseudowords. Since these tests could not be conducted with subjects with SCSP1, a decision was made to focus on the phonological recoding levels of recognition (speech-to-print matching) phonological recoding and spelling phonological recoding (or phonemic word spelling as the variable is labelled in this thesis). If viewed on a phonological processing developmental continuum, these tasks would appear at a more advanced level than the phoneme awareness tasks to which Stanovich applied the "sensitivity" distinctions. They would appear, however, at an earlier stage in phonological processing than the retrieval form of the decoding pseudoword task. The three tasks included in this investigation all make use of the systematic relationship between letters and phonemes and hence qualify as phonological recoding tasks.

Vandervelden and Siegel describe the broad term of phonological recoding as a strategy to close the gap between the sounds of each element in a phoneme sequence and the spoken word or pseudoword it represents. In studying the development of phonological recoding in early reading (as the ability to accurately read one-syllable, one-vowel pseudowords is developing), Vandervelden and Siegel (1995) measured three levels and within each of these levels, partial to full recoding. The levels can be defined by the type of task by which they are operationalized — recognition task (speech-to-print matching), spelling task (from spoken stimulus) and retrieval decoding task (from print stimulus). The detailed analysis of subjects' performance in the Vandervelden (1992) study revealed a partial to full developmental pattern of initial consonant, final consonant, then medial vowel processing within a general progression from recognition, to spelling, to decoding pseudowords.

Two types of recognition phonological recoding were tested in Study 2 of this thesis using as stimuli (a) consonant-vowel-consonant nonconventional (CVC-NC)
words and (b) pseudowords. In Study 1, only the CVC-NC task was a recognition level task, as the Kindergarten subjects in being able to speak could be given the retrieval phonological recoding task of reading pseudowords.

In the consonant-vowel-consonant non-conventional word (CVC-NC Word) task, given to both the SC SPI and Kindergarten subjects, the subject was instructed regarding the nonconventional manner in which the words were spelled, shown a printed word such as "LAAK, Tiim, NEET" and asked to select the matching word for each print stimulus from five spoken distractors. The CVC-NC test was adapted from a test by Ehri and Robbins (1992) to provide an additional format for testing the recognition (speech-to-print matching) level of phonological recoding.

The decoding of pseudowords was tested in two formats using in each instance the stimuli derived from Ehri and Robbins (1992). In Study 1, the Kindergarten subjects were tested using the conventional retrieval phonological recoding task format. In the retrieval format, the subject read each pseudoword (such as "fop, mal, bev") as it was presented in printed form. In Study 2, the SC SPI subjects were tested using the recognition (speech-to-print matching) format in order to accommodate to the SC SPI subjects inability to read orally and be understood. In the recognition format, the subject was presented with the printed nonsense word and asked to select the matching pseudoword for each print stimulus from five spoken distractors.

The spelling level of phonological recoding was tested in two ways. All subjects in both studies were tested using the phonemic word spelling test, taken from Vandervelden (1992). This test contained words such as "bat, mit, top" and responses were evaluated for phonemic correctness. Responses were analysed as to total number of words correct and as to numbers of letters correct in initial, final and medial (vowel) positions. The letter analysis within this test was used in comparing the early development in phonological recoding of the SC SPI adults in Study 2 and the Kindergarten children in Study 1. A word pair spelling test was given to the SC SPI subjects in Study 2 who were identified as Print Readers with a grade level of 3.0 or higher on the Peabody Individual Achievement Test (PIAT).

Visual Processing

The role of visual processing in reading acquisition was summed up by Adams' (1990) as she described the connectionist model underlying her reading model: "First and most important, the entire workings of the system depend squarely on the
individual letters that fall within the reader's field of view" (p. 110). One would expect, therefore, that visual deficits would be a major determinant of variability in reading ability. Yet this has not proven to be the case. Stanovich has reported that "several major reviews of evidence have all concluded that visual deficits are not a major cause of reading disability or a major determinant of variability in reading ability" (1992, p. 313). He recommended, however, that judgement on this topic remain open, particularly with regard to reading acquisition. Willows (1991), following an insightful examination of the literature relating to the visual perception and visual memory abilities of individuals who have difficulties in processing print concluded that visual-perceptual and visual memory deficits may be implicated in reading disabilities. She identified visual memory deficits for beginning readers (age range 6 to 8 years) as an area warranting further investigation.

A recent study by Bjaalid, Hoien, and Lundberg (1996) has demonstrated the value of examining both orthographic and phonological processes with subjects beyond the primary age level. A group of 147 Norwegian, Grade 3 students with an age range of 9 years, 4 months to 10 years, 6 months were studied. Bjaalid et al. found a difference between the poor and skilled readers in the way the phonological and orthographic factors were balanced, with phonological ability being the most powerful factor in explaining variance in word reading ability for the poor readers, and the orthographic task of error detection being the best predictor among the skilled readers. These findings further support the need for continued research in this area and the importance of a developmental approach to better understand the role of visual processing in reading acquisition.

Willows (1991) identified the visual demands imposed upon novice readers and called for study of how basic processing weaknesses of various types might relate to and interact with each other in causing individual differences in reading acquisition. The visual processing skills described by Willows were:

1. Accurate visual perception of letters and words
2. Visual analysis of letter forms and the extraction of invariant features
3. Visual discrimination between similar forms in the writing system
4. Visual memory for the patterns of individual letters, of letter strings and of whole words — both to recognize them for reading and to recall or "revisualize" then for writing
5. Visual-spatial and scanning ability to track print from left to right and top to bottom on the page
6. Visual-motor ability to reproduce letters and words in writing
7. Visual-linguistic integration to associate letters and words with sounds and word meanings

This thesis examines skills related to the first three skills listed above, through testing the accurate visual perception of line drawings in a picture recognition task and the analysis and discrimination of sequenced Blissymbols in a visual matching task. The fourth skill listed, visual memory for patterns, is tested through the recognition of sequenced Blissymbols in a visual analysis retrieval task. All of the visual tasks in this thesis were developed by the author. They differ from those identified by Willows in that the visual stimuli have semantic rather than phonological referents, allowing the tests to be used with subjects who have varying levels of letter sound knowledge.

A study by Stanovich and West (1989), examining exposure to print and orthographic processing, recognized the need for study of visual processing in addition to phonological processing. In a series of analyses examining the additional variance in word recognition ability, beyond that caused by phonological processing skills, their results consistently indicated "that variability in phonological processing skill and differences in print exposure do not exhaust the reliable variance in orthographic processing" (Stanovich & West, 1989, p. 422). They suggested that it might be fruitful to pursue Frith's (1985) hypothesis that differences in orthographic processing ability "may result from a habitual shallow and nonanalytic processing style when encountering words" (Stanovich & West, 1989, p. 422).

The work of Byrne and Carroll (1989) explored both visual and phonological processing through introducing university students to artificial orthographies representing phonetic features without the provision of independent information about the speech structures reflected in the orthographies. They concluded that individuals tend to learn nonanalytically in the earliest stages of reading acquisition. As a result of his following work with children, Byrne (1992) proposed the notion of "the default option — the acquisition procedure that applies unless the child has access to certain initial representations of phonological structure ("phonemic awareness")" (p. 5) The tendency has been, however, to focus on how children can be assisted by instruction in the phonemic organization of speech (Byrne & Fielding-Barnsley, 1995; Cunningham, 1990; Lundberg, Frost, & Petersen, 1988; Tunmer & Hoover, 1993) rather than directing any attention to the potential role of visual processing in developing an analytical approach in word recognition.
Research from a related domain, that of visual perception, offers new insights to this topic. Beminger (1987) undertook a study to examine different types of processing of printed words in beginning reading. She drew on the work of Rayner (1976) who suggested that the relative importance of different kinds of visual information (individual letters or overall word shape) may change at various stages of reading acquisition. Beminger (1987) was interested in both "developmental changes in attention to different sources of information in a stimulus word" and "the kind of linguistic representations accessed in memory during the reading act" (p. 388). She relied as well on the work of Kolers and Roediger (1984) who argued for a process-oriented view of information processing in which both stimulus information and "procedures of mind" for manipulating symbols are represented in memory. Their model assumes that different units of visual information can be extracted from the same stimulus and predicts that competence in applying the different procedures will change as the individual learns to read. It also predicts that the unit of visual information extracted from the word will affect the process by which visual codes are translated into linguistic codes during word decoding. Beminger found that nonreaders remembered a whole word more accurately than a letter in a word or a letter sequence in a word. Beginning readers, however, remembered a whole word more accurately than a letter sequence in a word, but not more accurately than a letter in a word. In summarizing her results she reported that:

(a) visual perceptual structures imposed on printed words are affected by the unit of stimulus information available for differentiating among similar stimulus words; and (b) visual procedures for remembering whole-word patterns, component letters, and serial multiletter units are not acquired simultaneously, are not perfectly correlated, and have different relationships with criterion measures of word decoding.

(p. 415)

Further she commented:

Global, component and serial procedures for single words (different levels of visual processing) may all contribute to this decoding process. Global procedures may anchor attention to the visual configuration of a written word in a running line of text and may facilitate a preliminary search of potential matches with representations of words in memory. Component procedures may facilitate attention to individual letters... and thus application of phonic rules of letter-
phoneme correspondence and discrimination among alternative matches with representations in memory. Serial procedures may facilitate attention to letter sequences... and thus abstraction and application of the orthographic code as well as discrimination among alternative matches with representations in memory.

Berninger's work is of interest, adding as she does, the theory and findings of a visual perception study to the developmental studies in the beginning reading literature. Her approach offers a view of various types of visual processing working in harmony, yet changing their roles as the individual develops and gains increasing experience with print. Her conclusions would appear to complement those of many researchers within the area of reading acquisition (e.g., Bryant, MacLean, Bradley, & Crossland, 1990; Byrne, 1984, 1992; Byrne & Carroll, 1989; Byrne & Fielding-Barnsley, 1989, 1995; Cunningham, 1990; Juel, 1988; Lundberg, Frost, & Petersen, 1988; Tunmer & Hoover, 1993).

The findings of the above researchers provide interesting empirical results to consider along with a theoretical proposal offered by Olson (1997). In seeking congruities between the work of Frank Smith (1971, 1973, 1979) and Marilyn Adams (1990), Olson has offered an interpretation of the relationship between phoneme awareness and exposure to print which helps unify the findings of a reciprocal relationship from many empirical investigations (Ehri & Wilce, 1980; Foorman, Jenkins & Francis, 1993; Mann, 1986; Morais, Alegria & Content, 1987; Stanovich, 1986; Vandervelden & Siegel, 1995). Olson theorizes that reading requires the analysis of speech into a novel set of categories, which are arbitrary and determined by the model of the writing system. He suggests that the processing of written material be conceived as a model by which one discovers knowledge of one's own speech, previously undetected — i.e., the discovery of the phonemic level of speech, not recognized prior to processing print, is derived from experiences with print. If the work of Berninger along with that of the reading researchers who advocate phonological instruction is considered within the context of Olson's theory, the case can be made for explicit instruction directing attention to both visual and phonological analytic processing. Further implications of Olson's theory as it can be applied to the reading acquisition of persons with SCSP is discussed later in the section entitled Constructivist View of Development and Learning.
It is of special interest within this thesis that both visual and phonemic analytic processing be considered as factors influencing movement from a dependency on holistic processing to the analytic process required in reading. The possible relationship to reading acquisition of explicit instruction relating the visual analytic processing of Type Two AAC symbols prior to the processing of print cannot be addressed directly in this thesis. It is hoped, however, that the findings regarding performance on the visual tests using AAC symbols (picture identification, visual matching and visual analysis retrieval) will stimulate future study. There is need to explore possible relationships between type of graphic representation system used for communication, explicit instruction, and reading acquisition.

Language and Memory Factors

In addition to phonological processing and visual processing, variables related to language and memory have been shown to relate to individual differences in reading acquisition. Papers by Daneman (1991), examining the range of reading abilities encountered in school children, and Siegel (1993), discussing the basic cognitive processes involved in reading, provide an excellent resource for factors affecting reading acquisition other than those relating to phonological and visual processing. Siegel postulated syntax, working memory, semantics and orthography, in addition to phonology, as the five basic processes that are possibly significant in the development of reading skills. Daneman discussed eye movements, perceptual span, word recognition, word knowledge, language comprehension, working memory and world knowledge as factors worthy of examination in accounting for individual differences among readers.

Of the potentially important variables that were identified by these two authors, eye movements and perceptual span were found not to differentiate between good and poor readers. Semantic (word knowledge) and orthographic processes also did not appear to be disrupted during the period of early acquisition of reading skills in children who were reading disabled. In addition to word recognition and phonological processing, therefore, the remaining variables that differentiated between good readers and those with reading difficulties were syntactic knowledge, working memory, language comprehension and world knowledge.

Gottardo's (1995) investigation was the source for the tests of syntactic processing skills and working memory included in the present study. From her two
syntactic processing tasks (sentence judgement and sentence correction), only the
tsyntactic error judgement test was used due to difficulties in administering the latter test
to individuals with SCSPI. The verbal working memory test used in Gottardo's study
was adapted from the reading span test developed by Daneman and Carpenter (1980).
Gottardo tested working memory performance within listening comprehension rather
than within reading comprehension. Use of the syntactic judgement and verbal
working memory tests developed by Gottardo provided the opportunity within this
thesis to compare the performance of adults with SCSPI on these two measures with
the performance of normally achieving children in Grade 1, 2 and 3. It should be noted
that the verbal working memory test, in addition to requiring listening comprehension,
tapped world knowledge through a true/false rating of statements such as "Lettuce and
peas are vegetables", "Canada is close to the United States", "We get milk from cows"
(Gottardo, 1995). The scores on this component provided a useful indicator of world
knowledge for diagnostic purposes.

The need to consider the relationship between listening comprehension and
reading performance has received support from several areas of reading research.
Daneman (1991) reported an interesting finding from a study with college students by
Jackson & McClelland (1979). These investigators found that "as the absolute level of
reading performance increases, so the proportion of reading variance accounted for by
listening comprehension ability also increases" (Daneman, 1991, p. 526). Daneman
concluded that "Reading seems to depend on a set of language processes that are
common to both reading and listening" (p. 526). Byrne and Fielding-Barnsley (1995)
conducted a study with children that provides further support to this position. They
tested Hoover and Gough's (1990) "simple view" of reading that reading
comprehension is jointly determined by listening comprehension and decoding with
115 Grade 2 children. Their results showed that listening comprehension and
pseudoword reading each accounted for substantial portions of variance in reading
comprehension, with listening comprehension showing $R^2$ change = .21 ($p<.001$) and
pseudoword reading showing $R^2$ change = .25 ($p<.001$). In another context, Stanovich
(1991b) argued that a discrepancy between listening comprehension and reading
achievement would have more face validity and more educational relevance than the
traditional procedure of defining reading disability by the discrepancy between
intelligence and reading achievement.

In addition to the inclusion of the language-related variables of syntactic
judgement, listening comprehension (termed "receptive language" in this thesis) and
verbal working memory, communication competence was rated and expressive language was assessed using each subject’s primary means of communication. In this way language factors unique to subjects with SCSP may be considered. Subtests relating to expressive and receptive language from the Clinical Evaluation of Language Fundamentals-Revised (CELF-R) (Semel, Wiig, & Secord, 1987), used by Foley (1989, 1993) in her studies with adults with SCSP, were used for the language testing. The performance scores on the Word Classes subtest of the CELF-R were considered as providing a further diagnostic indication of world knowledge, in addition to the True/False subtest of the Working Memory Task (Gottardo, 1995). The Evaluation of Spontaneous Communication with Focus on Blissymbols, developed by Jennische and Lorstrom (1996), was used to rate communication competence. Other items from Jennische and Lorstrom (1996), combined with environmental variables of interest to this author, were used to develop an ecological checklist.

Although arguments have been offered against using intelligence measures in reading research with persons with SCSP, the Test of Nonverbal Intelligence (TONI) developed by Brown, Sherbenou & Johnsen (1990) was added to the test battery. This test was selected to provide descriptive information supportive of comparisons between the subjects in this thesis with the adult subjects with SCSP studied by Foley (1989, 1993). Another test used by Foley, to investigate phonological coding in short term memory — phonological similarity effect on retention of visually presented consonant sequences — was adapted for use in this thesis. Within the present study, it was named Phonological Recoding and STM Task. Again, this test was included as a means of comparing the performance of subjects in this thesis with that of other subjects with SCSP on a variable considered to be related to vocabulary development (Gathercole & Baddeley, 1989) and reading performance (Foley, 1989, 1993; Liberman, Shankweiler, Liberman, Fowler & Fischer, 1977).

The Peabody Individual Achievement Test (PIAT) for sentence comprehension was given to all print readers and the general vocabulary, syntactic similarities and paragraph reading from the Test of Reading Comprehension (TORC) (Brown, Hammill, Wiederholt, 1995) were included for those subjects who read beyond a grade level of 2.9. These tests enabled comparisons to be made between the subjects of the present study and the subjects examined by Foley (1989, 1993). A summary of all the variables for which data was obtained in this thesis appears in Table 2-3.
Table 2-3: Variables* Tested in Kindergarten and SC SPI Subjects

<table>
<thead>
<tr>
<th>Kindergarten Subjects Only</th>
<th>SC SPI Subjects Only</th>
<th>Kindergarten &amp; SC SPI Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phonological/Visual Processing</strong></td>
<td><strong>Phonological/Visual Processing</strong></td>
<td><strong>Phonological/Visual Processing</strong></td>
</tr>
<tr>
<td>- retrieval decoding pseudowords (Ehri &amp; Robbins)</td>
<td>- recognition decoding pseudowords (Ehri &amp; Robbins)</td>
<td>- letter name and sound</td>
</tr>
<tr>
<td>- homophone word-pair (Siegel)</td>
<td>- consonant-vowel-consonant non-conventional (CVC-NC) word task</td>
<td>- primary word reading (Vandervelden)</td>
</tr>
<tr>
<td><strong>Phoneme Awareness</strong></td>
<td><strong>Phoneme Awareness</strong></td>
<td><strong>Phoneme Awareness</strong></td>
</tr>
<tr>
<td>- phoneme segmentation (YoppSinger)</td>
<td>- phoneme segmentation (YoppSinger)</td>
<td></td>
</tr>
<tr>
<td>- phoneme deletion (Rosner)</td>
<td>- phoneme deletion (Rosner)</td>
<td></td>
</tr>
<tr>
<td><strong>Visual Processing</strong></td>
<td><strong>Visual Processing</strong></td>
<td><strong>Visual Processing</strong></td>
</tr>
<tr>
<td>- picture recognition/ line drawings</td>
<td>- visual matching of Blissymbols</td>
<td>- visual analysis retrieval of Blissymbols</td>
</tr>
<tr>
<td>- visual matching of Blissymbols</td>
<td>- visual matching of Blissymbols</td>
<td></td>
</tr>
<tr>
<td>- visual analysis retrieval of Blissymbols</td>
<td>- visual analysis retrieval of Blissymbols</td>
<td></td>
</tr>
<tr>
<td><strong>Spelling</strong></td>
<td><strong>Spelling</strong></td>
<td><strong>Spelling</strong></td>
</tr>
<tr>
<td>- spelling word-pair (Siegel)</td>
<td>- spelling word-pair (Siegel)</td>
<td>- phonemic word spelling (Vanderhelden)</td>
</tr>
<tr>
<td><strong>Reading Comprehension</strong></td>
<td><strong>Reading Comprehension</strong></td>
<td><strong>Reading Comprehension</strong></td>
</tr>
<tr>
<td>- sentence comprehension (PIAT)</td>
<td>- sentence comprehension (PIAT)</td>
<td></td>
</tr>
<tr>
<td>- reading comprehension (TORC)</td>
<td>- reading comprehension (TORC)</td>
<td></td>
</tr>
<tr>
<td><strong>Memory</strong></td>
<td><strong>Memory</strong></td>
<td><strong>Memory</strong></td>
</tr>
<tr>
<td>- working memory (Gottardo)</td>
<td>- working memory (Gottardo)</td>
<td></td>
</tr>
<tr>
<td>- phonotactical recoding and short term memory (Foley)</td>
<td>- phonotactical recoding and short term memory (Foley)</td>
<td></td>
</tr>
<tr>
<td><strong>World Knowledge</strong></td>
<td><strong>World Knowledge</strong></td>
<td><strong>World Knowledge</strong></td>
</tr>
<tr>
<td>- working memory (Gottardo)</td>
<td>- working memory (Gottardo)</td>
<td></td>
</tr>
<tr>
<td><strong>Language</strong></td>
<td><strong>Language</strong></td>
<td><strong>Language</strong></td>
</tr>
<tr>
<td>- receptive language (CELF-R)</td>
<td>- receptive language (CELF-R)</td>
<td>* The source, other than McNaughton, of tests used</td>
</tr>
<tr>
<td>- expressive language (CELF-R)</td>
<td>- expressive language (CELF-R)</td>
<td>— standardized and informal — is indicated in brackets.</td>
</tr>
<tr>
<td>- syntactic error judgement (Gottardo)</td>
<td>- syntactic error judgement (Gottardo)</td>
<td></td>
</tr>
<tr>
<td>- communication competence (Jennische &amp; Lorstrom)</td>
<td>- communication competence (Jennische &amp; Lorstrom)</td>
<td></td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td><strong>Other</strong></td>
<td><strong>Other</strong></td>
</tr>
<tr>
<td>- nonverbal intelligence (TONI)</td>
<td>- nonverbal intelligence (TONI)</td>
<td></td>
</tr>
<tr>
<td>- ecological rating</td>
<td>- ecological rating</td>
<td></td>
</tr>
</tbody>
</table>

The range of variables being examined combined with the many constraints associated with research involving subjects with SC SPI and the goal of applying the results educationally, made it imperative that careful consideration be given to the strategies selected for data analysis. A fishing analogy helped clarify the topics selected for discussion and the direction taken in this thesis. A new metaphor was required for the data analyses.
Analytic Strategies

It was decided that Bronfenbrenner's (1979) nesting toy analogy, which he used for an ecological analysis, could serve equally well for the several other tiers of analyses that would be needed in order to examine all the "fish", once caught. Multi levels of analysis were used both to examine the data as well as to select the appropriate statistical procedures.

Issues of generalizability and the reconciling of group results and individual performances are important considerations in research that studies a population with large diversity and has an educational application as one of its objectives. To meet the requirements of such investigations, Light (Manuscript submitted for publication) has proposed a three-tiered model of data analysis. By applying this model to the results of the study involving adults with SCSPI (Study 2) both the research and educational objectives could be addressed. The model was first proposed by Rapport et al. (1988) in research with children with attention deficits. The three levels of analysis are (a) molar level, (b) intermediate level and (c) molecular level.

The three-tiered model of analysis recommended by Light focuses on the statistical interpretation of the results from skill testing. A second domain of analysis was required to examine the ecological factors influencing the performance of the subjects and to ensure that socio-cultural factors were addressed. Through a broad approach to data analysis, relevant information was derived that could be of value to both the researcher and clinician/educator.

Molar Level Analysis

The molar level of analysis consists of comparisons among various groups. At the molar level, three types of statistical analysis were applied to the group results of the adults with SCSPI. Parametric techniques were used for group comparisons whenever the assumptions for their application were met. When this was not the case, nonparametric techniques were applied. When neither parametric nor nonparametric measures were appropriate for the data, the performance of the groups was visually presented displaying score distribution scatterplots and plots of means.

Comparisons were made between two criterion groups. The first group was composed of the adult subjects who were able to read print and the second group was composed of those who were unable to decode words and pseudowords and who read
Blissymbols. Comparisons were also made with the results obtained with nondisabled groups of children from (1) a study of 107 kindergarten children in 1994 by McNaughton which is presented as Study 1 in this investigation, (2) a study of Kindergarten, grade 1 and grade 2 children by Vandervelden (1992), and (3) a study of grades 1, 2 and 3 children by Gottardo (1995). Comparisons were only made when the tests used in this thesis were the same as those used in the other studies.

In comparing the results of adults with SC SPI with children who were nondisabled, attention was upon the primary characteristic the two populations shared. They each had subgroups which were at similar stages of performance in reading acquisition tasks. An attempt was made to benefit from the additional information that could be obtained from the studies of the larger nondisabled population in which the distribution of the scores would be more homogeneous and the number of subjects could be larger, thus making parametric statistical procedures applicable. In following this approach, heed was given to the "importance of making a conscious linkage between one's conceptualization of the research question and the choice of subjects to address the problem" (Higginbotham, 1995, p. 2), and also to the limitations of the inferences that could be made.

Intermediate Level of Analysis

According to Rapport et al. and Light, the intermediate level of analysis provides a bridge between the molar (group) results and those at the molecular (individual level). The focus is narrowed and calculations are made of the proportions of subjects whose performance patterns are congruent with the pattern of group results. The intermediate level of analysis provides an indication of the generalizability of the group results within the sample population and hence the significance of the findings for educational intervention with individuals. For the present thesis, this analysis level translated into comparisons between four criterion sub-groups and between the subgroups and other populations as performance on the various tests permitted. There were many limitations to the comparisons that could be made, given the wide range of reading abilities represented among the four sub-groups. Nonetheless, from these analyses, variables that would be informative in evaluating the performance of individuals were identified.
Molecular Level of Analysis

Rapport et al. and Light describe the molecular level of analysis as focusing on individual cases and providing the opportunity for considering individual performance patterns. At this level of analysis, typical and atypical response patterns can be identified and case studies can be undertaken that may provide support or raise questions regarding accepted theories (McEwen & Karlan, 1990). In the present thesis, profiles that could be used to compare the performance of individuals to the performance of their subgroup were developed. These Reading Profiles along with an Ecological Checklist provided the structure for case examples of initial instructional objectives for one subject from each subgroup, presented in Appendix 3-2-E.

Ecological Analysis

As described more fully earlier in this paper, the four levels of analysis within the Ecological Model proposed by Bronfenbrenner (1979) involved consideration of (a) the Microsystems (immediate environments) in which the subjects interacted; (b) the mesosystems involving links between the settings and groups in which subjects interacted; (c) the exosystem — agencies and organizations that play a role in the subjects' lives; and (d) the macrosystem involving the consistencies, in the form and content of lower-order systems (micro-, meso-, and exo-) that existed for the subculture to which the subjects belonged, that of the scattered community of persons with SCSPSI. In this thesis, the ecological analysis was confined to the microsystem level for the reporting of group results, however, factors related to the other three levels were influential in the direction taken by the author in designing the Educational Application.

Applying the Analysis Results

Because this is primarily a descriptive study, causality cannot be inferred from any of the analyses. Nor are the findings generalizable beyond adult Bliss users and Bliss alumni in Ontario. All analyses, whether pertaining to the criterion subject groups with SCSPI or to the comparison groups from other studies, were undertaken to provide a frame of reference for interpreting the performance of the adult subjects with SCSPI. The findings have been offered as a preliminary empirically-based framework for assessment and instruction, and for learning more about the reading performance of persons with SCSPI of all ages.
Rationale for Educational Application

The Educational Application that is proposed in Section IV incorporates several areas of knowledge: (a) the findings from the Empirical Studies, (b) the opportunity for an innovative instructional program afforded by the new communication capability of BlissInternet, (c) the mediated approach to learning underlying Dynamic Assessment, (d) a constructivist view of development and learning and (e) the author's educational experience. Each area contributes to the proposed instructional program to be called Writing and Reading with the Internet and Bliss (WRIB).

Findings from Empirical Studies

The Ecological Checklist and Profile for Reading Acquisition (PAR) that have been planned as an outcome from the two empirical studies within this investigation provide a means of displaying an individual's environmental support and skill levels compared with those of his or her reading peers on variables demonstrated as related to reading acquisition. This preliminary documentation is considered the minimum level of subject information required prior to planning an instructional program. The checklist and profile are the first requisites for the proposed instructional program, Writing and Reading with the Internet and Bliss (WRIB), designed for volunteer instructors with limited knowledge of reading instruction. They also constitute the assessment information upon which a report and instructional recommendations can be written for experienced reading instructors responsible for a Bliss user's reading instruction in a school setting.

BlissInternet

With this information available at the outset, BlissInternet can be considered as an instructional medium for the implementation of a mediated approach to reading acquisition. BlissInternet is a software package used for sending and receiving messages displayed in Blissymbols, in print, or using a combination of the two. It enables individuals to communicate by email using their own Internet Service Provider (ISP). BlissInternet contains two components: (a) BlissWrite a word processing program for creating, saving, retrieving and printing messages and (b) a
communication component that allows the user to create messages off-line and automatically connect to the Internet when messages are ready to "mail". When connected to the Internet, outgoing messages can be sent, and incoming messages can be received and saved. WRIB takes advantage of all of the technical features of BlissInternet along with key members of the BlissInternet user community to provide a reading instructional program electronically.

Precedence for the use of computer mediated communication (CMC) as the medium for literacy training can be found in the work of Gandell (1992). In Gandell's study, the software used was BlissCom, a primitive version of BlissInternet. Graphics could be transmitted over telephone lines and two persons could "carry on a conversation" through the sending and receiving of Blissymbol messages between two different locations. Chat mode was used and allowed the investigator to interact on-line with each of two subjects. There were four treatment periods. Each period consisted of three on-line interactions for up to nine hours per week and one face-to-face meeting after every fifth on-line conversation, over eight weeks. As described by Gandell, "The on-line conversations resembled a typical telephone conversation that could occur between two friends with two exceptions: the communicative turns were written instead of verbal and the written form comprised Blissymbols instead of English written language" (p. 66). The last two periods in the study differed from the first two by the addition of a translation component in which:

The telecommunications partner translated the subjects' transmissions into as close to proper English form as the software allowed. For example, the subject's transmission might have read, 'I,me (to) think, (to) reason you (singular) (to) go, (to) leave bed'. The telecommunications partner would translate that as 'I think you should go to bed'. The translation would combine the Blissymbol and accompanying English gloss, as well as words spelled out when no Blissymbol was available.

The extra on-line conversation steps for the telecommunications partner was to translate the subject's message prior to responding to the message.

The extra on-line step for the subjects was to read the translation of the previous message prior to reading the response from the telecommunications partner.

(Gandell, 1992, p. 74)
Gandell conducted intensive case studies of two subjects who began the intensive telecommunications interaction with word identification skills tested at a grade level equivalence of 1.9 and 1.0 (Stanford Diagnostic Reading Test, Karlsen, Madden & Gardner, 1984) and 1.8 and 1.6 (Woodcock Reading Master Tests - Revised, Woodcock, 1987). At the end of the four periods, the subjects tested at grade levels 2.3 and 1.3 (Stanford Diagnostic Reading Test) and 2.0 and 1.7 (Woodcock Reading Master Tests - Revised). Gandell's purpose was to evaluate the effect of increased opportunities for the subjects to communicate using both Blissymbols and words by means of telecommunications. She found a general pattern of increased test scores on the two reading measures undertaken (word identification and passage comprehension) and on the language measures of vocabulary development and changes in morphology and grammar. These results led Gandell to conclude that meaningful and functional reading, writing, and 'speaking' opportunities, similar to those provided by the telecommunications opportunities of her research could have a positive effect on reading and writing.

There are many differences between the instructional approach evaluated by Gandell in her two case studies and that being proposed in this thesis. Gandell focussed upon increasing the opportunities to process written material in a meaningful, interactive and enjoyable way (except for the limitations and frustrations of the early software). Explicit instruction in skills related to word recognition was not included in the communication sessions. The two subjects' improved reading performance was evaluated by word identification and comprehension measures rather than by tapping performance levels on a test battery of reading related skills. The learning program involved the learner and a telecommunications partner. Gandell's work provides an important first step, demonstrating as it does the viability of CMC as an educational medium for persons with SCSP; the positive results to be derived from ongoing meaningful experiences with words along with Blissymbols, and the importance of maintaining a socially reinforcing element within telecommunications instruction.

Mediated Learning and Dynamic Assessment

Writing and Reading with the Internet and Bliss (WRIB) is based on the premise that mediation provides an appropriate instructional approach for adults with SCSP. In the context of WRIB, mediation is considered to be intervention that is relevant for the learner's zone of proximal development (ZPD) and in which control
gradually shifts from the instructor to the learner. For Vygotsky, the ZPD was "the place at which a child's empirically rich but disorganized spontaneous concepts 'meet' the systematicity and logic of adult reasoning" (Vygotsky, 1986, p. xxxv). The present author's educational philosophy, as it has developed over 25 years of teaching and learning with children and adults with SCSPSI has been influenced by the theoretical framework of Vygotsky and the model of dynamic assessment (Campione & Brown, 1987; Feuerstein, 1979, 1980; Vye, Burns, Delclos, & Bransford, 1987) which has close ties with Vygotsky's view of development. In this investigation, adults who demonstrate similar skill levels to children at the onset of reading are considered to be at a comparable "place" with regard to reading acquisition. Hence, the construct of ZPD and the instructional approach of mediation are considered applicable.

Dynamic assessment originated with Budoff and Friedman (1964) as they sought a means of measuring the ability to profit from experience (their definition of intelligence) of adolescents with limited cognitive ability (Rothman & Semmel, 1990). Budoff and his associates devised and evaluated a Learning Potential Assessment which involved test-teach-test strategies to assess the learning potential of individuals. Their focus was upon the development of quantitative methods for measuring learning potential.

With a similar orientation, Feuerstein and his associates (1979, 1980) sought richer clinical information concerning an individual's underlying cognitive thought processes. They developed the Learning Potential Assessment Device (LPAD) and the Instrumental Enrichment (IE) instructional program, emphasizing mediated learning in contrast to incidental learning. Feuerstein's work has been criticized for lack of scientific rigour (Savell, Twohig, & Rachford, 1986) as many design weaknesses were apparent in the evaluation of the instructional programs. Nonetheless, the LPAD/IE was considered by Rothman and Semmel (1990) in their review of dynamic assessment to be "the most comprehensive dynamic assessment program available". For those concerned regarding the limitations of static intellectual assessments for persons with various types of impairments, dynamic assessment implemented within an intervention program remains a valuable approach to consider.

Other researchers influenced by Vygotsky's work, Campione, Brown, Ferrara, Jones, and Steinberg (1985) and their associates at University of Illinois examined clinical and psychometric variables associated with dynamic assessment. They compared learning and transfer characteristics of 25 mildly retarded and 25 nonretarded students in doing matrix problems on a computer and provided a systematic series of
hints to help them. Instead of emphasizing a final level of performance they measured the number of hints needed to solve a particular problem. The hints were provided in a general-to-specific sequence, beginning by providing general problem-solving information and progressing to explicit hints relating directly to the content of the question. In another study, Campione and Brown (1987) addressed the need of linking assessment to the academic instructional program and meaningful remediation. In still other studies (Brown & Palincsar, 1982. Palincsar & Brown, 1984), reciprocal teaching was examined. The goal was improved comprehension skills. Toward this end, the teacher and student alternately lead dialogues on assigned readings. Included within reciprocal teaching was ongoing diagnosis.

A team at Vanderbilt University (Vye, Burns, Delclos, & Bransford, 1987), also included research related to dynamic assessment as an approach within their continuum of assessment services. They compared gradual prompting (graduated hints) and "mediated" dynamic procedures. In the former, a set sequence of prompts based on the subject matter are given until a specific learning criteria is reached. The prompts are based on a comprehensive task analysis of content so that each prompt gives more explicit information than the previous one. With mediated dynamic procedures, more in-depth information based on the subject's needs is given. In a series of studies, this research group found results favouring the mediation group. Dynamic measures were shown to provide objective and qualitative information not available when static test instruments were used (Rothman & Semmel, 1990). In addition dynamic assessment was found to positively affect teacher opinions concerning a child's learning potential.

Although the assessment of broad metacognitive aspects of learning and the evaluation methods used with the early dynamic assessment programs have been found to lack validity, later research involving dynamic assessment has found reliable, positive results from mediation when it is related to specific content areas (Rothman & Semmel, 1990). Several components of dynamic assessment derived from the techniques of the early studies and the procedures of the later studies have relevance for the proposed WRIB program: mediation based on the learner's assessed strengths and weaknesses, pretesting with standardized and informal tests to establish a baseline, linking assessment with instruction, ongoing diagnosis, and provision of graduated hints as one technique of several within mediated instruction.
Constructivist View of Development and Learning

Mediation as conceived in dynamic assessment and derived from the thinking of Vygotsky has its roots in the tradition of constructivism, the approach to human development in which the active construction of knowledge by the learning individual is emphasized. Because the focus is upon the learner, "teachers are seen as assisting performance and the construction of powerful knowledge, rather than explicitly providing knowledge and information" (Harris & Graham, 1994, p. 234). Their primary role is providing functional, meaningful, and authentic contexts in which individuals can construct their own knowledge. The writing related to constructivism that has influenced this author applies primarily to the learning and development of children (Britton, 1970; Bruner, 1966; Donaldson, 1978; Entwistle, 1970; Piaget & Inhelder, 1969; Vygotsky, 1934/1986). The various manifestations of constructivism that will be described, however, have relevance as well to the adult instructional program proposed in this thesis.

Harris and Graham (1994), referencing a classification system devised by Moshman (1982), distinguish between three constructivist paradigms. Endogenous constructivism is exemplified by Piagetian theory which focusses on the understanding and explaining of spontaneous learning within a developmental context. The child is viewed as constructing new knowledge from old through metacognitive reflection. Child-directed exploration and guided discovery are the key elements of an educational program planned by endogenous constructivists. This approach, as exemplified in the whole language paradigm initiated in the seventies (Goodman, 1976, 1986; Smith, 1971, 1973, 1979), strongly influenced the beginning reading programs for persons with SCSP that were provided and recommended by this author in the seventies and eighties. Although the need for explicit focussed instruction in word-recognition related skills was perceived to be important at a later stage of reading acquisition, it was not considered appropriate during the onset of reading. Along with other educators who have studied the reading research of the past two decades, this author now has concern about the omission of structured explicit instruction in specific skills within beginning reading programs, particularly for students with special needs.

Exogenous constructivism, on the other hand, perceives environmental (exogenous, external) guidance of the child's constructive activity as the principal factor in directing the course of learning. Moshman (1982) cites contemporary social learning theory and information-processing theories as reflecting this end of the constructivist
continuum. Teaching is emphasized within an exogenous constructivist approach and extensive modeling, discussion and explanation is undertaken. This approach will be discussed further in the context of instruction related to word recognition skills.

Dialectical constructivism is the third approach to be considered and best describes the perspective taken by this author in developing WRIB. As described by Harris and Graham (1994), in dialectical constructivism "the source of knowledge is seen as lying in continuing interactions between the child and environment; a complex and dynamic reciprocity between the developing individual and a simultaneously changing world is posited" (p. 236). Teaching within this paradigm includes scaffolded instruction, reciprocal teaching and teacher-guided or prompted discovery. Explanations may be less explicit than with exogenous constructivists, but they can occur if a need is indicated by the child's response to instruction.

Within the dialectical constructivist approach of WRIB, the social constructivist dimension must be identified. Moran and Calfee (1993) have proposed an example of literacy instruction designed around the principles of student-centered, authentic instruction in a socially engaging context. Their attention was directed toward classrooms that were both English-monolingual and Spanish-English bilingual. Their focus was on students gaining a meta-understanding of the complexities of language through engaging "with one another in the formulation (with guidance) of practical principles" (p. 208). In WRIB, the focus is upon all participants gaining a meta-understanding of reading acquisition through examining both Blissymbolics and traditional orthography and being engaged with one another in cyber space.

While dialectical constructivism is the source for the general approach in WRIB and is also viewed as appropriate for supporting the development of reading comprehension, another approach is needed for the acquisition of phonological recoding within the word recognition domain. The rationale for differing approaches at different points of learning has been convincingly presented by Stanovich (1994). In describing the different levels of processing in reading, Stanovich drew on the differentiation between modular and central processes made by Fodor (1983) and made a distinction between the modular, encapsulated, data-driven processing of word recognition and the central processing, meta-cognitive strategies of reading comprehension. He used the different theoretical conceptualizations of these two types of processing to recommend a different instructional approach for each. The inclusion of Fodor's conceptualization of modular processing within a discussion of constructivism may, at first reading, seem paradoxical. There is an important link,
however, if Moshman's constructivist model is used. An exogenous constructivist approach, as described above, provides the paradigm for explicit instruction to facilitate an awareness that phonemes are abstractable and manipulable components of language. It is thus, through an exogenous constructivist approach that the foundation is laid for the modular and encapsulated processing of phonological recoding.

Share (1995), in an excellent paper elaborating the view that phonological recoding is the *sine qua non* of reading acquisition, describes phonological recoding as a self-teaching mechanism by which the individual acquires an autonomous orthographic lexicon. This "self-teaching" and the reading accomplishment it affords, however, require the development of a domain-specific knowledge base that includes phonemic awareness. For many beginning readers, phonemic awareness is acquired through explicit instruction. It is thus through an exogenous constructivist approach that the foundation is laid for the modular and encapsulated processing (self-teaching) of phonological recoding. Hence, Stanovich is able to argue that for *word recognition*, the most efficacious training programs are those based on an exogenous approach; for processing that relies on the meta-cognitive strategies such as *reading comprehension*, the most efficacious programs are those that practise an endogenous approach.

Since the acquisition of phonological recoding skill is essential to word recognition, it must be the primary objective for Bliss readers wishing to progress to the reading of print. An exogenous approach, therefore, has an important role to play. In the domain of word recognition within WRIB, explicit, analytic teaching of spelling-sound correspondences will be emphasized. This instruction will occur, however, within a learning environment that is interactive and supportive of a mediated approach to instruction in the general language and knowledge areas. These domains must have an integral place, along with word recognition, in any reading program for adults with SCSPi. The design of WRIB reflects Moshman's (1982) position concerning current practice related to constructivism, "at different times or points, endogenous, exogenous, or dialectical considerations can be seen as predominant, thus indicating which root metaphor is most useful at that time" (Harris & Graham, 1994, p. 237).

Olson's (1996, 1997) theorizing offers an additional perspective relating to constructivism which has relevance for the direction taken in WRIB. As mentioned earlier, Olson has proposed a theoretical framework to identify the congruencies between two approaches to reading acquisition. The first approach which would be described as endogenous is supported by many emergent literacy and whole language advocates and was originally proposed by Smith (1971, 1973, 1979). In it, the child
constructs his or her own understanding relating to the recognition of words from rewarding experiences with print. The second approach to reading acquisition discussed by Olson emphasizes the need for explicit instruction to gain an awareness of the alphabetic function in reading (e.g., Adams, 1990; Cunningham, 1990; Lundberg, Frost, & Petersen, 1988). It is described by Stanovich (1994) as derived from exogenous constructivism.

Olson explores symmetries between the approach that recommends explicit teaching (exogenous) and the approach that stresses providing an environment in which children can construct their own learning (endogenous). He offers an amendment to the two approaches to accommodate the seemingly polar positions that (a) letter-sounds relationships must be taught and (b) children construct their own understanding of what they are reading and from there discover the letter-sound relationships. Olson argues that reading requires the analysis of speech into a novel set of categories, which are arbitrary and determined by the model of the writing system to which the child is exposed. It is through the processing of written material that children gain knowledge of their own speech that was previously undetected, i.e., the categories of speech at the phonemic level which have not been recognized prior to processing print. Olson thus identifies the environment as the principal stimulant to phonemic awareness. If one accepts Olson's "amendment", it follows that explicit instruction would merely constitute an expansion of the environmental influence.

Whether or not Olson's proposal succeeds in satisfying proponents of the exogenous and the endogenous approaches to word recognition, it does offer a useful framework for the instruction of Bliss Readers aspiring to become Print Readers. By viewing the analysis of speech into a novel set of categories determined by the model of the writing system to which the individual is exposed rather than being determined by the individual's analysis of his or her own speech output, a rationale is provided for speculation that individuals with SCSPi could have the same potential to acquire phonemic awareness as those who speak. The novel set of speech categories (phonemes) revealed through the processing of print could be attained through knowledge of the speech of others or of synthetic speech as readily as through knowledge of one's own speech. In addition, if Olson is correct in identifying print as the source of the learning, there would seem to be little justification for arguing against explicit instruction enriching the external input by directing attention to phonemes. Furthermore, since the semantic components in Blissymbols are more easily identified than the phonological components in printed words, it can be argued that the analysis of
Blissymbols can serve as a first step in providing graduated "hints" toward the analysis of print. Within WRIE, therefore, explicit analysis will be recommended of those features of Blissymbolics which can be related to reading instruction.

Experience Derived from Blissymbol Programs

Through this author's experience with Blissymbols, first as classroom teacher (1971-1973) then as coordinator of the Symbol Communication Research Project at the Ontario Crippled Children's Centre (1973-1978) and project officer of a formative evaluation of Blissymbol use by 157 persons in 32 settings (1974-1978) (Silverman, McNaughton & Kates, 1978), and throughout the past 25 years of training instructors in Blissymbolics, the relationship between the processing afforded by Blissymbols and the acquisition of print literacy by Bliss users has always been of strong interest. Educational reports written as the Blissymbol program was being developed emphasized the importance of integrating symbol use into early reading instruction even though the primary focus was learning to communicate in Bliss in face-to-face interaction. In reporting activities of the first year of full-time Blissymbol classes, the following "reading" activities: were listed:

- continuous opportunities to use symbols for active communication at many levels ... the language experience foundation upon which all reading instruction must build
- development of comprehension skills through symbol sentence completion and through the unscrambling of compound symbols and symbol sentences
- exploring time-place relationships through classifying with symbols
- utilization of symbols in initial consonant and rhyme word recognition activities, as the child's mode of response
- visual discrimination, matching, and sequencing tasks using symbols
- building of sight vocabularies through matching word with symbol
- written symbols were used for tasks and for questions in assignments which required a typed response or indication of the correct answer by marking
- the composing and reading of symbol stories and letters was a regular component of the reading program

McNaughton, 1973, p. 27
An anecdotal example of what was considered notable reading accomplishment in 1974 came from an informal assessment of the four most capable Blissymbol students after two years in the full-time Blissymbol program. Three of the four students recognized as sight words over 75% of the words accompanying the symbols on their communication displays. Their performance was valued as "incidental learning" for the reading program had focussed on the type of activities listed above.

In the *Handbook of Blissymbolics* (Silverman, McNaughton & Kates, 1978), a product of the formative evaluation study contracted by the Ontario Ministry of Education, Blissymbols were treated as the medium through which readiness activities and a sight vocabulary could be facilitated. Their use was encouraged in such activities as sequencing events in stories, sentence completion, comprehension questions, matching symbol sentences to pictures and reading symbol stories. It was learned through the evaluation study that for the 120 subjects described as being involved in a reading program, 87% were using reading materials into which Blissymbols had been integrated and 57% of these subjects had materials which were adapted to incorporate Blissymbols either "often" or "totally" (Silverman et al, 1978, Part 2, p. 76).

Preparing a paper as supplementary reading for Blissymbol Workshops in the late eighties, Fairley, Lageer, Mann and Mann (1987), all experienced Blissymbol instructors, compiled a list of "reading" comprehension skills that could be developed through Blissymbol use: (1) summarizing, (2.) determining the relevant details and the main idea, (3) sequencing events, (4) drawing conclusions, (5) making inferences (p. 3). In so doing they reinforced the premise that underlay the reading programs for Bliss users in the seventies and eighties (McNaughton, 1985) — that many of the general language and reading readiness skills required to become a competent print reader could be fostered by "reading" Blissymbols. While these skills are recognized as important contributors to reading, the limited reading performance of many Blissymbol users has demonstrated that further support is needed.

One of the motivating factors in undertaking this thesis was a recognition that there has been a critical gap in the conceptualization of Bliss readers progressing to the reading of print. The conceptual framework influencing many Blissymbol instructors in the seventies was the whole language model of reading acquisition. Only in the eighties and nineties, when extensive attention was directed to the development of word recognition skills, did the limitations of the whole language model become apparent. Supported strongly by the reading acquisition research literature of the past 15 years,
explicit instruction in word recognition skills can now confidently be recommended along with continuing support to general language development.

In the Educational Application presented as *Writing and Reading with the Internet and Bliss (WRIB)*, several factors relating to the instructional possibilities for adult Bliss users have been considered. In most instances, adults who use Bliss but who have been unable to successfully progress to the reading of print must rely on the assistance of volunteers for further reading assistance. It is highly likely that most of these volunteers will lack a theoretical understanding of reading. For the instruction to be effective, both the volunteer and each Bliss symbol user will need support. While this might initially appear to prohibit the implementation of a reading program, Bliss Internet and computer mediated communication (CMC), now available to many Bliss users, makes an ongoing instructional support program possible. In designing WRIB, the model of teacher training found to be most effective in comparing various implementations of Clay's (1985) Reading Recovery (RR) Program (Pinnell, Lyons, DeFord, Bryk & Seltzer, 1994) has been adapted for application through the use of Bliss Internet and CMC. In the Pinnell et al study, teacher change was found to be most effective when, in a year long program, "the teachers engage in social interaction with their colleagues and mentors (teacher leaders) to construct a view of learning and teaching that supports literacy learning" (p. 12) and when learning could occur through their working with children. The most important features of the teacher training program were peer support, group discussion, coaching by experienced teachers, and time to reflect.

It is recognized that many conditions differ from those described by Pinnell et al in the proposed application of WRIB for the reading instruction of adults with SCSP. The volunteer partners will rarely have teaching experience or an understanding of the constructs familiar to reading teachers to bring to the literacy learning. The time will be limited. The computer technology will initially be intimidating and the CMC medium will be unfamiliar for many. Even the Bliss symbols will be foreign to some volunteers. Nonetheless, the critical elements of a mediated instructional program can be included. An assessment and instructional plan, peer support, group discussion, coaching by experienced teachers and time to reflect can be provided through CMC. The most critical factors will be the motivation and commitment of each Bliss user and his or her volunteer, the support provided by their peers from the Bliss Internet community and the ongoing guidance of an experienced teacher. This author plans to serve as the first resource teacher ("teacher leader"), providing a model for others
through interacting with the first learning teams. The arrangements and format to be followed are outlined in Section IV.

**Primary Theoretical Issues and Key Questions**

Within the current AAC literacy research and germane to this investigation's goal of better instructional practice, there is a questioning of the assumption that a congenital impairment of speech function is itself the primary factor impeding reading acquisition. In rejecting this premise, Koppenhaver and Yoder (1992) expressed concern regarding the heavy emphasis on abilities relating to reading and writing subskills and the relatively limited attention being given to the sociocultural context in which learning was supposed to take place. As has been described earlier, the work of these two authors and their colleagues at the Center for Literacy and Disability Studies, formerly of the University of North Carolina at Chapel Hill and now located at the Duke University Medical Center, has stimulated the development of North American intervention programs to rectify this imbalance. This author is totally supportive of efforts to strengthen the sociocultural support for literacy. However, literacy programs for individuals with SCSPSI could continue to be inadequate if the result of focusing on the social and assistive technology components of the learning environment results in less attention being directed toward individualized skill development.

From this author's perspective a new imbalance is in the making with reading acquisition skills becoming the area that requires redress. This calls for ongoing efforts to examine the basic theoretical premises underlying reading acquisition as they relate to the unique developmental path of persons with SCSPSI. In order to contribute constructively to this process, a number of assumptions and/or findings from small-sample studies have been identified. These have influenced the educational provision of reading instruction to persons with SCSPSI and have, in many instances, motivated the delaying or withholding of reading instruction. To further examine these assumptions/findings and determine whether or not they warrant consideration in instructional practice, a set of key questions have been formulated.
The following are the assumptions and questions that will be addressed in the discussion of the results of Study 2:

Assumption relating to articulatory ability and reading acquisition:
The greater the speech loss, the greater the reading difficulty, i.e. persons with anarthria have greater difficulty learning to read than persons with dysarthria.

Question 1:
Is there a difference in (a) reading level, (b) phonological coding in short term memory, and/or (c) phonological recoding ability attained by those subjects with anarthria (total loss of speech function) and subjects with dysarthria (partial loss of speech function), in favour of the dysarthric group?

Assumption relating to phonological recoding ability by persons with SCPI:
Persons with SCPI have the ability to discriminate and complete phoneme awareness tasks but have greater difficulty than persons with no speech impairment in the active manipulation of information at the phonemic level, i.e, in applying the grapheme-phoneme rules.

Question 2:
Is there a difference between persons with SCPI and persons with no speech impairment in ability to perform phonological recoding tasks (as distinct from phoneme awareness tasks)?

Assumption relating to developmental differences between adults with SCPI and able-bodied children in phonological recoding:
The development in phonological recoding of nonreading adults with SCPI is not the same as that of able-bodied children at the onset of reading.

Question 3:
Do the results for nonreading adults with SCPI in phonological recoding tasks show a different developmental pattern from the results of nonreading children in late Kindergarten?
Assumption relating to language abilities of persons with SCSPI:
Persons with SCSPI function at lower language comprehension levels than persons with no speech impairment.

Question 4:
Is there a difference in language comprehension between persons with SCSPI and persons with no speech impairment?

Assumption related to memory capabilities of persons with SCSPI:
Persons with SCSPI have difficulty in tasks requiring verbal working memory. This assumption appears to rest on the concept of limited cognitive resources. It presupposes that persons with SCSPI have additional verbal processing demands placed upon them and as a result they have less functional working memory capacity. This is attributed to reduced capacity for storing information resulting from the processing demands consuming more of the available capacity.

Question 5:
Is there a difference in performance on a verbal working memory task between persons with SCSPI and nondisabled persons, and among persons with SCSPI at different reading levels?

Assumption related to different developmental path of persons with SCSPI:
Persons with SCSPI have limited world experiences which in turn influence the level of reading achieved.

Question 6:
Is there a measurable difference in world knowledge between persons with SCSPI and nondisabled persons, and among persons with SCSPI at different reading levels?

Assumption related to role of environment in supporting reading acquisition of persons with SCSPI:
A supportive environment is a necessary factor in reading acquisition by persons with SCSPI.

Question 7:
Is there a relationship demonstrated between ecological rating and reading level achieved?
Assumption related to the application of findings from mainstream reading research to reading acquisition by adults with SCSP1:

Factors that are predictive of reading acquisition for children as identified in the mainstream reading acquisition literature are predictive of reading acquisition for adults with SCSPI.

Question 8:
Is the pattern of results in reading related and reading acquisition tasks similar for adults with SCSPI who have not yet acquired the ability to decode and able-bodied children at the onset of reading (late Kindergarten)?

Assumption relating to usage of different types of graphic representational systems and reading acquisition:

There is no relationship between the type of graphic representational system (GRS) being used by an individual and reading acquisition.

Question 9:
Do the results on visual processing tasks indicate a potential relationship between type of visual processing undertaken in the use of the individual's GRS and performance on tasks related to reading acquisition?

Assumption relating to intelligence and reading acquisition:

Persons with SCSPI who perform well on a test of intelligence are more likely to achieve literacy.

Question 10:
Are the performance results in the Test of Nonverbal Intelligence (TONI) related to reading level?
SECTION III

EMPIRICAL STUDIES

The design issue is one of matching
the research design to the substantive problem
without distorting the problem.

Shavelson, 1988, p. 1

The problem addressed in this investigation can be stated quite simply:
Empirical knowledge relating to reading acquisition by persons with severe congenital
speech and physical impairments (SCSPI) is in its infancy, yet instructional programs
must be implemented. The method used herein to advance knowledge in this domain
begins with one of the first steps in any science, "to describe objectively the subjects
with which the science is concerned" (Borg, 1987, p. 10). This descriptive information
is analyzed using a multi-tiered approach. A provisional instructional program is then
proposed.

Two empirical studies were conducted as part of this undertaking. Study 1 was
undertaken with Kindergarten subjects in order to obtain performance measurements in
reading acquisition tasks of nondisabled children at the onset of reading. The
measurements were used for group and test comparisons within both studies. Study 2
obtained performance measurements in reading acquisition and reading related tasks, as
well as descriptive and ecological information concerning adults with SCSPI.
STUDY 1

Goals

1. To provide normative data for Study 2 comparisons, by determining the performance levels of children in the last two months of their Kindergarten year on a battery of reading acquisition tests.

2. To compare performance levels of two criterion groups of Kindergarten children — High Readers and Low Readers.

3. To determine the relationship of a newly designed CVC-NC (consonant-vowel-consonant non-conventional) Word Task with other phonological tasks used in reading acquisition research. This CVC-NC Word Task was developed by McNaughton for use by persons with SCSPI. It was based on a test designed by Ehri and Robbins (1992).

4. To determine the relationship of a newly designed Visual Analysis Retrieval Task with other visual processing tasks and with decoding tasks used in reading acquisition research. This Visual Analysis Retrieval Task was developed by McNaughton for use by persons with SCSPI. It applied semantic-based Blissymbols as the components for visual analysis.

5. To examine a potential developmental pattern in the performance of Kindergarten children on phonological recoding tasks.
Methodology

Design

This study employed a criterion group design. Descriptive analyses were conducted for the full group of 107 Kindergarten children, comparisons were made between two criterion sub-groups identified as High and Low Readers, and intercorrelations of reading acquisition measures were determined.

Subjects

The subjects were 107 children from 12 full day Kindergarten classrooms located in the Early Learning Center, Effingham Community Unit #40, Effingham, Illinois. The Early Learning Center had 13 Kindergartens in all, with one classroom providing a Kindergarten Readiness program. The total number of children attending the school was approximately 250. The subjects were selected from applications by 141 families agreeing to have their child participate in the study. The children were tested during April and May (the last two months) of their Kindergarten year. The age range of the participants was 66-80 months at the time of testing (mean 73 months). The following criteria were applied to the selection: equal number of boys and girls; equal number of children from the older and younger half of those applying; oral proficiency in English (teacher judgement); member of regular (Senior) Kindergarten program (i.e., no children were selected from the Kindergarten Readiness class); representation from all (Senior) Kindergarten classes. Selection otherwise was random. The number of subjects was determined by the time available for testing prior to school year-end.

Procedure

Four months before the study was scheduled to begin, school board administrative approval was obtained and arrangements were made with the principal. An explanatory letter was sent two months before the research project to each parent along with a Consent Form to be signed and returned to the principal if the parents agreed to their child participating in the study (See Appendix 3-1-A). At the onset of the study, a meeting was held with all the teachers to explain the objectives, time commitment and procedures to be undertaken.

The children were withdrawn individually from the classroom for five to six sessions spread over two to three weeks. The maximum time for any session was 20
minutes. The typical session lasted 10 -15 minutes and included one to three tasks. The tasks were randomly presented depending on the time available for a particular session. An exception was made for the letter knowledge tasks, which were considered the easiest. These tasks were always administered in the first session. The total time spent with a child working on tasks ranged from 60 to 80 minutes. The work session schedule was arranged to avoid interfering with classroom activities, school outings and special events. Children enjoyed their time out of the classroom and viewed their trip to the small conference room where the testing was done as a treat. They were accompanied to and from the testing room by a volunteer with whom they enjoyed talking. They looked forward to their visits with the volunteer and the two examiners and were highly motivated to work on the tasks.

Testing was administered by the primary researcher and an assistant who was a retired elementary school teacher. The assistant had taught many of the children's fathers and mothers and knew many of their relatives. She frequently had a recollection to share or a message to send regarding her association with a family member. This made it very easy to establish rapport with the children. The atmosphere was always friendly and informal, similar to most of the Kindergarten classrooms. Within the requirements of the test procedures, every attempt was made to make the testing situation as child-centered as possible. Kindergarten tables were used for the test materials and the computers and both examiners sat at the child's level on Kindergarten chairs.

Training of the assistant on test administration was done by the provision of written instructions and the primary researcher modelling the procedures by administering each test as it was given for the first time. This was followed by the assistant administering the test as it was given to the next three children, observed by the primary researcher. Advice was given by the primary researcher regarding administration procedures, as required. New tests were introduced on different days so that the assistant would become familiar with each test before another one was introduced. Written instructions for all of the tests were available for the assistant to reference following initial training. Since the testing was being done by both examiners working in the same room, the primary researcher was always available if a question arose. The tests involving Blissymbols were administered only by the primary researcher. Marking of each test was done by the examiner who had administered it, and was checked by the primary researcher.
Tasks

Each subject was individually tested on a battery of reading acquisition tasks which included measures of letter knowledge, recognition phonological decoding of pseudowords and nonconventional words, primary word reading, picture recognition, phoneme deletion and segmentation, phonemic word spelling, visual matching and visual analysis retrieval. The Examiner forms for the test battery appear in Appendix 3-1-B.

Letter Name and Sound Tasks.

The measures included were 1) Vowel Naming Task, 2) Vowel Name Recognition Task, 3) Consonant Naming Task, 4) Consonant Name Recognition Task, 5) Consonant Sound Recognition Task.

All the vowels were tested. The consonants tested in these measures were those included in the words of the CVC Non-Conventional Word Task. The Letter Name and Sound Tasks were administered in the order presented below and were administered during each subject's first session.

(1) Vowel Naming Task

The five vowels were presented on a card as upper case capital letters except for the letter 'i' which was presented in lower case. The order of the letters, left to right, was: A, E, i, O, U.

Instructions:
"Tell me the name of the letter I point to."
The order of pointing by the examiner was: O, A, U, i, E.

(2) Vowel Name Recognition Task

The five vowels were presented on the same type card used in the Vowel Naming Task — as upper case capital letters except for the letter 'i' which was presented in lower case. The order of the letters, left to right, was: A, E, i, O, U.

Instructions:
"I will say a letter name. I want you to point to the letter that has the name I say."
The order of naming by the examiner was: E, O, U, i, A.
(3) Consonant Naming Task

The twelve consonants included in the CVC-NC Word Task were presented on two cards as upper case capital letters in sets of six. The cards were presented one at a time, to facilitate scanning. The order of the letters was alphabetical and left to right: B, D, F, K, L, M and N, P, R, S, T, V.

Instructions:
"Tell me the name of the letter I point to."
The order of pointing was: F, B, L, D, M, K and V, P, S, N, T, R.

(4) Consonant Name Recognition Task

The twelve consonants included in the CVC-NC WORD TASK task were presented as upper case capital letters in the same sets used in the Consonant Naming Task. The order of the letters was alphabetical and left to right: B, D, F, K, L, M and N, P, R, S, T, V.

Instructions:
"I will say a letter name. I want you to point to the letter that has the name I say."
The order of naming by the examiner was: M, F, L, B, K, D and P, V, N, S, R, T.

(5) Consonant-Phoneme Sound Recognition Task

The twelve consonants included in the CVC-NC WORD TASK task were presented as upper case capital letters in the same sets used in the Consonant Naming Task. The order of the letters was alphabetical and left to right: B, D, F, K, L, M and N, P, R, S, T, V.

Instructions:
"I will say a sound. I want you to point to the letter that writes the sound I say."
The letters were sounded in the following order: D, M, K, B, F, L and V, S, R, T, P, N.
Phonological Recoding Tasks.

The measures included were a newly designed word task using nonconventional spelling (McNaughton) and a pseudoword task adapted from Vandervelden (1992).

**CVC-NC Word Task - Part I**

This task was designed to provide a new means of testing subjects with SCSP1 on a phonological recoding test that was potentially easier than the phonological decoding of pseudowords. The test format is replicated in the visual matching and visual analysis retrieval tasks (Description to follow). Responses were given by the subject through using an 8 x 12 inch, 2-switch Unicorn "keyboard" with Ke:Nx software to activate the computer to say "Yes" or "No". The Unicorn keyboard display was divided into two sections, one green with a happy face to symbolize "Yes" and one red with a sad face to symbolize "No". The digitized speech for these two words had been programmed using the voice of a five-year-old and was very expressive. The subject had to press gently on the appropriate section of the Unicorn keyboard to initiate a spoken response from the computer. This method of responding was very appealing to the children and maintained their attention despite the repetitive nature of the task.

Orientation:

The task involved recognition of the matching spoken distractor for an orthographic stimulus, from a set of five distractors presented in a predetermined order. The position of the matching distractor within the set differed for each stimulus. A nonconventional method of spelling (Ehri & Robbins, 1992) was followed.

Subjects were introduced to the spelling method by describing it as "sheep talk". They were taught 5 written "sheep names" after playing with a sheep puppet named DAAL. They were told that they would never see names or any words spelled this way in any place other than our computer room. The different way of spelling was emphasized in order not to interfere with introductory reading and spelling programs that were being undertaken in the classrooms.

Each subject played with the puppet DAAL and then was shown a picture of five sheep. Their names were shown to the subject on separate cards.
The names were **DAAV**  JOON  **JUUN**  **PEET**  **MIiK**.

Instructions for Orientation:
"I am going to show you some special "sheep" names. They belong to the five sheep you see in this picture. Do you see the special letters in the middle of the name?

Whenever you see special letters like this - two of them together, with a line over them, they are going to say their own name. The line over the middle letters tells you that the letters say their own name in the word.

This is the letter **A**. See the line over the two **A**'s. It tells you the **A** will say its own name. This word says **DAAV** (Dave) (pronounced with an emphasis on the long **A**).

This is the letter **O**. See the line over the two **O**'s. It tells you that the **O** will say its own name. This word says **JOON** (Joan) (pronounced with an emphasis on the long **O**).

This is the letter **U**. See the line over the two **U**'s. It tells you that the **U** will say its own name. This word says **JUUN** (June) (pronounced with an emphasis on the long **U**).

This is the letter **E**. See the line over the two **E**'s. It tells you that the **E** will say its own name. This word says **PEET** (Pete) (pronounced with an emphasis on the long **E**).

This is the letter **i**. See the line over the two **i**'s. It tells you that the **i** will say its own name. This word says **Miik** (Mike) (pronounced with an emphasis on the long **i**).

Reviewing Orientation:
"Now I am going to see which names you remember."

One card with a sheep name was shown to the subject, with the following instructions:
"I am going to say some words. When the word you hear is the same as the word on the card, push the 'happy' green pad and the computer will say "Yes" for you. When the word you hear is not the same as the word on the card, push the 'sad' red pad and the computer will say "No" for you. I will tell you if you are right or wrong each time you push the red or green pad. Whether right or wrong, you keep going and listen to the next word I say."

With every correct response, the examiner gave appropriate feedback by saying "Good" alternating with "Right" OR "Not right" alternating with "No" followed by "Try the next one."

As much help as was required was given to responding to the sheep names correctly and to using the "Yes" and "No" pads, to ensure that the subject understood the task and the response format.

Testing:
Following completion of the set of sheep names, the first set of test words was presented. In the testing, feedback only as to the correctness or incorrectness of each response was given. No further assistance was provided in the correct naming of the words or in the method of responding. Only the primary researcher gave this test.

Test Items:

<table>
<thead>
<tr>
<th>Set 1</th>
<th>TAAK</th>
<th>RAAK</th>
<th>LAAK</th>
<th>KAAK</th>
<th>BAAK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set 2</td>
<td>Biik</td>
<td>BUUT</td>
<td>BOOL</td>
<td>BAAT</td>
<td>BEEK</td>
</tr>
</tbody>
</table>

Instructions:
Cards were shown one at a time, with the word being read aloud by the researcher. The cards were left in a column and the names were read a second time.

"Now I am going to see which words you remember."
After collecting all the cards, one word at a time was shown to the subject, with the following instructions:
"I am going to say some words. When the word you hear is the same as the word on the card, push the 'happy' green pad and the computer will say "Yes" for you. When the word you hear is not the same as the word on the card, push the 'sad' red pad and the computer will say "No" for you. I will tell you if you are right or wrong, each time you push the red or green pad. Whether right or wrong, you keep going and listen to the next word I say."

With every correct response, the examiner said, "Good" or "Right".
with every incorrect response, the examiner said, "Not right" or "No" and "Try the next one."

Scoring: A point was given for every word for which there was a correct match with no prior incorrect responses for the word.

Total score possible for CVC-NC Word Task - Part 1, if all matches were correctly identified with no incorrect prior responses for the word: /10

CVC-NC Word Task - Part 2

This test was given to each subject who scored 6 or higher on CVC-NC Word Task - Part 1.

Orientation:
The first two items from each set of Test 1 were reviewed.

TAAK, Bi.iK and further items were reviewed if the task was not remembered or understood.

Testing:
The procedure was the same as for CVC-NC Word Task - Part 1, except for the instructor drawing to the subject’s attention that the rule about which spoken word would match the word on the card, would keep changing. Sometimes it was important to think whether or not the spoken word and the word on the card were the same at the beginning, sometimes at the end, sometime in the middle. The children were told the
examiner was trying to fool them and would keep changing what they had to think about.

Test Items:

```
- - - - -
Set 1 LAAN Tiim SUUN TOOD NEET
- - - - -
Set 2 LUUP Kiit LOOP FEEL RAAT
```

Instructions:
The Yes/No method of responding was reviewed by asking the child to test the computer. "Tell me 'Yes' with the computer. Tell me 'No' with the computer." The child was told, "Good it's working fine!" or help was given if child had forgotten how to give the Yes/No responses.

Once the child's ability to use computer was established, instructions were given regarding the change in task.
"This time I am not going to tell you what this word says. Instead, I will say some words and you tell me "No" with the computer if the word you hear is not the same as the word I am showing you. Tell me "Yes" if the word you hear is the same as the word I am showing you."

Testing:
"Now I am going to see which words you know."

One card with a word was shown to the subject, with the following instructions:
"Remember, when the word you hear is the same as the word on the card, push the 'happy' green pad and the computer will say "Yes" for you. When the word you hear is not the same as the word on the card, push the 'sad' red pad and the computer will say "No" for you. I will tell you if you are right or wrong, each time you push the red or green pad. Whether right or wrong, you keep going and listen to the next word I say."

With every correct response, the examiner said, "Good" or "Right".
with every incorrect response, the examiner said, "Not right. Try the next one."
Scoring: A point was given for every word for which there was a correct match with no prior incorrect responses for the word.

Total score possible for CVC-NC Word Task - Part 2 if all matches were correctly identified with no incorrect prior responses for the word: /10

Total score for CVC-NC Word Task, Parts 1 and 2: /20

Retrieval Decoding Pseudoword Task: adapted from Vandervelden (1992)

This test considers partial as well as complete decoding performance and provides a measure that is independent of word naming skill. Vandervelden designed the test to afford greater variability in performance for Kindergarten children than is possible in word naming tasks. Three adaptations were made to the Vandervelden task in this study: (1) Upper case letters were used instead of lower case letters, in order to be consistent with the print form of the CVC-NC Word Task. (2) Five additional items were added in lower case, to include the items used by Ehri & Robbins (1992) so the results from this study could be compared with those of Ehri & Robbins. (3) Eight additional items were added to those included by Vandervelden, in order to include nonsense words containing all the long vowel sounds and the consonant sounds included in the CVC-NC Word Task.

A set of pseudowords in capital letters were presented on cards.

Instructions:
"These are some silly words. You have never heard these before. I want you to sound these words out to guess what they sound like".

Pretrials
Three nonsense words presented - *op, tat, stek*.
"How would you say this one? this one? this one?"
Subjects were corrected once for each example by naming the pseudoword (pretrials only).
Items:
*kin, fop, mal, rut, bev, DI, MO, TA, SUP, MIF, FAK, TOK, BES, KUS, PIF, DEP, HUB, GAM, BAME, FEAM, PUNE, NIRE, SOAM, VITE, DAKE, KILE, BISK, SPAK.*

(Underlined words are those added to the Vandervelden Partial and Complete Decoding Task, to be analysed separately.)

Scoring (as in Vandervelden, 1992, p. 108):

**Complete Decoding (Vandervelden, 1992, items)**
- Score based on number of pseudowords read correctly.
- Score complete decoding: /15

**Partial Decoding (Vandervelden, 1992, items)**
To obtain a partial decoding score, substitutions were examined for letter-phoneme matches. If the initial letter only was correctly decoded (e.g. /SOCK/ for *SUP*), a score of one was given for the response. Likewise, if only the last letter was correct (e.g. /BOP/ for *DEP*), a score of 1 was assigned. If both first and last letter were correct (e.g. /SOUP/ for *SUP* a score of two was given. An additional point was given for correctly decoding the consonant blends. Correct decoding of the vowel was given one point (e.g. /MIT/ for *MIF* was scored two points).
- Score partial decoding: /44

**Subscores (Vandervelden, 1992, items):**
- Subscores for initial and final consonant decoding were based on the following subset of pseudowords:
  - *SUP, MIF, FAK, TOK, BES, KUS, PIF, DEP, BISK, SPAK*
- Decoding - Initial: Score /10
- Decoding - Final: Score /10

The subscore for decoding vowels was based on the subset:
- *SUP, MIF, FAK, TOK, DEP*
Score /5

Subscore (Ehri & Robbins, 1992, items):
The subscore is based on the subset:
kin, fop, mal, rut, bev.
Score /5

Subscore Long Vowel items (McNaughton):
The subscore is based on the subset:
BAME, FEAM, PUNE, NIRE, SOAM, VITE, DAKE, KILE
Score /8

Primary Word Reading and Picture Identification Tasks.

Primary Word Reading Task
This test contained the word list from Vandervelden (1992), which included the following words: Primer list (Ehri & Wilce, 1985) plus additional, non overlapping words, selected sequentially to a Grade 1 reading level from each of the Spache Diagnostic Reading Scales, Word List 1, the Woodcock Reading Mastery Test, and the Wide Range Achievement Test, Level 1, to a total of 60 words.

Word Items:
no, up, yes, you, the, go, we, jump, is, book, see, stop, yellow, red, play, dog, in, come, green, look, eat, it, mom, dad, run, big, man, cat, to, work, was, me, milk, and, bed, are, ball, boy, car, girl, like, little, pig, sleep, good, help, all, fast, fish, rug, said, swim, this, with, away, him, name, day, two, she.

Picture Identification Task
The Primary Word Reading Task was adapted to include twelve Picture Communication Symbols (PCS) symbols, one presented after every fifth word. The PCS were added for two reasons: (1) to provide easier stimuli for children who were
having difficulty with the word task; (2) to assess the processing of Type One symbols.

PCS Items:
house, woman, pencil, bowl, bicycle, rake, cake, brush, butterfly, truck, computer, mouse.

Administration:
Words and PCS were presented on separate word cards, one by one, and in order listed above, with PCS being inserted after every 5 words.

Instructions:
"I am going to show you some words and pictures. If I show you a word you can read, read it out loud. When I show you a picture, tell me what you think it is, that is, tell me the name of the picture. If you are not sure that you know the word or the picture, you may guess".

The examiner showed each word and picture 3 sec. and recorded substitutions. If a child self-corrected, the word or picture was counted correct.

Score Primary Word Reading Task: /60 words;
Score Picture Identification Task /12 PCS
Phoneme Awareness Tests.

Rosner Phoneme Deletion Test

This test was developed by Rosner (1975). It begins with simple syllable omissions from compound words such as sunshine and progresses to deleting a syllable from a multisyllabic word and deleting a phoneme from the beginning, ending, or middle of a word. There are 15 items on the original Rosner test, 2 training items and 13 test items. The child repeats the word. "Now say sunshine but don't say shine." The subject's score is the number of items correct with a possible range of 0-13. (Yopp, 1988).

The items of the phoneme deletion test, Test of Auditory Analysis Skills (TAAS) (Rosner, 1975), included in the battery of test investigated by Yopp (1988) were supplemented by four three-syllable items from the Rosner (1973), Perceptual Skills Curriculum, Level E, Unit 8 — up-side-down, unhappy, dynamite, telephone (items 4, 5, 6, 7). Three-syllable items represent the highest performance level expected of children in Kindergarten (Rosner, 1975) and the additional items were included in order to observe variation of performance at this level. As well, two single syllable items with the long vowel sound — nose, seal (items 11, 12) — and five single syllable items without the long vowel sound — lark, tan, mill, fin, sink (items 13, 14, 15, 16, 17) — were added (from Rosner (1973), Perceptual Skills Curriculum, Levels F and G, Unit 8, to bring the number of items in each of these two word classes for which the initial letter was deleted, to five.

The Rosner (1975) Phoneme Deletion Test was included in the present study because it had the highest loading on the Compound Phonemic Awareness factor identified by Yopp (1988). The expanded version was added in order to observe variation of performance within the level of expected kindergarten performance (Rosner, 1975, p.79; Vandervelden, 1992, p.175); however the score on the expanded version was not used in the data analyses.

Score: Rosner Phoneme Deletion Test (1975) /13 Expanded version/24
Yopp-Singer Phoneme Segmentation Test

This test was developed by Yopp-Singer for use in the Yopp (1988) study to determine the reliability and validity of tests used to operationalize the concept of phonemic awareness.

Its purpose was to measure a child's ability to articulate the sounds of a word separately, in order. The word list for this test was based upon both word familiarity and feature analysis. All words except one occurred on Thorndike and Lorge's (1963) list as most frequently occurring (i.e., at least 100 occurrences per million). The exception was the word *zoo*, which was included to meet the feature analysis criteria described below... Words occurring on the Yopp-Singer list were selected based on an analysis of their component sounds. All commonly occurring places and manners of articulation of English-language consonants were represented on the list. Likewise, all heights and locations of English vowels were represented on the list.

Yopp, 1988, pp.165-166

The Yopp-Singer phoneme segmentation test was included in the present study because it had the highest loading on the Simple Phonemic Awareness factor identified by Yopp (1988). Only words that the children responded to accurately on their own were scored as correct. Scores had a possible range of from 0-22. (Yopp, 1988).

Instructions:

"Now we're going to play a different word game. I'm going to say a word, and I want you to break the word apart. You are going to tell me each sound in the word in order. For example, if I say *old*, you will say *o-l-d*.

Let's try a few words together.

*ride* ....... *r-ie-d*;
*go* ....... *g-o*;
*man* ....... *m-a-n.*"

Test items:

dog lay keep race fine zoo no three she job wave in grew ice that at red top me by sat do
As child was given the test, feedback was given as follows:
If the child responded correctly, examiner nodded or said, "That's right." If the child gave an incorrect response, he or she was corrected.

Score: Yopp-Singer Phoneme Segmentation Test /22

*Phonemic Word Spelling Task*

The subject's early spelling abilities were recorded in the following manner.

1) Subject was asked to write his/her name - first and last name.

2) Subject was asked what other words he/she would like to write.

3) Phonemic spelling with oral stimulus was tested.
   Items (from Vandervelden (1992) spelling phonological recoding task):
   bat, mit, puck, sock, desk, top, feet, dime, mif, fak.

Instructions:
"Show me how you write ............" 

Scoring (as in Vandervelden, 1992, p. 107):
Only unassisted spellings were included in the score for this measure. Simple phonetic spellings, even if these were not accurate spellings (e.g. sok or soc for sock) were counted as correct. Letter name spellings were also counted (e.g. cok, sok, and sock all earned the maximum score of 3 points), because the interest was in phonological recoding (i.e. the ability to produce phonetic spellings using simple letter-phoneme mapping). The subscore for vowel recoding was based on the number of correctly spelled vowels in the first 5 words (bat to desk).

The total score was calculated from the following set of subscores to a total score of 25.

Subscores:
Recoding initial consonant, Score: /10
Recoding final consonant, Score: /10
Recoding Vowel (based on the vowel spellings), Score: /5
Visual Matching and Visual Analysis Retrieval Tasks.

Blissymbols of increasing levels of difficulty and with increasing numbers of components were introduced to the subjects, accompanied by an explanation suitable for Kindergarten children for the components of the stimulus symbol. Symbols were presented in a set of 5 symbols and procedures resembling those of the CVC-NC Word Task were followed. The first presentation of the symbol set was used to test visual matching and to provide the subject with experience processing the Blissymbols. The second presentation of the symbol set was used to test visual analysis retrieval.

Visual Matching Task

Following an explanation of the stimulus symbol, one matching and four distractor symbols were presented in a randomly ordered sequence. The subject was instructed to use the computer "Yes/No game" to say "No" for each non-matching symbol and "Yes" for the matching symbol. If the subject had not previously learned to use the computer to respond, the computer training described in the CVC-NC Word Task was given.
Orientation Items:

This is not 'Y' upside-down!
This is a little stickman.
See his legs and body?
(point to legs and body)

Distractors

house and (Child asked
to name wheeled vehicle.
Responses ranged from bicycle, truck, wagon, etc).
This is the house for the (whatever the child
named the wheeled vehicle as being).
I bet it's the garage.

Distractors

woman and love and house
The woman loves her house.

Distractors

time and house and up -
Time for the house to go up.
It's time to build the house!

Distractors

Instructions:
Orientation items were introduced as follows:
"This symbol has one, two or three parts and the parts tell a little story."
The parts were repeated again in a phrase or sentence.
The stimulus symbol was left visible and the distractors and matching symbol were
placed next to the stimulus symbol one at a time, in a designated order which had been
determined randomly. The subject was asked, "Is it the same?" and given time to
respond "Yes" or "No" using the computer. Assistance was given if the subject did not give the correct answer or if help was needed in using the computer to respond.

Test Items:
The same set of items was used for both Visual Matching and Visual Analysis Retrieval Tasks.

1  
\[\text{time and car and man}\]  
\[\text{It's time (See the clock?)}\]  
\[\text{for the car to come to the man.}\]  
\[\text{It's being delivered.}\]

2  
\[\text{water and eye and animal}\]  
\[\text{Water is coming from the eye of the animal:}\]  
\[\text{I think he's crying!}\]

3  
\[\text{child and give and love}\]  
\[\text{(Point to the parts of child symbol}\]  
\[\text{and demonstrate "giving")}\]  
\[\text{The child is giving love.}\]  
\[\text{I think he/she is giving love}\]  
\[\text{to his/her mother on Mother's Day!}\]

4  
\[\text{love and big and time}\]  
\[\text{I love having a big long time}\]  
\[\text{with the boys and girls!}\]
get and little and heart
Getting a little heart.
I think it's one of those
little candy hearts!

Testing:
Instructions:

Examiner told subject that all the symbols would now have three parts to them.
"This symbol has three parts and the parts tell a little story."
The parts were repeated again in a phrase or sentence. The five symbols were presented and the stimulus symbol remained visible. The distractors, one of which was the matching symbol, were placed one at a time next to the stimulus symbol, in a designated order which had been determined randomly. The subject was asked, "Is it the same?" and given time to respond "Yes" or "No" using the computer.

If subject gave an incorrect response to a non-match, examiner said, "Try again" and presented the next distractor. When subject gave an incorrect response to a match, examiner said, "This is the same. See this is ...... and this is also ............. Let's try another symbol."

Examiner then proceeded with the next symbol to a total of five symbols.

Scoring: A point was given for every symbol for which there was a correct match with no prior incorrect responses for the symbol.
Score: /5
**Visual Analysis Retrieval Task**

This task was always presented in the same session and immediately following the Visual Matching Task. The set of symbols was presented a second time. In this presentation, the stimulus symbol was shown and the child was asked to say either the symbol parts or its story. If the child was inaccurate, he/she was corrected by saying that their story was interesting, but the story the examiner had told was ".....". The stimulus symbol was then turned over, and the distractors were presented sequentially, following a different order from that used in the Visual Matching Task. The child was asked if the distractor was the same as the symbol on the overturned card. The subject was given time to respond "Yes" or "No" using the computer.

Examiner proceeded with the next symbol to a total of five symbols.

Scoring: A point was given for every symbol for which there was a correct match with no prior incorrect responses for the symbol.

Score: \( \frac{4}{5} \)

**Data Analyses**

The data results were analysed for four purposes: (1) to derive normative data from a group of 107 Kindergarten children at the end of the Kindergarten year; (2) to make comparisons between those subjects who had achieved a working knowledge of phonemes as abstractable and manipulable components of language which they could apply to the decoding of words and those subjects who had not yet acquired this knowledge; (3) to determine the relationship of the newly designed CVC-NC Word Task and the Visual Processing Tasks with established tasks in the reading research literature; (4) to examine a possible developmental pattern involving the CVC-NC Word Task, Phonemic Word Spelling Task and Retrieval Decoding Pseudoword Task that would be consistent with the developmental pattern found by Vandervelden (1992) for phonemic word spelling and decoding pseudowords.
Results

Normative Data for Kindergarten Children — Full Group (N = 107)

Descriptive data (mean, standard deviation, median and interquartile range) were obtained for the full group of 107 nondisabled Kindergarten children on the following measures: Letter Name and Sound Recognition, Retrieval Decoding Pseudoword Task (Ehri & Robbins, 1992; Vandervelden, 1992), Primary Word Reading Task (Ehri & Wilce, 1985; Vandervelden, 1992), Phonemic Word Spelling Task (Vandervelden, 1992), Phoneme Deletion Task (Rosner, 1975), Phoneme Segmentation Task (Yopp-Singer, 1988), CVC-NC Word Task (decoding of nonconventional CVC words), Picture Identification Task, Visual Matching Task and Visual Analysis Retrieval Task (the latter three tasks were developed by McNaughton for use in this investigation).

Table 3-1-1 and Figure 3-1-1 display the descriptive measures of mean, standard deviation, median and interquartile range for the full Kindergarten group's performance on the above battery of reading acquisition tests. A ceiling effect (defined in this study as mean equal to 100) can be seen in the Letter Name Tasks. A negatively skewed distribution with a median of 100 was found in the Letter Sound Recognition Task, Picture Identification Task and Visual Matching Task. Scores on the Visual Analysis Retrieval Task were in the high range (distribution was negatively skewed, with a median of 80). For the full group performance on phonological processing measures, Phonemic Word Spelling Task scores were the highest, followed by scores on CVC-NC Word Task and then the Retrieval Decoding Pseudoword Task.

Performance scores on all the phonological processing measures other than Phonemic Word Spelling fell below a mean of 50%.

The high scores in the Picture Identification and Visual Matching Tasks were anticipated. The Picture Communication Symbols (PCS) used in the Picture Identification Task were all nouns. Symbols of this type have been shown to be highly iconic (readily understandable) (Mizuko, 1987; Mizuko & Reichle, 1989). As indicated earlier, these symbols were inserted in the Primary Word Task to ensure that subjects who could not read any sight words would have success on every fifth item. They also provided a measure of processing Type One symbols, as described in the section relating to the visual processing of different types of graphic representational systems. Each Blissymbol used in the Visual Matching and Visual Analysis Retrieval Tasks was composed of three elements. From experience teaching Blissymbols to young
children with SCSPI, the expectation was that these two tasks would be easily performed. It was anticipated, however, that the memory demands in the Visual Analysis Retrieval Task would result in a lower performance level than in the Visual Matching Task. The ceiling levels on the Letter Naming Tasks and the high scores in the Consonant Sound Recognition Task were also expected given the intensive reading readiness program which had been conducted throughout the school year in the Kindergarten classes from which the subjects came.
Table 3-1-1
Descriptive Information — Full Kindergarten Group Performance on Battery of Reading Acquisition Tasks

<table>
<thead>
<tr>
<th>Variable</th>
<th>Descriptive Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vowel Name Recognition Task (N=107)</td>
<td>99.81 (1.93) 100.00 0.00</td>
</tr>
<tr>
<td>Consonant Name Recognition Task (N=107)</td>
<td>99.78 (1.32) 100.00 0.00</td>
</tr>
<tr>
<td>Consonant Sound Recognition Task (N=107)</td>
<td>97.20 (8.86) 100.00 0.00</td>
</tr>
<tr>
<td>CVC-NC Word Task (N=107)</td>
<td>48.97 (26.24) 50.00 50.00</td>
</tr>
<tr>
<td>Retrieval Decoding Pseudoword Task (Vandervelden, 1992) (N=107)</td>
<td>29.87 (31.70) 20.00 53.00</td>
</tr>
<tr>
<td>Retrieval Decoding Pseudoword Task (Ehri &amp; Robbins, 1992) (N=107)</td>
<td>32.71 (36.49) 20.00 60.00</td>
</tr>
<tr>
<td>Primary Word Reading Task (N=107)</td>
<td>34.22 (27.59) 23.00 30.00</td>
</tr>
<tr>
<td>Phonemic Word Spelling Task (N=107)</td>
<td>65.27 (28.87) 76.00 48.00</td>
</tr>
<tr>
<td>Rosner Phoneme Deletion Task (1975) (N=104)</td>
<td>37.38 (21.856) 23.00 31.00</td>
</tr>
<tr>
<td>Yopp-Singer Phoneme Segmentation Task (1988) (N=105)</td>
<td>45.26 (31.81) 45.00 60.00</td>
</tr>
<tr>
<td>Picture Identification Task (N=106)</td>
<td>96.92 (5.54) 100.00 8.00</td>
</tr>
<tr>
<td>Visual Matching Task (N=107)</td>
<td>92.71 (11.46) 100.00 20.00</td>
</tr>
<tr>
<td>Visual Analysis Retrieval Task (N=107)</td>
<td>80.19 (16.60) 80.00 20.00</td>
</tr>
</tbody>
</table>

Note.
All means are presented in percentages.
SD = standard deviation; IQR = interquartile range.
Figure 3.1-1
Descriptive Information — Full Kindergarten Group
Performance on Battery of Reading Acquisition Tasks

All means are presented in percentage scores

- Vowel Name Recognition
- Consonant Name Recognition
- Consonant Sound Recognition
- CVC-NC Name Task
- Decoding Pseudoword (Vandervelden)
- Decoding Pseudoword (Ehri & Robbins)
- Primary Word Reading
- Phonemic Word Spelling
- Rosner expanded
- Yopp-Singer Phoneme Segmentation
- Picture Identification
- Visual Matching
- Visual Analysis Retrieval

Cell Mean
Comparisons Between Kindergarten High and Low Readers

To give further indication of the skill-related variability in the data, the sample was split into two groups based on skill in decoding. Descriptive information (mean, standard deviation, median and interquartile range) was obtained for the High Kindergarten Readers (N=41) and the Low Kindergarten Readers (N=66) on a reduced battery of reading acquisition tests, namely, only tests that would be used in Study 2. The battery of tests for this analysis included Letter Name and Sound Recognition Tasks, Retrieval Decoding Pseudoword Task (Ehri & Robbins, 1992) (used in Recognition form in Study 2), Primary Word Reading Task (Ehri & Wilce, 1985; Vandervelden, 1992), Phonemic Word Spelling Task (Vandervelden, 1992), CVC-NC Word Task (decoding of nonconventional CVC words), Picture Identification Task, Visual Matching Task and Visual Analysis Retrieval Task.

The partial to full phonological recoding levels identified by Vandervelden and Siegel (1995) were used as a frame of reference for dividing the full Kindergarten group into High and Low levels of reading acquisition. The objective was to compare those subjects who had developed a working knowledge of phonemes as abstractable and manipulable components of language with those subjects who had not yet acquired this knowledge. Within Vandervelden and Siegel’s hierarchy of phonological recoding skills, the retrieval decoding pseudoword task was identified as demonstrating the most advanced level of phonological recoding. There is much support in the mainstream reading research for this task differentiating good and poor readers (Daneman, 1991; Jorm & Share, 1983). Within the present study, therefore, the Decoding Pseudoword Task was examined first as a potential criterion variable for dividing subjects into High and Low Readers. It was found that 48 subjects were unable to perform this task (scoring between 0 and 10), rendering this measure invalid as a criterion variable. (See Figure 3-1-3.) However, all subjects were able to perform the CVC-NC Word Task — a recognition task that required the active manipulation of information at the phonemic level and in which instruction was given for the new letter-sound conventions introduced within the task. (See Figure 3-1-2.)

The distribution of scores for the full group for both the CVC-NC Word Task and the Decoding Pseudoword Task (Ehri & Robbins, 1992) fell into two clusters, albeit the clusters differed in shape and range (Figures 3-1-2 and 3-1-3). After studying the scores on these two phonological recoding tasks, it was decided that the average score derived from the percentage scores of the Decoding Pseudoword Task and the
CVC-NC Word Task would serve as a criterion variable better than either of the task measures alone. The distribution of the percentage average scores resembled that of the Decoding Pseudoword Task results, thus retaining the pattern of results obtained using an established measure of phonological recoding. The inclusion of the new CVC-NC Word Task results within the criterion variable, however, allowed performance scores from all subjects to be examined. (See Figure 3-1-4.) This procedure allowed an accommodation to be made to the wide range in performance level of the Kindergarten subjects while still maintaining the influence of an established measure within the criterion variable. All subjects obtaining a percentage average score of 50 or higher were classed as High Kindergarten Readers (N=41); all subjects obtaining a percentage average score of less than 50 were classed as Low Kindergarten Readers (N=66). The number of subjects falling into the two groups using the three measures of Decoding Pseudoword Task, CVC-NC Word Task and the Averaged Score are presented in Table 3-1-2.

**Figure 3-1-2**
Distribution of full group scores for CVC-NC Word Task

**Figure 3-1-3**
Distribution of full group scores for Decoding Pseudoword Task

N = 107
Figure 3-1-4

Distribution of full group scores for percentage average scores of CVC-NC Word Task and Decoding Pseudoword Task

N = 107
### Table 3-1-2

<table>
<thead>
<tr>
<th>Decoding Pseudoword</th>
<th>CVC-NC Word Task</th>
<th>Averaged Score*</th>
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</thead>
<tbody>
<tr>
<td>Subjects scoring 50% and above</td>
<td>73</td>
<td>54</td>
</tr>
<tr>
<td>Subjects scoring Below 50%</td>
<td>34</td>
<td>53</td>
</tr>
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</table>

Note: The averaged score was the measure used as the criterion variable.

Unpaired t-tests for independent groups were conducted for the High and Low Reader Groups where appropriate, to determine those tests for which the performance level mean differences were statistically significant. Since the groups were unequal (N=66, N=41) the Hartley's F-max test for homogeneity of variance (which assumes group equality) was not used to judge the appropriateness of the t-test. In lieu of the Hartley's F-max test, results were judged eligible for a t-test whenever the variance of one group was not greater than four times the variance of the other (Gravetter & Wallnau, 1988, p.260). Other criteria precluding use of a t-test were skewed distribution and ceiling effect. When a t-test was inappropriate, the comparison was made by examining the cell chart of group means.

As shown in Table 3-1-3 and Figure 3-1-5, both reading groups had ceiling level scores on the Letter Name and Sound Tasks and negatively skewed distributions on the Picture Identification and Visual Matching Tasks. Ceiling level was determined within this study by a percentage score of 100 for both the mean and median. There were significant differences on the phonological and word reading tests favouring the High Readers. Table 3-1-3 shows the statistical analyses' results. Due to ceiling effects and negatively skewed distributions, the t-test analysis was conducted for only five of
the ten variables which were to be included in the study with adults with SCSP (Study 2). In addition to the difference between the two measures used to produce the criterion variable for defining the reading groups, the difference between groups was significant for the Primary Word Reading Task and Phonemic Word Spelling Task (p < .0001) and for the Visual Analysis Retrieval Task (p < .02). The largest difference in between-group mean scores appeared in the Retrieval Decoding Pseudoword Task and the smallest difference for a phonological test in between-group scores appeared in the Phonemic Spelling Task. For the visual tests, the only statistically significant difference between groups was found in the Visual Analysis Retrieval Task. The group difference for the Visual Analysis Retrieval Task was smaller than for the phonological recoding tasks.
Table 3-1-3

Differences Between Kindergarten High Readers (N=41) (upper values) and Kindergarten Low Readers (N=66) (lower values) on Reading Acquisition Tasks

<table>
<thead>
<tr>
<th>Variable</th>
<th>Descriptive Measures</th>
<th>Parametric Measures</th>
<th>F-max</th>
<th>F-test</th>
<th>status</th>
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<td></td>
<td>Mean</td>
<td>Median</td>
<td>(SD)</td>
<td>Median</td>
<td>(IQR)</td>
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<tr>
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<td>100.00</td>
<td>100.00</td>
<td>(0.00)</td>
<td>100.00</td>
<td>(0.00)</td>
</tr>
<tr>
<td>Consonant Name Recognition Task</td>
<td>100.00</td>
<td>100.00</td>
<td>(0.00)</td>
<td>100.00</td>
<td>(0.00)</td>
</tr>
<tr>
<td>Consonant Sound Recognition Task</td>
<td>100.00</td>
<td>100.00</td>
<td>(0.00)</td>
<td>100.00</td>
<td>(0.00)</td>
</tr>
<tr>
<td>CVC-NC Word Task *</td>
<td>73.66</td>
<td>75.00</td>
<td>(15.08)</td>
<td>75.00</td>
<td>(16.25)</td>
</tr>
<tr>
<td>Retrieval Decoding Pseudoword Task *</td>
<td>74.15</td>
<td>80.00</td>
<td>(20.61)</td>
<td>80.00</td>
<td>(25.00)</td>
</tr>
<tr>
<td>Primary Word Reading Task</td>
<td>57.90</td>
<td>47.00</td>
<td>(27.35)</td>
<td>47.00</td>
<td>(44.50)</td>
</tr>
<tr>
<td>Phonemic Word Spelling Task</td>
<td>87.12</td>
<td>92.00</td>
<td>(11.15)</td>
<td>92.00</td>
<td>(12.00)</td>
</tr>
<tr>
<td>Picture Identification Task</td>
<td>95.78</td>
<td>100.00</td>
<td>(7.01)</td>
<td>100.00</td>
<td>(8.00)</td>
</tr>
<tr>
<td>Visual Matching Task</td>
<td>95.12</td>
<td>91.00</td>
<td>(9.78)</td>
<td>100.00</td>
<td>(20.00)</td>
</tr>
<tr>
<td>Visual Analysis Retrieval Task</td>
<td>84.88</td>
<td>80.00</td>
<td>(13.99)</td>
<td>80.00</td>
<td>(20.00)</td>
</tr>
</tbody>
</table>

**Note.**
All means are presented in percentages.

* The percentage average score of the CVC-NC Word Task and the Decoding Pseudoword Task served as the criterion variables for the Kindergarten High and Low Reader Groups.
All means are presented in percentages.

![Graph showing the performance of high and low readers across various tasks.](image)

**Split by: Reader Type**

**Cell Mean**

**Figure 3-1-5**

Descriptive Information — Low and High Reader Groups
Relationship of Newly Designed Tasks with Established Tasks

Phonological processing task.

The relationship of the new tasks, developed by McNaughton, with the other early reading tasks from the reading research literature needed to be determined. To do this, correlations were first computed for all the tests in the test battery that would be used in Study 2. Caution had to be taken in interpreting the results of these intercorrelational analyses, however, as correlation coefficients based on extremely high or extremely low scores usually tend to be higher than those which also take moderate scores into account (Shavelson, 1988). In the Letter Name and Sound Recognition Tasks and the Picture Identification and Visual Matching Task, the scores were extremely high. In the Decoding Pseudoword Task and the Primary Word Reading Task, a large number of the scores were extremely low. The results of intercorrelation analyses for the full Kindergarten Group and for the Low Reader and High Reader Groups appear in Table 3-1-4, 3-1-5, and 3-1-6. Scattergrams of the relationships between variables for which the correlation coefficients shown in Table 3-1-4 could be inflated are shown in Figure 3-1-6, a-f.

Figure 3-1-6

Scattergrams, Relationships between Variables from Table 3-1-4

a
b
c
d
e
f
Table 3-1-4

Intercorrelations among the Variables included in both Study 1 and Study 2
Full Kindergarten Group (N=106)

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td>.57**</td>
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<tr>
<td>2. Consonant Name Recog.</td>
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<td></td>
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<td></td>
<td></td>
<td>.25*</td>
<td>.48**</td>
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<td>3. Consonant Sound Recog.</td>
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<td></td>
<td></td>
<td>.15</td>
<td>.25*</td>
<td>.39**</td>
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<td></td>
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<td>.15</td>
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<td>.39</td>
<td>.15</td>
<td>.25</td>
<td>.39</td>
<td>.15</td>
<td>.25</td>
<td>.39</td>
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<tr>
<td>5. Decoding Pseudoword</td>
<td>.09</td>
<td>.16</td>
<td>.28</td>
<td>.09</td>
<td>.16</td>
<td>.28</td>
<td>.09</td>
<td>.16</td>
<td>.28</td>
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<td>6. Primary Word Reading</td>
<td>.10</td>
<td>.19</td>
<td>.31</td>
<td>.10</td>
<td>.19</td>
<td>.31</td>
<td>.10</td>
<td>.19</td>
<td>.31</td>
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<td>7. Phonemic Word Spelling</td>
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<td>-.06</td>
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<td>-.11</td>
<td>-.01</td>
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<td>.13</td>
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<td>.31**</td>
<td>.24*</td>
<td>.24*</td>
<td>.31**</td>
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<td>.35**</td>
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* = p<.05

** = p<.01

One case was omitted due to missing values.
Table 3.1.5

Intercorrelations among the Variables included in both Study 1 and Study 2, Low Readers (N=66)

<table>
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<th>Variable</th>
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<tr>
<td>1. Vowel Name Recognition</td>
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<td>3. Consonant Sound Recog.</td>
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<td>4. CVC-NC Word</td>
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<td></td>
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<td>.26*</td>
<td>.38**</td>
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<td>5. Decoding Pseudoword</td>
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<td>.07</td>
<td>.13</td>
<td>.24</td>
<td>.42**</td>
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<td>8. Picture Identification</td>
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<td>9. Visual Matching</td>
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* = p<.05
** = p<.01

One case was omitted due to missing values.
Table 3-1-6

Intercorrelations among the Variables included in both Study 1 and Study 2
High Readers (N=41)

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</tr>
<tr>
<td>8. Picture Identification</td>
<td></td>
<td>-.12</td>
<td>.05</td>
<td>-.16</td>
<td>-.17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Visual Matching</td>
<td></td>
<td>.11</td>
<td>.10</td>
<td>.04</td>
<td>.25</td>
<td>.06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Visual Analysis Retrieval</td>
<td></td>
<td>.22</td>
<td>-.00</td>
<td>.03</td>
<td>.26</td>
<td>-.16</td>
<td>.18</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* = p<.05  
** = p<.01

Note: No correlations were computed for Variables 1,2,3 since all scores were at ceiling level.
Pearson product moment correlations were also computed for the CVC-NC Word Task, developed by McNaughton, with all the other phonological tasks given to the subjects in Study 1 — Retrieval Decoding Pseudoword Task (Ehri & Robbins, 1992), Retrieval Decoding Pseudoword Task (Vandervelden, 1992), Phonemic Word Spelling Task (Vandervelden, 1992), Primary Word Reading Task (Ehri & Wilce, 1985; Vandervelden, 1992), Phoneme Segmentation of Words Task (Yopp-Singer, 1988) and Phoneme Deletion of Words Task (Rosner, 1975). The correlations are shown in Table 3-1-7, listed in order of magnitude.

The results of the intercorrelational analyses showed the CVC-NC Word Task having the strongest relationship with tests that required decoding, word reading and spelling. The correlations were highest for the two Retrieval Decoding Pseudoword Tasks (\(r=.77; \ r=.73\)), Phonemic Word Spelling Task (\(r=.76\)) and Primary Word Reading Task (\(r=.75\)), and were somewhat more moderate for the Phoneme Segmentation Task (.66) and Phoneme Deletion Task (.50). All were statistically significant, \(p .0001\).

The correlations for the reduced set of phonological variables used in Study 2 with subjects with SCSPI are presented separately in Table 3-1-8. A further analysis was undertaken with this reduced set of variables because of the possibility that the correlation coefficient could be inflated (Shavelson, 1988) due to a large number of subjects (48/107), scoring 0 in the two Retrieval Decoding Pseudoword Tasks. A type of analysis that is resistant to extreme scores, the Spearman rank correlation coefficient, was computed for CVC-NC with this reduced set of variables. This analysis yielded a rho of .78 (\(p<.0001\)) for the CVC-NC Word Task and Phonemic Word Spelling Task, a rho of .76 (\(p<.0001\)) for the CVC-NC Word Task and Retrieval Decoding Pseudoword Task and a rho of .81 (\(p<.0001\)) for the CVC-NC Word Task and the Primary Word Task. The consistency of the findings from the two types of analyses provided support for a strong correlation between the CVC-NC Word Task with the Phonemic Word Spelling Task, the Retrieval Decoding Pseudoword Task and the Primary Word Task.
Table 3-1-7

Correlations of Reading Related Tasks with CVC-NC Word Task
Full Kindergarten Group (N= 104)

<table>
<thead>
<tr>
<th>Task</th>
<th>r</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrieval Decoding Pseudoword Task</td>
<td>.77</td>
<td>.0001**</td>
</tr>
<tr>
<td>(Vandervelden, 1992)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phonemic Word Spelling Task</td>
<td>.76</td>
<td>.0001**</td>
</tr>
<tr>
<td>(Vandervelden, 1992)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary Word Reading Task</td>
<td>.75</td>
<td>.0001**</td>
</tr>
<tr>
<td>(Ehri &amp; Wilce, 1985 and Vandervelden, 1992)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retrieval Decoding Pseudoword Task</td>
<td>.73</td>
<td>.0001**</td>
</tr>
<tr>
<td>(Ehri &amp; Robbins, 1992)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phoneme Segmentation Task</td>
<td>.66</td>
<td>.0001**</td>
</tr>
<tr>
<td>(Yopp-Singer, 1988)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phoneme Deletion Task</td>
<td>.50</td>
<td>.0001**</td>
</tr>
<tr>
<td>(Rosner, 1975))</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note:

\[ r \text{ (critical)} = .254, p < .01 \]

*p < .05

**p < .01

CVC-NC Word Task was designed by McNaughton for this study.
3 subjects were excluded from the analysis due to missing values on some of the tests.
Table 3-1-8

Correlations of Reduced Set of Phonological Variables with CVC-NC Word Task

Full Kindergarten Group (N= 104)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. CVC-NC Word Task *</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Phonemic Word Spelling Task</td>
<td>.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Vandervelden, 1992)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Primary Word Reading Task</td>
<td>.75</td>
<td>.59</td>
<td></td>
</tr>
<tr>
<td>(Ehri &amp; Wilce, 1985 and Vandervelden, 1992)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Retrieval Decoding Pseudoword Task</td>
<td>.73</td>
<td>.67</td>
<td>.72</td>
</tr>
<tr>
<td>(Ehri &amp; Robbins, 1992)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note:
These are the phonological processing variables measured in both Kindergarten children and adults with SCSPI.

* CVC-NC Word Task was designed by McNaughton for this study.
** 3 subjects were excluded from the analysis due to missing values on some of the tests.
Visual processing tasks.

No correlational analyses were attempted for the three visual processing tasks due to the ceiling effects found in the Picture Identification and the Visual Matching Tasks. The histograms for score distributions are presented in Figure 3-1-7. The Visual Analysis Retrieval Task appears to have a different distribution of scores compared to the other two visual tasks.

Figure 3-1-7

Histograms for Score Distributions for Visual Tasks

Correlations were computed for the Visual Analysis Retrieval Task with the phonological measures of CVC-NC Word Task, Phoneme Deletion Test (Rosner, 1975), Phoneme Segmentation Test (Yopp-Singer, 1988), Decoding Pseudoword Task (Vandervelden, 1992), Decoding Pseudoword Task (Ehri & Robbins, 1992), Phonemic Word Spelling Task (Vandervelden, 1992), and Primary Word Reading Task (Ehri & Wilce, 1985; Vandervelden, 1992) to determine the relationships between these measures. The Pearson product moment correlations for the Visual Analysis Retrieval Task with the six phonological processing tasks are shown in Table 3-1-9. The correlations were weak, but statistically significant for all but the Rosner...
Phoneme Deletion Task, $r = .14$, the Primary Word Reading Task, $r = .24$, and the Decoding Pseudoword Task (Ehri & Robbins, 1992), $r = .24$ ($r$ critical = .25, p.01). The same constraint on the validity of these results as for the correlational analysis on the phonological processing tasks above had to be considered. Because of the large number of subjects (48/107) scoring 0 in the two Retrieval Decoding Pseudoword Tasks, the correlations relating to the two tasks operationalizing this variable have limited validity.

Table 3-1-9

Correlations of Phonological Processing Tasks with Visual Analysis Retrieval Task
Full Kindergarten Group (N= 104)

<table>
<thead>
<tr>
<th>Task</th>
<th>$r$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVC-NC Word Task</td>
<td>.31</td>
<td>.0011**</td>
</tr>
<tr>
<td>Retrieval Decoding Pseudoword Task</td>
<td>.26</td>
<td>.006**</td>
</tr>
<tr>
<td>(Vandervelden, 1992)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phonemic Word Spelling Task</td>
<td>.35</td>
<td>.0002 **</td>
</tr>
<tr>
<td>(Vandervelden, 1992)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary Word Reading Task</td>
<td>.24</td>
<td>.0130 *</td>
</tr>
<tr>
<td>(Ehri &amp; Wilce, 1985 and Vandervelden, 1992)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retrieval Decoding Pseudoword Task</td>
<td>.24</td>
<td>.0129 *</td>
</tr>
<tr>
<td>(Ehri &amp; Robbins, 1992)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phoneme Segmentation Task</td>
<td>.30</td>
<td>.002 **</td>
</tr>
<tr>
<td>(Yopp-Singer, 1988)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phoneme Deletion Task</td>
<td>.14</td>
<td>.19</td>
</tr>
<tr>
<td>(Rosner, 1975))</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note:
$r_{critical} = .25, p .01$  
$p < .05$  
$** p<.01$


3 subjects were excluded from the analysis due to missing values on some of the tests.
Given the statistically significant, albeit small, difference between the High and Low Readers on the Visual Analysis Retrieval Task (means 84.88, 77.27, p.02), a Pearson product moment correlations analysis was conducted separately for each of the two Kindergarten Reading Groups between the Visual Analysis Retrieval Task and the four phonological tests that would be used in Study 2 — CVC-NC Word Task, Decoding Pseudowords Task (Ehri & Robbins, 1992), Phonemic Word Spelling Task and Primary Word Reading Task. For the High Readers (N=41) there was no statistically significant correlation found for any test. For the Low Readers (N=66), there was a weak correlation (r = .29, p.02) between Visual Analysis Retrieval Task and Phonemic Word Spelling Task (r_{critical} = .24, p.05).

**Developmental Pattern in Phonological Processing**

To determine where the CVC-NC Word Task placed on the continuum of phonological processing, performance on the task was compared to performance on the Phonemic Word Spelling Task and Retrieval Decoding Pseudoword Task. In examining the means for the three measures, a developmental pattern was obvious. Performance on the Phonemic Word Spelling Task was 16.30 percentage points better than performance on the CVC-NC Word Task, which in turn was 16.26 percentage points better than the Retrieval Decoding Pseudoword Task. A paired t-test, comparing the means produced significant differences between the means for the CVC-NC Word Task and the Phonemic Word Spelling Task, t(106)=8.825 (p<.0001) and between the CVC-NC Word Task and the Retrieval Decoding Pseudoword Task, t(106)= 6.798 (p<.0001). These results for the Phonemic Word Spelling Task and the Retrieval Decoding Pseudoword Task are consistent with those found by Vandervelden. The CVC-NC Word Task appears to fall midway between the other two tasks. Figure 3-1-8 presents a graph of the mean percentage scores obtained by the Kindergarten subjects on these three tasks.
The new CVC-NC Word Task seems to provide an independent recognition decoding task that is more difficult than the Phonemic Word Spelling Task, but is easier than the Retrieval Decoding Pseudoword Task, falling somewhere between the two. By tapping a decoding level that appears to develop earlier than the decoding of pseudowords, the CVC-NC Word Task offers a useful addition to the battery of recognition phonological tasks appropriate for assessing adults with SCSP1.
Discussion

The usefulness of the data obtained in Study 1 for the purpose of statistical analyses comparing the reading acquisition of Kindergarten children with that of adults with SCPI was limited somewhat by the ceiling effect in the Letter Name and Sound Tasks, the Picture Identification Task and the Visual Matching Task, and by the skewed distribution in the Visual Analysis Retrieval Task. Nonetheless, the data base that was obtained provided a useful reference for nonstatistical comparisons and for examination of performance patterns with a larger population than was possible in Study 2. A similar advantage was derived from comparing the Kindergarten High and Low Readers. While statistical comparisons were not possible for all the variables, those tasks for which a statistically significant difference between the two groups was found — Retrieval Decoding Pseudoword Task, Primary Word Reading Task, Phonemic Word Spelling Task, CVC-NC Word Task and Visual Analysis Retrieval Task — provided indications of a developmental pattern and identified those measures which warranted further attention as the Profile for Reading Acquisition (PAR) was being developed within Study 2.

The validity of the CVC-NC Word Task as a measure of phonological recoding was supported by both the Pearson product-moment correlation and the Spearman rank correlation analyses, and by the pattern of high correlations with the other phonological tests. The stronger relationship of the CVC-NC Word Task with the phonological recoding tasks than with the Phoneme Segmentation of Words Task (Yopp-Singer, 1988) and the Phoneme Deletion of Words Task (Rosner, 1975) is consistent with the construct of phonological recoding and its development as proposed by Vandervelden and Siegel (1995, 1997). According to these authors, phonological recoding has three developmental stages — recognition, spelling and (retrieval) decoding. The results indicate that the CVC-NC Word Task provides a measure on the phonological processing continuum between Phonemic Word Spelling (spelling stage) and Retrieval Decoding Pseudowords (decoding stage).

In contrast to the CVC-NC Word Task, the relationship of the Visual Analysis Retrieval Task to the phonological processing tasks was weak. This would be expected from the wide body of research with children at the onset of reading. Results have consistently shown that the phonological processing factors are the strongest predictors of reading acquisition at the onset of reading. The only processing characteristic that the
Visual Analysis Retrieval Task would have in common with the phonological processing tasks would be in the analysis of visual elements, as required in the phonemic word spelling and decoding tasks. In several of these tests a weak but statistically significant relationship was found (Table 3-1-4). Of interest was the occurrence of a statistically significant correlation of $r = .27$ ($p < .03$) for the Low Readers (Table 3-1-5) but no statistically significant correlation for the High Readers for the Visual Analysis Retrieval Task and the Phonemic Word Spelling Task. This finding would be consistent with Willows' (1991) proposal that visual deficits characterize reading failure only in the earliest stages. It also raises the possibility of the capability operationalized by the Visual Analysis Retrieval Task having a developmentally limited relationship with phonological recoding. Whether or not repeated exposure to this type of visual analysis, as can occur for Blissymbol users within some Blissymbol instructional programs, might have an impact upon beginning reading was examined further in Study 2.

The correlational results and the difference in means on the visual tasks indicate that (1) performance on the Visual Analysis Retrieval Task differed from that of the Picture Recognition and Visual Matching Tasks, (2) some relationship with the processing required in phonological recoding tasks can be considered for the processing involved in the Visual Analysis Retrieval Task and (3) this relationship might be more apt to appear at the early stages of reading acquisition. Further study of this is warranted. A longitudinal study that can take into account the different developmental stages, both phonologically and orthographically, through which individuals progress in acquiring word recognition skills would appear to offer the most relevant method of investigation.

Overall, the objectives of Study 1 were accomplished. The results with tests selected from the reading research literature along with the new tasks, provided normative data from beginning readers for comparisons with the data obtained from adults with SCSP in Study 2. The CVC-NC Word Task appeared to tap a level of processing on the phonological development continuum between Phonemic Word Spelling and Retrieval Decoding Pseudowords. The new visual tasks were shown to measure different types of visual processing. The findings were weak, however, with regard to the role of the Visual Analysis Retrieval Task in measuring a visual factor related to phonological recoding. Further study would be needed to support this speculation.
STUDY 2

Goals

1. To determine performance levels on a battery of reading acquisition and reading related tests and to derive descriptive information pertaining to speech, communication and ecological factors associated with reading acquisition for a sample of adults with severe congenital speech and physical impairments (SCSPI).

2. To determine the measurable differences on reading acquisition and reading related tasks in a sample of adults with SCSPI between those who were Bliss Readers and and those who were Print Readers and between criterion-based subgroups.

3. To compare a sample of adults with SCSPI on reading acquisition and reading related measures with the following populations: (a) Kindergarten students (Study 1); (b) Kindergarten, Grade 1 and Grade 2 students (Vandervelden, 1992); (c) Grades 1, 2 and 3 students (Gottardo, 1995).

4. To explore the social and cultural factors relating to communication and beginning reading for a sample of adults with SCSPI with the objective of developing an Ecological Checklist that can be applied within an Educational Application to be produced through this investigation.

5. To develop a learner's Reading Profile that could be applied within an Educational Application to be produced through this investigation.

6. To contribute to the small body of AAC reading acquisition research by responding to the following questions identified in the Theoretical Infrastructure section:
Question 1:
Is there a difference in (a) reading level, (b) phonological coding in short term memory, and/or (c) phonological recoding ability attained by those subjects with anarthria (total loss of speech function) and subjects with dysarthria (partial loss of speech function), in favour of the dysarthric group?

Question 2:
Is there a difference between persons with SCSPi and persons with no speech impairment in ability to perform phonological recoding tasks (as distinct from phoneme awareness tasks)?

Question 3:
Do the results for nonreading adults with SCSPi in phonological recoding tasks show a different developmental pattern from the results of nonreading children in late Kindergarten?

Question 4:
Is there a difference in language comprehension between persons with SCSPi and persons with no speech impairment?

Question 5:
Is there a difference in performance on a verbal working memory task between persons with SCSPi and nondisabled persons, and among persons with SCSPi at different reading levels?
Question 6:
Is there a measurable difference in world knowledge between persons with SCSP and nondisabled persons, and among persons with SCSP at different reading levels?

Question 7:
Is there a relationship demonstrated between ecological rating and reading level achieved?

Question 8:
Is the pattern of results in reading related and reading acquisition tasks similar for adults with SCSP who have not yet acquired the ability to decode and able-bodied children at the onset of reading (late Kindergarten)?

Question 9:
Do the results on visual processing tasks indicate a potential relationship between type of visual processing undertaken in the use of the individual's GRS and performance on tasks related to reading acquisition?

Question 10:
Are the performance results in the Test of Nonverbal Intelligence (TONI) related to reading level?
Methodology

Design

This study employed a criterion group design as in Study 1. Descriptive information was obtained concerning reading acquisition, communication, literacy and ecological factors. Comparisons on a battery of reading acquisition and reading related measures were undertaken between the performance of adults with SCSPI in two criterion groups — Bliss Readers and Print Readers — and between subjects in four criterion subgroups — Pre-Readers, Pre-Decoders, Primary Readers and Independent Readers. The results on specified tests were compared with the findings from studies by Vandervelden (1992) and Gottardo (1995). Analyses were conducted at several levels according to the characteristics of the data. A learner’s Reading Profile and an Ecological Checklist were developed for inclusion in a proposed Educational Application.

Subjects

The subjects were 32 adults with severe congenital speech and physical impairments (SCSPI) who indicated a willingness to participate in a study relating to reading acquisition. They all lived in Southern Ontario within a day’s commuting distance of Toronto. Exceptions to this were five subjects in Ottawa and one subject in Windsor for whom special arrangements were made. Over half of the subjects had been known by the primary investigator since their introduction to Blissymbolics as children in the early seventies, or since their involvement in the Formative Evaluation Study conducted 1974-75 (Silverman, McNaughton & Kates, 1978). The remaining subjects were located through a search of the data base of Blissymbol users maintained by Blissymbolics Communication International. All the subjects had a formal communication system which they used functionally and all but one were either Bliss users or Bliss alumni (had used Blissymbols prior to using print for communication). The one subject with no association with Blissymbols (TB) had been introduced as a child to print as his first communication system.

The age range of the participants was from 17 to 44 years (mean 33 years). They ranged in reading ability from a pre-reading level at which they experienced difficulty in recognizing letter names and/or sounds to a community college/university level literacy competency. Details relating to the subjects’ age, sex, speech disorder, communication system, physical and sensory capabilities, literacy expectations and
place of residence during formative years are presented in Tables 3-2-1-A and 3-2-1-B. Initially 34 subjects were included in this study. Due to the deaths of two subjects before their testing was completed, the results for only 32 subjects could be analyzed.

As in Study 1, the subjects were divided into two groups based on skill in phonological recoding. Within Study 2, however, one of the tests included in the criterion measure differed from that in Study 1. As will be described further in the Tasks for Study 2, the Decoding Pseudoword Task (Ehri & Robbins, 1992) had to be changed from its retrieval form to a recognition task to accommodate the subjects with SCSP1. The task name was changed to Recognition Decoding Pseudoword Task to distinguish it from the Decoding Pseudoword Task used in Study 1. It was recognized that the recognition form of the task tapped an earlier level of phonological recoding development according to Vandervelden and Siegel's (1995) hierarchy of phonological recoding skills. The same procedures were followed as in Study 1 for dividing the subjects into two groups. In Study 2, however, the average score, serving as the criterion variable for dividing the full group into high and low readers, was derived from the percentage scores of the Recognition Decoding Pseudoword Task and the CVC-NC Word Task. Those subjects with a percentage average score of 50 or higher were classed as Print Readers (N=16); those subjects obtaining a percentage average score of less than 50 were classed as Bliss Readers (N=16). Each of the two reading groups were divided into two subgroups based on criteria related to instructional considerations. The criteria are presented in Table 3-2-2.

The names chosen for the groups and subgroups were for the most part descriptive of the abilities of the subjects. The term Pre-Reader was used to denote subjects who had little or no knowledge of the sounds associated with specific letters. The Pre-Decoders, on the other hand, knew the letter sounds but were unable to use them to decode words. The term Bliss Readers rather than Non-Print Readers was chosen, to draw attention to the ability of these subjects to read Blissymbols. The term Primary Reader denoted the grade level attained on the Peabody Individual Achievement Test (PIAT). The term Independent Reader was used to designate the wide range of readers who achieved higher than a primary level of reading on the PIAT.
<table>
<thead>
<tr>
<th>I.D.</th>
<th>age</th>
<th>gender</th>
<th>speech disorder</th>
<th>speech reliance</th>
<th>modes</th>
<th># 'Bliss'</th>
<th>access</th>
<th>VOCA</th>
<th>Computer</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE</td>
<td>32</td>
<td>male</td>
<td>anarthria</td>
<td>never attempts to speak</td>
<td>BlissBoard</td>
<td>200-500</td>
<td>eyes</td>
<td>none</td>
<td>Windows</td>
</tr>
<tr>
<td>DP</td>
<td>42</td>
<td>male</td>
<td>anarthria</td>
<td>never attempts to speak</td>
<td>BlissBoard</td>
<td>200-500</td>
<td>head light</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>JM</td>
<td>40</td>
<td>female</td>
<td>anarthria</td>
<td>never attempts to speak</td>
<td>BlissBoard + Pictures</td>
<td>under 50</td>
<td>hand/finger</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>TQ</td>
<td>43</td>
<td>male</td>
<td>anarthria</td>
<td>never attempts to speak</td>
<td>Bliss + Spelling</td>
<td>200-500</td>
<td>hand/finger</td>
<td>Digivox</td>
<td>Windows</td>
</tr>
<tr>
<td>NU</td>
<td>33</td>
<td>male</td>
<td>anarthria</td>
<td>never attempts to speak</td>
<td>Bliss + Spelling</td>
<td>over 500</td>
<td>hand/finger</td>
<td>none</td>
<td>Windows</td>
</tr>
<tr>
<td>TE</td>
<td>26</td>
<td>female</td>
<td>anarthria</td>
<td>never attempts to speak</td>
<td>Bliss + Voic</td>
<td>50-199</td>
<td>hand/finger</td>
<td>DAC</td>
<td>none</td>
</tr>
<tr>
<td>KE</td>
<td>17</td>
<td>male</td>
<td>dysarthria</td>
<td>tries to speak often</td>
<td>Bliss + Speech</td>
<td>200-500</td>
<td>hand/finger</td>
<td>none</td>
<td>Apple</td>
</tr>
<tr>
<td>YE</td>
<td>30</td>
<td>male</td>
<td>anarthria</td>
<td>tries to speak often</td>
<td>BlissBoard</td>
<td>200-500</td>
<td>hand/finger</td>
<td>none</td>
<td>Mac</td>
</tr>
<tr>
<td>DK</td>
<td>32</td>
<td>male</td>
<td>anarthria</td>
<td>tries to speak a little</td>
<td>Bliss + Voic</td>
<td>200-500</td>
<td>hand/finger</td>
<td>Epson</td>
<td>Windows</td>
</tr>
<tr>
<td>IC</td>
<td>44</td>
<td>female</td>
<td>anarthria</td>
<td>never attempts to speak</td>
<td>Bliss + Voic</td>
<td>over 500</td>
<td>eyes</td>
<td>Alphastalker</td>
<td>Windows</td>
</tr>
<tr>
<td>KD</td>
<td>23</td>
<td>female</td>
<td>anarthria</td>
<td>never attempts to speak</td>
<td>Bliss + Spelling</td>
<td>over 500</td>
<td>hand/finger</td>
<td>Liberator</td>
<td>Windows</td>
</tr>
<tr>
<td>EF</td>
<td>32</td>
<td>male</td>
<td>anarthria</td>
<td>never attempts to speak</td>
<td>Bliss + Voic</td>
<td>50-199</td>
<td>hand/finger</td>
<td>TouchTalker</td>
<td>Windows</td>
</tr>
<tr>
<td>DS</td>
<td>24</td>
<td>male</td>
<td>anarthria</td>
<td>never attempts to speak</td>
<td>BlissBoard</td>
<td>200-500</td>
<td>eyes</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>DW</td>
<td>40</td>
<td>female</td>
<td>anarthria</td>
<td>never attempts to speak</td>
<td>BlissBoard</td>
<td>over 500</td>
<td>head light</td>
<td>none</td>
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<td>Bliss + Speech</td>
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<td>hand/finger</td>
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<td>Bliss + Speech</td>
<td>over 500</td>
<td>hand/finger</td>
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<td>WordBoard</td>
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<td>Bliss + Spelling</td>
<td>over 500</td>
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<td>Windows</td>
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<td>LetterBoard</td>
<td>•</td>
<td>hand/finger</td>
<td>Epson</td>
<td>Windows</td>
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<td>dysarthria</td>
<td>tries to speak often</td>
<td>Bliss + Speech + Letters</td>
<td>200-500</td>
<td>hand/finger</td>
<td>Epson</td>
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<td>Words + Speech + Signing</td>
<td>•</td>
<td>hand/finger</td>
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<td>hand/finger</td>
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<td>weekly</td>
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### Table 3-2-2

**Criteria for Subgroups**

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<th>Subgroup Name</th>
<th>Criteria</th>
<th>Subjects</th>
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<tr>
<td>Pre-Reader</td>
<td>• less than 80% correct in recognizing letter sounds&lt;br&gt;</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>• unable to apply letter-sound knowledge to decoding words</td>
<td></td>
</tr>
<tr>
<td>Pre-Decoder</td>
<td>• 80% or higher correct in recognizing letter sounds&lt;br&gt;</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>• average percentage score&lt;br&gt; on the Recognition Decoding Pseudoword Task&lt;br&gt;and the CVC-NC Word Task of less than 50%</td>
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<tr>
<td>Primary Reader</td>
<td>• average percentage score&lt;br&gt; on the Recognition Decoding Pseudoword Task&lt;br&gt;and the CVC-NC Word Task of 50% or higher&lt;br&gt;• PIAT score between 1.00 and 2.9 grade level</td>
<td>7</td>
</tr>
<tr>
<td>Independent Reader</td>
<td>• average percentage score&lt;br&gt; on the Recognition Decoding Pseudoword Task&lt;br&gt;and the CVC-NC Word Task of 50% or higher&lt;br&gt;• PIAT score of 2.9 or higher</td>
<td>9</td>
</tr>
</tbody>
</table>

No honorarium was paid to subjects, although it was realized that an extensive time commitment was required of them. In lieu of payment, a commitment was made by the primary investigator to provide each subject with feedback as to their performance in the form of a personal Reading Profile accompanied by explanatory information. Not promised, but a further commitment that will be made at the time subjects are presented with their Reading Profiles is an offer by the primary investigator to all Bliss Reader subjects to volunteer as their first Resource Teacher for the implementation of *Writing and Reading with the Internet and Bliss (WRIB)*, the proposed Educational Application developed within this thesis. This, of course, will
apply only to subjects who wish to undertake a daily literacy program and are able to access BlissInternet. (See the Educational Application, Section IV.) Print Reader subjects will be invited to become WRIB Peer Tutors. Every effort will be made to facilitate access to BlissInternet for those expressing interest. It is this new software capability, completed in 1996, that has made possible these learning and teaching opportunities for those with computer access.

Procedure

Visits, phone calls, email messages, faxes or letters were used to communicate with eligible participants or their caregivers to outline the purpose of the study and the extent of their involvement. Those who expressed a willingness to participate were visited and questions regarding objectives, time commitment and procedures were answered by the primary investigator. For the distant subjects this information was provided by fax. A Consent Form confirming a willingness to participate was signed by each subject (See Appendix 3-2-A).

The subjects were tested individually in their apartment, group home, school, or place of work. Testing sessions were spread over a period of time that varied from two days to two months depending on the circumstances. The most typical testing schedule consisted of weekly sessions for a period of four to six weeks. Sessions lasted from one hour to three hours with conversation and refreshment breaks as needed by the subject. The total time spent with a subject working on tasks and completing the questionnaire ranged from six to eight hours. The tasks were presented in a designated order as shown in Checklist of Tasks, Figure 3-2-1, but with some flexibility within this ordering to respond to time constraints and availability of the appropriate examiner. Whenever possible a task was completed within a single session. Visits by the examiners were arranged to meet the schedule of each subject, as was the duration of the testing session. Time for relaxed discussion about topics of mutual interest was included in every session. Motivation on the part of subjects was high, as they all were interested in knowing more about their reading abilities. Since a number of subjects found some of the tasks very demanding, examiner discretion was used in deciding whether or not all test items would be given.
Figure 3-2-1

Checklist of Tasks

*order matters  ** Readers + order matters

1. Consent form
2. Questionnaire booklet
3. Letter Name and Sound tasks
4. Dysarthria/Anarthria evaluation  EB
5. CVC-NC Word Task  SMcN
6. Recognition Decoding Pseudoword Task  SMcN
7. Phonemic Word Spelling Task
8. Primary Word Reading Task and Picture Recognition Task
9. Visual Matching and Visual Analysis Retrieval Task  SMcN
10. Working Memory Task
11. Syntactic Error Judgement Task
12. Phonological Recoding and STM Task
13. Word-Pair Spelling Test
14. Homophone Word-Pair Matching Task
15. Spontaneous Communication Rating Scale
16. PIAT  Sentence Reading Comprehension
17 CELF-R  EB

Receptive Language
- Oral direction, p.16
- word classes, p.34
- listening to para's, p.47

Expressive Language
- formulated sentences, p.19
- word structure, p.11

18. TONI

19. TORC  Reading Comprehension,
- General Vocabulary, p.2 Student Booklet
- Syntactic Similarities, p. 4
- Paragraph Reading, p.6

Initials following task name indicate the examiner who administered the task. Other tasks were given by either examiner.
Testing was administered by the primary investigator (SMcN) and a speech language pathologist colleague (EB). The language tests were administered only by the speech language pathologist and the Blissymbols tasks were administered only by the primary investigator. The other tests were given by either examiner as scheduling dictated. Initial administration of all tests was undertaken with Ottawa subjects during a four-day-period in which examiners could work in the same setting at the same time. In this way they could share their expertise and refine the modifications that needed to be made in procedures to accommodate the diverse needs of persons with SCSP1.

Adaptations were made whenever necessary to enable each subject to perform at his or her potential level. This applied (a) to methods of responding, e.g., utilizing "Yes/No questions" or giving a set of choices when subjects lacked the necessary vocabulary items but indicated they had an answer to give, and (b) to method of presentation, e.g., use of large print or covering all lines of text on a page other than the line of print to be read. Since some subjects were tested while in their hospital beds or in wheelchairs that lacked trays, or at times when their regular communication equipment was being repaired, flexibility had to be maintained at all times. Overall, the approach to testing was that of adapting to the needs of each subject rather than attempting to maintain standard procedures. No time limits were used. This was judged as the only way to ensure a result that reflected the subject's performance capability. Similar adaptations have been used in other research projects involving persons with SCSP1 as subjects (e.g., Dahlgren Sandberg, 1996; Smith, 1989).

Tasks

Subjects' performance was measured using a battery of tests comprised of: (a) the reading acquisition tasks from Study 1, except for the Phoneme Deletion Task (Rosner, 1975) and the Phoneme Segmentation Task (Yopp-Singer, 1988), neither of which could be performed by subjects with SCSP1; (b) reading related tasks addressing language, world knowledge and memory factors; (c) a nonverbal intelligence test; (d) two reading assessment tests (Print Readers only). Subjects' communication and motor capabilities, along with a range of ecological factors were subject-rated by means of a questionnaire. Speech functionality was assessed by the speech language pathologist participating as an examiner in this investigation.
The tests were selected from: (a) the tests used in Study 1, adapted in some cases for administration to persons with SCSPSI, (b) standardized tests used in a study of adults with SCSPSI by Foley (1989) and (c) studies relating to reading acquisition by nondisabled primary children by Gottardo (1995) and Vandervelden (1992). See Appendix 3-2-B for the non-standardized test battery administered in Study 2.

**Reading acquisition tasks from Study 1.**

**Letter Name and Sound Tasks**

In Study 2, only the Vowel Name Recognition Task, the Consonant Name Recognition and the Consonant Sound Recognition Task could be included. The other two letter name and sound tasks from Study 1 (Vowel Naming Task and Consonant Naming Task) could not be given to persons with SCSPSI as they were unable to orally name the letters. Except for the omission of two tests, the test items and the procedures followed were the same as those described in Study 1.

**Phonological Recoding Tasks.**

**CVC-NC Task - Parts 1 and 2**

Since this task was designed to provide a new means of testing subjects with SCSPSI, it was anticipated that the test items and procedures that were followed for the subjects in Study 2 could be the same as those described in Study 1 (pp. 104-109). The need to adapt the method of responding, however, was discovered. Although the computer controlled response by means of a Unicorn keyboard with Ke:nx hardware and software had been planned for use by subjects with SCSPSI, it was found that the many different seating positions of the adult subjects combined with their restricted hand function made it much more efficient to use each subject's personal way of indicating "Yes" and "No". Thus a range of response methods were used, including a vocalized "Yes" and "No", head and eye signals and synthetic speech activated by a voice output device or a computer. The method of administering the CVC-NC Word Task differed in another way in Study 2. In giving the test to adults, the training phase consisted of direct explicit information of the non-conventional letter-sound associations, rather than the sheep puppet DAAL introducing the letter-sound associations and playing with sheep names. The same information was given to both subject groups but in a context that was age appropriate. Otherwise the procedures were the same as in Study 1.
Recognition Decoding Pseudoword Task

Only the five items used by Ehri & Robbins (1992) were selected from the Retrieval Decoding Pseudoword Task from Study 1 for inclusion in the Recognition Decoding Pseudoword Task used in Study 2. Two adaptations were made. The smaller number of items was selected in order to reduce the time needed for this test. In addition, a change had to be made in the method of presentation. The subjects in Study 1 could respond by orally reading the pseudowords and performing the task at the highest developmental level, that of phonological recoding (Vandervelden, 1992). For the subjects in Study 2, however, the task became the Recognition Decoding Pseudoword Task and was presented as a recognition task, tapping phonological recoding at the lowest developmental level (Vandervelden, 1992). As in Study 1, the stimulus pseudowords were printed in lower case on separate cards.

Instructions:
"On each card, you will see a silly word. You have never heard any of these silly words before. Look carefully at the silly word on the card and think what it sounds like. Now, I am going to say some silly words. When you hear me say the silly word that you see on this card, tell me "Yes". If the word I say is not the same as the silly word on the card, tell me "No".

"Is it ...? " "Is it ...?" etc

Testing Items:

<table>
<thead>
<tr>
<th>item</th>
<th>Distractors</th>
</tr>
</thead>
<tbody>
<tr>
<td>kin</td>
<td>nik, kib, lin, kin, ken</td>
</tr>
<tr>
<td>fop</td>
<td>fox, fip, fop, sop, pof</td>
</tr>
<tr>
<td>mal</td>
<td>mul, nal, maf, lam, mal</td>
</tr>
<tr>
<td>rut</td>
<td>rut, tur, rot, rud, vut</td>
</tr>
<tr>
<td>bev</td>
<td>dev, bev, veb, hav, bet</td>
</tr>
</tbody>
</table>

Scoring: /5
Primary Word Reading and Picture Identification Tasks

Primary Word Reading Task

The word list from Study 1 was reduced to 30 words from 60 words in order to reduce the time required for the test. Every second word was eliminated from the list. The subjects identified words by pointing to the equivalent symbol on their display, by giving a synonym for the word, or by placing the word in a sentence to demonstrate they had read the word's meaning.

Word Items:
no, yes, the, we, is, see, yellow, play, in, green, eat, mom, run, man, to, was, milk, bed, ball, car, like, pig, good, all, fish, said, this, away, name, two.

Picture Identification Task

This test was given as in Study 1, except that a line drawing from Picture Communication Symbols (PCS) was presented after every second word until all the line drawings had been shown. The PCS were added for two reasons: (1) to provide easier stimuli for subjects who were having difficulty with the word task; (2) to test for Picture Identification. The subjects identified the PCS by pointing to the equivalent symbol on their display, by giving a synonym for the line drawing, or by spelling the word represented by the line drawing.

PCS Items:
house, woman, pencil, bowl, bicycle, rake, cake, brush, butterfly, truck, computer, mouse.

Administration:

Words and PCS were presented on separate word cards, one by one, and in order listed above, with PCS being inserted after every 2 words.

Instructions:

"I am going to show you some words and pictures. If I show you a word you can read, show me on your display that you know the meaning of the word. You can show me the symbol that means the same thing or close to the same thing, or you can put the word in a sentence. When I show you a picture, tell me what you think it is; that is,
show me on your display what the picture is. If you are not sure that you know the word or the picture, you may guess".

The examiner showed each word and picture 3 sec. and recorded items correct and substitutions. If a child self-corrected, the word or picture was counted correct.

Score Primary Word Reading Task: /30 words;
Score Picture Identification Task  /12 PCS

**Phonemic Word Spelling Task**

The subject's early spelling abilities were tested in the same manner as in Study 1, except spelling was accepted in whatever form was possible by the subject — spelling by pointing to the letters on a letter board, using a computer, using a voice output communication aid.

Score: Phonemic Word Spelling  /25

**Visual Matching and Visual Analysis Retrieval Tasks**

The Visual Matching and Visual Analysis Retrieval Tasks were conducted in the same manner as in Study 1 (pp. 116-120), except each subject's preferred ways of indicating "Yes" and "No" were used.

Score: Visual Matching Task  /5
Score: Visual Analysis Retrieval Task  /5

Reading Acquisition Tasks introduced in Study 2.

**Word-Pair Spelling Test**

This informal diagnostic test was developed by Siegel. It contained pairs of items such as "rane - rain", "need - nead", "milk - milk" and the subject was asked to indicate the correctly spelled item in each pair. The test was given to all subjects with a grade level of 3.0 or higher on the Peabody Individual Achievement Test (PIAT).
**Homophone Word-Pair Matching Task**

This task was modelled on an informal diagnostic test developed by Siegel. It was included as a measure to assess the phonological recoding skills of the Print Readers. The task comprised a list of 18 word and non-word pairs, each spelled phonetically. The subject had to select the phonetically spelled item in each pair that sounded the same as a real word, e.g., *saip* and *saif*, *soef* and *seet*, *deace* and *peece*, etc. The task involved, in effect, matching a generated phonological code with an item in the mental lexicon.

**Instructions:**

"**Only one group of letters on each line** sounds like a real word when you sound out the letters. This is a job that you must do without any help. You must look at the letters and think of their sounds in your own head *all by yourself*. The person who is your helper must not say anything or help you in any way as you think about the sounds.

Try to sound out the groups of letters in your head by looking first at one group of letters and then at the second group of letters.

Show your helper which group of letters sounds (in *your* head) like a real word.

(Remember your helper should not say anything!)

If you don't know which group of letters sounds like a real word, tell your helper so."

**Scoring:** A mark was given for each pair in which the correct group of letters was selected.
Score: /18

**Syntactic Processing, Memory and World Knowledge Tasks.**

Three tasks designed by Gottardo for use with children in Grades 1, 2 and 3 were included within this study to measure syntactic error judgement, phonological recoding and short term memory (STM), and working memory. The only adaptations that were made were in method of response. Subjects used their typical way of communicating and in some cases this meant combining symbols in order to give a response.
In order to obtain an indication of world knowledge, the decision was made to consider subtests of the Clinical Evaluation of Language Fundamentals — Revised (CELF-R) and Working Memory Task (Gottardo, 1995) as diagnostic indicators of World Knowledge. The size of the test battery being administered prohibited further specific testing relating to world knowledge.

**Syntactic Error Judgement Task**

This task was designed to include five types of syntactic errors: (1) errors in clause order within sentences, (2) errors in word order within clauses, (3) errors in subject-verb agreement, (4) errors in subject-copula verb agreement, (5) errors in function word usage. The error types were presented in each task in a random order. Ten distractor sentences that did not contain an error were included in random order within the set of error sentences. Each of the five error types was represented by five sentences of varying length.

**Procedure:**
The procedure outlined by Gottardo (1995) was followed. The sentences were presented orally by the examiner.

**Instructions:**
"I am going to say some sentences. Some of them are right and some of them are wrong. I just want you to tell me which sentences are right and which sentences are wrong. Let's practice."

The two training items were given.
"This is a chair."
"I am sit."

Feedback was given on each of the training items and attention was focussed on syntactic acceptability rather than semantic plausibility.

Each subsequent sentence was read to the subject with normal sentence prosody, in order not to draw the subject's attention to the error. A maximum of one repetition was allowed per sentence upon the subject's request or if the subject failed to respond to the sentence within approximately 15 seconds.
Scoring:
The Syntactic Error Judgement task received a total number correct score based on whether the subject responded that the grammatically correct sentences were correct while the grammatically incorrect sentences were wrong. A global score was calculated consisting of the number of correct responses across the 35 items.

Score: Syntactic Error Judgement /35

Working Memory

The test of verbal working memory was developed by Gottardo (1995) and based on a variation of a memory task developed by Daneman and Carpenter (1980). Subjects were required to listen to a series of statements and respond true or false. At the end of each set of sentences the subjects were required to recall the final word of each sentence in the trial. In each trial the number of sentences increased by one, starting with two sentences, to a maximum of five. The sentences were of a simple construction in order to "separate verbal memory from syntactic sensitivity as much as possible" (Gottardo, 1995, 39). There were three 2-sentence sets, three 3-sentence sets, three 4-sentence sets and three 5-sentence sets. The sentences were designed to contain information familiar to primary school children.

Procedure:
The Working Memory Task was presented on audiotape with the training items being presented orally by the examiner. The subject was first asked if they knew the meaning of "true" and "false" and the examiner compared the terms to the Blissymbols for "real" and "opposite of real". While the true/false responses were intended to focus the subject's attention on the semantic plausibility of the sentence in Gottardo's study, the total score was also used as an indicator of world knowledge for diagnostic purposes in the present study.

The subject was informed that he would hear some sentences on tape and would respond to each sentence indicating if it was true or false in whatever way his communication system allowed. His means of communicating this was established prior to beginning the test. After each set of sentences, two beeps would sound and the child should attempt to recall the last word of each sentence in the set. After hearing the second beep, the examiner turned the tape recorder off and encouraged the subject to recall as many of the last words as she remembered. It was stressed that the order in
which the last words were recalled was not important. If the subject gave the tester the whole sentence, the first word, or the most salient word, as a recall response, she was reminded to give only the last word of each sentence.

Scoring:
The subject's exact responses were recorded for the recall component of the task. Responses were counted as correct if a synonym was given, if the word was orally approximated, or if a strategy was used to communicate the word, e.g., for 'warm', 'little' + 'hot'; for 'evening', 'after' + 'afternoon'; for fur, 'hair' + 'animal'. The total score from the true/false judgements and the recall of the last word in each sentence was used as the working memory measure.

Score: Working Memory / 74

Phonological Recoding and STM Task

The task was designed to follow the model used by Foley (1989, 1993) in which subjects were asked to recall sequences of visually presented consonants in serial order. This recall task was presumed to indicate whether or not a subject was utilizing subvocal phonological coding to rehearse consonant sequences. If articulation is not used and if performance is poorer on phonologically similar consonant sequences than on phonologically dissimilar sequences, the subject is presumed to be using phonological coding. If there is no significant difference in performance on phonologically similar and dissimilar sequences, then the subject is presumed to not be using phonological coding in this short term memory task.

Twenty sequences of three, four, five, or six consonants were printed in 1" letters on 3"x5" index cards. Ten sequences of each length were chosen at random from a phonologically similar set of letters (BCDPTV). Ten sequences of each length were chosen at random from a dissimilar set (FHJRWY). Within each sequence, no letters were repeated. A response card was made for each set of letters. On each card, consonants were arranged in alphabetical order. A question mark was included on the card so that subjects could indicate forgotten items. Spacing of items on response cards was determined by each subject's motoric abilities. For subjects who could not point to a letter, adaptations were made, e.g., answering by means of the computer, responding to examiner's scanning of the letters, use of own communication display.
The consonant sequences were presented for immediate recall. The sequences had been chosen at random from either the phonologically similar set or the dissimilar set. Letters were placed in front of the subject at a rate of one per second. After the last item in the set, the cards were removed. A response card was then placed in front of the subject or an adapted response method was accepted. Since the task was initially designed to follow the model used by Foley (1989, 1993), the plan was that each subject would be given 5 sequences from each set of length 3, followed by 10 similar and 10 dissimilar sequences of 4 and 5 items. It was found, however, that four Bliss Readers were unable to do the task at any level, and only six of the 32 subjects were able to perform beyond the level of 3 consonants.

Scoring:

Original scoring scheme from Foley involved calculating the percentage of sequences recalled completely correctly and the percentage of individual items recalled in the correct serial position. Because of the difficulty experienced by the subjects in doing this task, scores were not calculated. Instead, the highest level at which the subject could perform was examined and the scores for the similar and dissimilar sequences were compared. If there was a difference of 2 or more items correct, the type of sequence of the higher score was noted. If the scores were the same or the difference was less than 2 items, the performance was rated as equal. Subjects for whom the difference was 2 or more in favour of the dissimilar sequences were rated as performing in an expected manner (compared to a speaking person). Those for whom the scores were equal on the two types of sequences or for whom the difference was in favour of the similar sequences were rated as performing in an unexpected manner (compared to a speaking person). This adaptation to the scoring made it impossible to undertake any statistical comparisons with the Foley results. It did, however, offer results of interest to supplement the Reading Profile within the preliminary assessment of each subject.

**Standardized measures.**

*The Test of Nonverbal Intelligence (TONI)*

This test was developed by Brown, Sherbenou, & Johnsen in 1982 (2nd. edition, 1990). It was administered as a language-free measure of cognitive ability and was selected for this study because it had been used by Foley (1989) in her study with
adults with SCSPI. In deciding to use this test within the test battery of Study 2, all of the limitations described earlier with the regard to the Raven's Progressive Matrices were noted. The test items are similar to the second through fifth levels of the Raven's Progressive Matrices test items (nonverbal intelligence measure used by Smith (1989, 1992) and Dahlgren-Sandberg (1996)). The TONI, however, has more variation in the presentation configuration than the Progressive Matrices. Both tests rely heavily on visual perceptual and spatial skills. Any results obtained with the TONI should be seriously questioned, as should those of the Raven's Progressive Matrices test, when either is used as a single measurement of "intelligence". See discussion relating to intelligence testing in the section entitled, "Investigation of literacy abilities of children with cerebral palsy in Sweden", in Section II.

The TONI was designed as a language free, motor reduced and culture reduced testing format. It is recommended for "subjects who have language and/or motor impairments stemming from such conditions as cerebral palsy, stroke, or head trauma" (Brown et al, 1982, p. 5). It is based on abstract/figural problem solving and requires the subject to solve problems by identifying relationships among abstract figures and then solving problems created by the manipulation of these relationships. Each item presents a stimulus pattern in which one or more of the figures comprising the pattern is missing. The subject completes the pattern by selecting the correct response from among either four or six alternatives.

The figures in the items contain one or more of the following characteristics: shape, position, direction, rotation, contiguity, shading, size, length, movement and figured pattern. For the most part, the more difficult items contain several of these characteristics while the easier items contain only one or two. Item difficulty also is increased by manipulating the type and number of problem solving rules that must be applied in order to arrive at a solution. The rules are (1) simple matching, (2) analogies (the relationship among the figures in one of the rows or columns is the same as the relationship among the figures in the other rows and columns), (3) classification (the figure in the stimulus is a member of one of the sets of figures in the response alternatives), (4) intersections (a new figure is formed by joining parts of figures in the rows and columns), and (5) progressions (the same change continues between or among figures.)
Scoring:

The ceiling of the norms is 85-11 years. On the TONI, raw scores are converted to TONI Quotients with a mean of 100 and a standard deviation of 15. Scores between 85 and 100 are considered to be within the average range.

Clinical Evaluation of Language Fundamentals — Revised (CELF-R)

This test was developed by Semel, Wiig, and Secord (1987) as a "practical clinical tool for the identification, diagnosis, and follow-up evaluation of language skill deficits in school-age children" (p.1). For the purposes of this investigation, the subtests used were Oral Directions, Word Classes, and Listening to Paragraphs as measures of Receptive Language, and Formulated Sentences and Word Structure as measures of Expressive Language. The result on the Word Classes subtest was also used as a diagnostic indicator of world knowledge.

All the CELF-R subtests were administered by E. Baird, speech pathologist. Notes that appear in italics following the description of subtests were recorded by Baird (personal communication, 1996).

Receptive Language

A Receptive Language score is obtained by adding the three standard scores of the subtests for Oral Directions, Word Classes and Listening to Paragraphs and converting the sum to an adapted standard score for Receptive Language.

Oral Directions

The subject is trained by the examiner demonstrating how to do the test and by giving feedback as required, as the subject tries three trial items. The task requires the subject to point to some shapes in the same order in which the examiner says them, e.g., "Point to the second triangle and the fourth square. Go." Each set of shapes appear on a separate page in the Test Stimulus Manual.

Score: Raw score is converted to norm-referenced standard score by using the 16 year-age table.

This subtest was problematic for those individuals who did not use direct access. The number of steps to respond to each direction were increased as the
subjects had to respond to the examiner’s scanning of the possible answers. Only a few individuals, however, required adaptive administration of the subtest.

Word Classes
The subject is trained by the examiner demonstrating how to do the test and by giving feedback if required, as the subject tries three trial items. A set of four words is read to the subject. The subject is instructed, "Now listen to these words. Remember you are to tell me the two that go together best, e.g., slow, nurse, doctor, rain.

Score: Raw score is converted to norm-referenced standard score by using the 16 year-age table.

Usually this test is administered by having the subject give oral responses. When administered to subjects with SC SPI responses were given by using an array of numbers 1 to 4, corresponding to each word presented. The subject was asked to indicate the numbers corresponding to the words that go together. This may provide more of a memory load to subjects with SC SPI because they have to “translate” the words into numbers and then access the appropriate numbers. Secondly the categories (semantic, opposite, spatial and temporal) for the word classes may be concepts that are influenced by academic experiences. The limited formal education of some of the subjects could influence their performance.

Listening to Paragraphs
The subject is trained by having one of three trial paragraphs read and questions being asked. Prompting by providing cues to answers is done during the training, if the student’s response is vague or incomplete. Test paragraphs are then read and introduced by the examiner saying, "Now listen carefully to what I read next. I will ask you questions about what I read." Selection of the level for the paragraphs is judged by the examiner by estimating the receptive language level of the subject and adjusting for the second paragraph. Responses are given by answering content questions concerning the paragraph. Instructions for scoring are given in the CELF-R Examiner's Manual.

Score: Raw score is converted to norm-referenced standard score by using the 16 year-age table.

Usually this test is answered orally and vocabulary that has been introduced in the paragraph is required in the response. For subjects using communication displays or voice output devices for their responses, there is an added cognitive demand. Frequently the vocabulary introduced in the paragraph does not appear on their
communication display. New vocabulary has to be produced through symbol strategies or spelling. Furthermore, the topics of the two paragraphs within the 5-0 to 7-11 year age level are not within the experience range of persons with SCSP, e.g., ice-skating, tennis.

Expressive Language

An Expressive Language score in the CELF-R is obtained by adding the three standard scores of the subtests for Formulated Sentences, Recalling Sentences and Word Structure. In this study, the Recalling Sentences had to be eliminated from the test battery due to time limitations. Because of the many different means of communication used by the subjects and the need on the part of all Bliss Readers to create new symbols and use strategies to produce words not on their displays, the time required to complete the test rendered it inappropriate within such a large test battery. Therefore, only two subtests were used in obtaining the Expressive Language Score. The calculations were adapted by dividing the totalled standard scores for Formulated Sentences and Word Structure by 2 and multiplying the result by 3. This figure was then converted to an adapted standard score for Expressive Language.

Formulated Sentences

The subject is trained by the examiner modeling the task followed by the examiner presenting the subject with one trial item and giving feedback if the subject fails to respond appropriately. The subject is asked to make a sentence with a word that is orally presented by the examiner. A picture is also shown to the subject with the option of using the picture to make the sentence or talking about something else. Words are given until all 20 items are completed or until there are 4 consecutive zero scores. The stimulus word must be used in order to get a score. The responses are scored from 0 to 4 according to rules in the Examiner's Manual which consider syntax, semantics and completeness of sentence.

Score: Raw score is converted to norm-referenced standard score by using the 16 year-age table.

Only a few individuals required adaptive administration of this subtest. Assisted scanning was used if needed. This resulted in the number of steps to respond to each direction being increased and an increase in the memory load. The amount of school experience was not considered as affecting performance on this subtest, but method of communication was considered to be an important factor.
Similar to the Word Structure subtest, performance on the Formulated Sentences subtest was improved by speech production. Formulated Sentences requires strict adherence to English grammar and scoring severely penalizes deviation from it. Therefore although individuals were able to convey meaning, often in telegraphic sentences, they were penalized for not including structures that do not convey any meaning such as articles or structures that reflect verb tenses (such as the present progressive copula verb + -ing). These structures are easier to formulate orally. Production using AAC methods involves use of strategies and special symbols. These are often time consuming and perhaps trade-offs are made between time required and increased comprehension of the message. Additionally good AAC communication strategies are violated when there is less co-construction by the communication partner than would be expected in non-test environments. Performance can be further constrained by limitations in the vocabulary items present on the individual's communication board.

Word Structure

The Word Structure subtest measures English morphemes, the smallest units of language that carry meaning, such as -s for plural, and -ed for simple past, as well as other structures such as pronouns and comparative and superlative. The subject is shown a picture and asked to finish the incomplete sentence spoken by the investigator using the picture as reference for the answer. Examples of test items are, (a) "Here is one dog. Here are two .... (dogs)." (b) "Here is a tooth. Here are some ...... (teeth)." (c) "His father won a new coat. The coat is .... (his). All 36 items are given. Instructions for scoring are given in the CELF-R Examiner's Manual.

Score: Raw score is converted to norm-referenced standard score by using the 16 year-age table.

Performance on the Word Structure subtest can be influenced by the ability to produce functional speech. Any ability to respond verbally is advantageous for this subtest because of the ease of vocally producing the structures being tested compared to the use of either Bliss or traditional orthography. In the latter cases, the knowledge and ability to use special symbols and strategies (plural, possessive past action, etc.) or spelling is required. The AAC user was often constrained by the symbols that were present on her/his board in creating the structures. The presence and/or ability to use the special symbols and strategies could also be considered as reflecting previous instructional experiences.
**Peabody Individual Achievement Test (PIAT)**

This test was developed by Dunn and Markwardt and published in 1970. It is a norm-referenced, individually administered test designed to provide a wide-range screening measure of academic achievement in five content areas. Its standardization is rated by Salvia and Ysseldyke (1988) as superior to that of most other individually administered achievement tests. It was standardized nationally in twenty-nine different school systems throughout the United States, during the 1968-69 school year. The Reading Comprehension subtest of the PIAT was selected for this study because, like some of the subtests from the TORC, this subtest was used by Foley (1989, 1993) in her study of reading performance of 12 adolescents and adults with SCSP1.

The PIAT Reading Comprehension subtest contains 66 multiple choice items assessing skill development in what is read. After reading a sentence, the subject is asked to indicate the picture that best describes what has been read, from a group of four pictures. The complexity of the reading passages in the subtest is increased by means of the vocabulary level of the words used, the length of the sentences, and the complexity of the sentence structure. The administration instructions indicate that subjects should always be encouraged to guess if they are not sure of the answer. The basal level is five consecutive correct responses. The ceiling level is five errors in seven consecutive responses. The grade equivalent of any given raw score is the grade level for which that score is the median score for pupils at that grade level, determined from the norm tables. The grade equivalent range in the Reading Comprehension subtest is from grades 1.9 to 12.8.

**Test of Reading Comprehension — Third Edition (TORC-3).**

This test was first published by Brown, Hammill and Wiederholt in 1978 (third edition, 1995). It was administered to subjects who scored above the grade 2.9 level in the PIAT. The TORC was selected for this study because it had been used in its second edition by Foley (1989) in her study with adults with SCSP1. TORC-3 provided a Reading Comprehension Quotient (RCQ) based on four subtests. Only three subtests were administered due to time constraints. They were the same three subtests as those used by Foley: General Vocabulary, Syntactic Similarities and Paragraph Reading. Standard score equivalents for raw scores were obtained for the three subtests using the norms for the 16-0 through 17-11 ages. The equivalent of the sum of standard scores was derived by calculating the average of the three standard scores and multiplying the result by 4. The sum of the standard scores was converted to the RCQ.
TORC-3 General Vocabulary Subtest
This subtest contained 25 items. For each item, subjects were asked to read three related words such as heavy, big, and giant. They were then asked to find two more words from a list of four (in this example, large, thumb, ladder, tall) which were related conceptually to the target items. Both related words had to be chosen for the response to be scored as correct. Testing was discontinued after three errors were made in any five consecutive items.

TORC-3 Syntactic Similarities Subtest
This subtest contained 20 items. For each item, subjects were required to read five sentences, then choose which two of the five were equivalent in meaning (e.g., (a) Billy went. (b) Billy can not go. (c) Billy can't go. (d) Billy may go. (e) Billy wants to go. Testing was discontinued when a subject missed three in any consecutive five items.

TORC-3 Paragraph Reading Subtest
This subtest contained 6 story-like paragraphs followed by five comprehension questions. Testing was discontinued when two or more errors were made in any story. All items marked correctly, including those in the ceiling paragraph, were counted in the raw score.

Communication assessment.

The Spontaneous Communication Rating Scale, developed by Jennische and Lorstrom (1996), was used to rate communication competence. (See Appendix 3-2-C).

Anarthria/Dysarthria assessment.
An informal screening was conducted by the speech language pathologist. The screening consisted of timed Maximum Sound Prolongation (Wit, Maassen, Gabreels & Thoonen 1993), diadochokinetic tasks (nonsense syllable repetition rate) and the intelligibility word repetition subtest from the Frenchay Dysarthria Assessment (Enderby, 1983) to evaluate speech production abilities. The Maximum Sound Prolongation task included the phonemes /a/, /s/, and /z/. Subjects who sustained the /a/ phoneme for less than 1 second, were considered to demonstrate anarthria. Similarly, subjects who made no attempts to produce any words from the Frenchay Dysarthria Assessment word repetition subtest were also considered to demonstrate anarthria.
Questionnaire re communication and literacy history.

A questionnaire designed to gather descriptive ecological information was given to each subject, to complete with the assistance of a friend, attendant or research examiner. Questions included in the questionnaire related to place of residence; method of communication; details re graphic communication system, voice output device and computer; written communication; telecommunication; means of technology access; visual difficulties; and independence in getting to reading materials. Subject ratings were also included relating to enjoyment of different types of reading materials; personal skills in reading, writing and communicating; literacy instruction; and persons who had helped with literacy instruction. (See Appendix 3-2-D.) A positive rating was given for all items that were given a score of three or above on a five-point rating scale. An Ecological Composite Index (ECI) was calculated for each subject by totalling the number of positive ratings and percentaging the result.

Data Analyses

The data results were used for four major purposes: (1) comparing the pattern of performance on the reading acquisition and reading related measures, the communication competence measures and the ecological measures across SCSP1 groups and subgroups; (2) comparing the reading acquisition and reading related measures of SCSP1 subgroups and the Kindergarten subgroups from Study 1; (3) comparing the results of SCSP1 reading subgroups with the results of Kindergarten, Grades 1 and 2 students (Vandervelden, 1992) and of SCSP1 reading subgroups with Grades 1,2 and 3 students (Gottardo, 1995) on specified measures, and (4) determining the pattern of results for each subgroup and for performance groups of special interest in order to develop Profiles for the Acquisition of Reading (PARs) for each subgroup and recommendations for instruction.

Analyses were conducted at three levels, Molar in which descriptive information relating to group performance and comparisons between Bliss and Print Readers were reported, Intermediate in which reading subgroup comparisons were conducted and Molecular, in which individual performance patterns and subgroups of special interest were considered. At the Molecular level, the PARs were used to produce Reading Profiles by which the performance patterns of subjects that differed from the pattern of the subgroup could be examined. A summary of the comparisons and types of analysis at the Molar and Intermediate levels are presented in Table 3-2-3.
<table>
<thead>
<tr>
<th>Comparison Groups</th>
<th>Type of Analyses</th>
<th>Variables</th>
<th>Rationale</th>
<th>Level of analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bliss SCSPI Readers &amp; Print SCSPI Readers</td>
<td>Parametric, Nonparametric &amp; Descriptive</td>
<td>Reading Acquisition &amp; Reading Related Test Battery</td>
<td>Subject Data accessible</td>
<td>Molar</td>
</tr>
<tr>
<td>SCSPI Pre-Readers &amp; SCSPI Pre-Decoders</td>
<td>Descriptive</td>
<td>Reading Acquisition &amp; Reading Related Test Battery</td>
<td>Subject Data accessible</td>
<td>Intermediate</td>
</tr>
<tr>
<td>SCSP I Primary Readers &amp; SCSPI Independent Readers</td>
<td>Descriptive</td>
<td>Reading Acquisition &amp; Reading Related Test Battery</td>
<td>Subject Data accessible</td>
<td>Intermediate</td>
</tr>
<tr>
<td>SCSPI Print Readers &amp; Kgm. High Readers</td>
<td>Descriptive</td>
<td>Reading Acquisition &amp; Reading Related Test Battery</td>
<td>Subject Data accessible</td>
<td>Molar</td>
</tr>
<tr>
<td>SCSPI Bliss Readers &amp; Kgm. Low Readers</td>
<td>Descriptive</td>
<td>Reading Acquisition &amp; Reading Related Test Battery</td>
<td>Subject Data accessible</td>
<td>Molar</td>
</tr>
<tr>
<td>Pre-Readers (SCSPI), Bliss Readers Pre-Decoders (SCSPI), Bliss Readers Primary (SCSPI), Print Readers Independent (SCSPI) Print Readers &amp; Grade One (Gottardo, 1995) Grade Two (Gottardo, 1995) Grade Three (Gottardo, 1995)</td>
<td>Descriptive</td>
<td>Recall Working Memory True/False Working Memory Syntactic Error Judgement</td>
<td>Subject Data not accessible</td>
<td>Intermediate</td>
</tr>
<tr>
<td>Pre-Decoders (SCSPI), Bliss Readers Primary (SCSPI), Print Readers Independent (SCSPI) Print Readers &amp; Kindergarten (Vandervelden, 1992) Grade One (Vandervelden, 1992) Grade Two (Vandervelden, 1992)</td>
<td>Descriptive</td>
<td>Phonemic Word Spelling Test</td>
<td>Subject Data not accessible</td>
<td>Intermediate</td>
</tr>
</tbody>
</table>
In addition to the Molar, Intermediate and Molecular analyses, an ecological analysis at the microsystem level (Bronfenbrenner, 1979) was conducted for variables considered to be important within a reading instructional program. These related to environmental, social and cultural factors.

Molar level of analysis.

Descriptive data (mean, standard deviation, median and interquartile range) were obtained for the full group of 32 adults with SCSPI on (a) a battery of reading acquisition measures: Letter Name and Sound Recognition Tasks, Recognition Decoding Pseudoword Task (Ehri & Robbins, 1992), Primary Word Reading Task (Ehri & Wilce, 1985; Vandervelden, 1992), Phonemic Word Spelling Task (Vandervelden, 1992), and the CVC-NC Word Task, Picture Identification Task, Visual Matching Task and Visual Analysis Retrieval Task (developed by McNaughton for use in this investigation); (b) a battery of reading related tests: Receptive and Expressive Language Subtests (CELF-R, 1987), Non-Verbal Intelligence Test (TONI, 1990), and Working Memory and Syntactic Error Judgement Tests (Gottardo, 1995); and (c) four variables related to communication competence from the Spontaneous Communication Rating Scale (Jennische & Lorstrom, 1996) (Appendix 3-2-C) — Ability to Inform, Sentence and Grammar Ability, Functional Interaction and Motivation to Communicate.

To give further indication of the skill-related variability in the data, the sample was split into two groups based on skill in phonological recoding using a similar criteria as for the Kindergarten sample in Study 1, with the caveat that the decoding of pseudowords had to be tested at a lower level for the subjects with SCSPI. The criterion used in Study 2 was the percentage average score of the CVC-NC Word Task and the Recognition Decoding Pseudoword Task (Ehri & Robbins, 1992). All subjects obtaining a percentage average score of 50% or higher were classed as SCSPI Print Readers (N=16); all subjects obtaining a percentage average score of less than 50% were classed as SCSPI Bliss Readers (N=16).

Descriptive information (mean, standard deviation, median and interquartile range) was computed for the SC SPI Print Readers (N=16) and the SCSPI Bliss Readers (N=16) on (a) the battery of reading acquisition tests, (b) the battery of reading related tests and (c) variables related to communication competence. To examine the differences between the Bliss and SCSPI Print Reading Groups, three levels of
statistical analyses were applied, as the data allowed — parametric, nonparametric, and visual inspection of the descriptive data as presented in score distributions.

At the parametric level of analysis, unpaired t-tests for independent groups were conducted for the Print and Bliss Reader Groups for the reading acquisition and reading related measures where appropriate, to determine those tests for which the performance level differences were statistically significant. For measures in which a ceiling effect was discovered, a cell chart of group means was examined. Nonparametric analyses were conducted for measures which displayed a skewed distribution and thus violated the assumption of normality, or when the homogeneity of variance assumption was violated (assumptions on which the t-test relies). To evaluate homogeneity of variance, the Hartley's F-max test was conducted when groups were equal. In lieu of the Hartley's F-max test, when groups were not equal, results were judged eligible for a t-test whenever the variance of one group was not greater than four times the variance of the other (Gravetter & Wallnau, 1988, p. 260).

If there was no ceiling effect, and if a parametric analysis was judged to be inappropriate, two nonparametric techniques were computed — Mann Whitney U-test and Wald-Wolfowitz Runs test (Statview 4.0, 1992). The Mann-Whitney U-test is the nonparametric version of the two group unpaired t-test but considers the ranks of scores rather than the scores themselves. The Wald-Wolfowitz runs test counts the number of runs present in the ranked data. A run is a sequence of consecutive observations in the ranked data coming from one or the other of the groups.

Upon completion of one of the three types of analysis, a judgement was made as to the status of the variable, i.e., whether or not a difference between groups was supported by the analysis. Next, a decision was made as to whether or not, the test should be considered for inclusion in the Reading Profile for utilization within the Educational Application presented in Section IV.
Intermediate level of analysis.

The intermediate level of analysis addressed the performance of the reading subgroups within the SC SPI sample. As shown in Table 3-2-3, statistical analyses were conducted at the level of analysis that was appropriate — parametric, nonparametric and visual inspection of descriptive data — in order to examine differences in performance between pairs of subgroups within the SC SPI population. Those compared were the two subgroups within Bliss Readers, the Pre-Reader and Pre-Decoder Groups, and the two subgroups within Print Readers, the Primary Readers and the Independent Readers. Comparisons were made across all subgroups on (a) the reading related tasks of Test of Nonverbal Intelligence (TONI), Receptive Language (CELF-R), Expressive Language (CELF-R) and Syntactic Error Judgement Task, (b) the communication variables evaluated by the Spontaneous Communication Rating Scale (Jennische & Lorstrom, 1996) (See Appendix 3-2-C), and (c) speech capability (anarthria/dysarthria evaluation) and attempts to use speech.

In addition, comparisons were made between the SC SPI Pre-Decoder subgroup and the Kindergarten Low Reader group from Study 1, and between the SC SPI Primary Reader subgroup and the Kindergarten High Reader group, as each of these group pairs performed at comparable developmental levels, using phonological decoding as the defining criteria.

Comparisons were made, as well, by examining the means and standard deviations of the SC SPI subgroups with those of groups from studies conducted by Vandervelden (1992) and Gottardo (1995). For comparisons with the Vandervelden developmental results, the pattern of performance by SC SPI subjects in the Phonemic Word Spelling test on letter levels (initial consonant, medial vowel and final consonant) was studied. The means and standard deviations of the SC SPI subgroups on letter levels were compared to those of the Kindergarten, Grade 1 and Grade 2 students studied by Vandervelden and to the Kindergarten Groups of Study 1. The comparisons with the Gottardo study included the subtasks of the Working Memory Task — Working Memory-Recall and Working Memory-True/False — and the Syntactic Error Judgement Task. Individual subject data was not available for either the Vandervelden or the Gottardo studies so formal statistical comparisons could not be carried out.

Comparisons were made between the SC SPI Primary and Independent Reader subgroups for the two informal reading acquisition tasks (that could only be given to the Print Readers) — Spelling Word-Pair Task and Homophone Word-Pair Matching Task.
Molecular level of analysis.

The findings from the Intermediate level of analysis were applied to the development of Profiles for the Acquisition of Reading (PARs) for each of the four subgroups. Using these PARs, a Reading Profile could be developed for each subject. The Reading Profiles presented the performance of individual subjects on each test in the PAR battery, and compared them with the average performance of the subgroup in which their decoding skills placed them. In addition, the average performance of the subgroup at the next level of reading acquisition and/or the average performance of the Independent Reader group was shown.

Ecological analyses.

While all four interactional systems conceived by Bronfenbrenner (1979) are of interest in understanding the determinants of reading acquisition performance of adults with SC SPI, it was the microsystem — "pattern of activities, roles and interpersonal relations experienced by the developing person in a given setting with particular physical and material characteristics" (p. 22) — that were given primary attention in this study. Factors relating to all the ecological system levels that were speculated as influencing development were considered as the results were being analysed, discussed and applied in the Educational Application, Writing and Reading with the Internet and Bliss (WRIB). Probes pertaining to ecological variables that were speculated by the thesis author as being related to literacy acquisition, were undertaken. These included (a) educational and parental support to literacy through subject and thesis author ratings and through documenting place of residence during formative years (birth to age 8); (b) environmental support regarding provision of assistive technology; (c) environmental attitudes toward reading as indicated by subjects' reading frequency and rating of enjoyment derived from books; (d) degree of dependency upon others for physical and visual access to literacy-related materials within the environment and (e) self ratings of skill levels in independent reading, creative writing and spelling within communication, as indicators reflecting attitudes toward subjects' competencies by significant others in the immediate environment.

The analyses involved the relationship between two sets of categorical variables — the SC SPI Reading subgroups and the variables of ecological interest measured on a nominal scale. A chi-square contingency test, as used by Jennische & Lorstrom (1996) in analysing spontaneous communication ratings of 72 Blissymbol users would have
been the analysis procedure of preference. Given the small number of subjects in each subgroup, however, the requirement that the expected frequency for each category be not less than 5 for $df \geq 2$ (Shavelson, 1988, p. 440) could not be met. As a result, histograms are presented.

To determine the composite ecological support for each subject and to enable Reading Group comparisons to be made, the number of positive ratings were totalled and percentages computed to produce an Ecological Composite Index (ECI) for each subject. For variables that were measured by a five-point rating scale, scores of 3 or above were considered positive and less than 3 were considered negative. Variables from the ECI that would be relevant in educational planning were selected for inclusion in an Ecological Checklist.

Further analyses were taken using the ECI to examine differences between anarthric and dysarthric subjects and inspect the distribution of anarthric and dysarthric subjects within each reading subgroup.

Lastly, a comparison was undertaken between those subjects who were born in the fifties and those who were born after that decade, in the sixties and seventies. A scattergram was produced and the mean, standard deviation, standard error, and range of scores was calculated. This comparison was used to consider the possible ecological influence of changing societal conditions during the years in which the subjects were growing up.
Results

Molar Level of Analysis

Adults with SCSPi — Full group (N = 32).

Table 3-2-4 and Figure 3-2-2 display the means, standard deviations, medians and interquartile ranges for the full adult SCSPi group's performance (N = 32) on the battery of reading acquisition tests. No ceiling effects (defined in this thesis as scores having a mean of 100%) were noted, but distributions were negatively skewed (median of 100%) for Vowel Name Recognition, Consonant Name Recognition, Consonant Sound Recognition, Picture Identification and Visual Matching. For the full group performance on phonological processing measures, Phonemic Word Spelling scores were the highest, followed by scores on Primary Word Reading, then the two decoding tests (CVC-NC Word Task and Recognition Decoding Pseudoword Task). Performance on all the phonological processing measures ranged between 60% and 69%. 
### Table 3-2-4

**Descriptive Information — Full SCSPJ Group Performance on Battery of Reading Acquisition Tasks**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Descriptive measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Vowel Name Recognition Task (N=32)]</td>
<td>Mean (SD) Median (IQR)</td>
</tr>
<tr>
<td>Consonant Name Recognition Task (N=32)</td>
<td>95.63 (12.17) 100.00 (0.00)</td>
</tr>
<tr>
<td>Consonant Sound Task Recognition (N=32)</td>
<td>93.75 (17.09) 100.00 (0.00)</td>
</tr>
<tr>
<td>CVC-NC Word Task (N=27)</td>
<td>85.47 (29.58) 100.00 (0.00)</td>
</tr>
<tr>
<td>Recognition Decoding Pseudoword Task (N=27)</td>
<td>60.56 (28.16) 65.00 (41.25)</td>
</tr>
<tr>
<td>Primary Word Reading Task (N=32)</td>
<td>60.00 (35.95) 60.00 (80.00)</td>
</tr>
<tr>
<td>Phonemic Word Spelling Task (N=27)</td>
<td>66.69 (41.53) 93.00 (82.00)</td>
</tr>
<tr>
<td>Picture Identification Task (N=31)</td>
<td>69.48 (28.27) 76.00 (43.00)</td>
</tr>
<tr>
<td>Visual Matching Task (N=31)</td>
<td>93.07 (11.85) 100.00 (8.00)</td>
</tr>
<tr>
<td>Visual Analysis Retrieval Task (N=31)</td>
<td>89.03 (19.21) 100.00 (20.00)</td>
</tr>
</tbody>
</table>

**Note:**
All means are presented in percentages.
SD = standard deviation; IQR = interquartile range.
Five of the subjects with SCSPI could not be given the CVC-NC test or the other phonological processing tests due to their limited phonological processing skills. Thus no attempt was made to analyse the data from Study 2 to determine the relationship of the new CVC-NC test, developed by McNaughton, with other phonological processing tests.
Table 3-2-5 displays the descriptive measures of mean, standard deviation, median and interquartile range for the full adult SCSPI group's performance (N = 32) on the battery of reading related tests. The Receptive Language and Expressive Language results are presented as standard scores on the CELF-R Receptive and Expressive Language scale, with a mean of 100 and a standard deviation of 15. In Receptive Language, only one subject scored above the mean for the normal population, age 16 years; in Expressive Language, three subjects scored above the mean for the normal population, age 16 years. Furthermore, it should be noted that in both language measures, the scores of 75% of the SCSPI subjects fell more than 2 S.D. below from the mean for the able-bodied population of 16-year-olds.

Table 3-2-5

Descriptive Information — Full SCSPI Group
Performance on Reading Related Tasks

<table>
<thead>
<tr>
<th>Variable</th>
<th>Descriptive measures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Receptive Language (CELF-R) (N = 32) (standard score)</td>
<td>62.84 (16.39)</td>
</tr>
<tr>
<td>Expressive Language (CELF-R) (N = 32) (standard score)</td>
<td>66.53 (19.36)</td>
</tr>
<tr>
<td>Nonverbal Intelligence (TONI) (N = 31) (quotient score)</td>
<td>75.97 (14.42)</td>
</tr>
<tr>
<td>Working Memory (N = 29)</td>
<td>45.53 (21.14)</td>
</tr>
<tr>
<td>Syntactic Error Judgement (N = 32)</td>
<td>69.75 (15.83)</td>
</tr>
</tbody>
</table>

Note: Means for Working Memory and Syntactic Error Judgement scores presented in percentages.
Histograms shown in Figures 3-2-3-A & B display the positively skewed distributions for the two language measures, with Expressive Language standard scores distributed at a higher level than the Receptive Language standard scores. The TONI scores are presented as deviation quotients, a type of standard score, with the deviation quotients distribution having a mean of 100 and standard deviation of 15. Figure 3-2-3-C displays the bimodal distribution for the TONI scores, with only two subjects scoring at the mean or higher of the nondisabled population for their age group. The Working Memory and Syntactic Error Judgement percentage scores present a more normal-like spread, as displayed in Figures 3-2-3-D and 3-2-3-E. The results of the Working Memory and Syntactic Error Judgement tests were examined further by means of sub-group comparisons. These results are reported in the Intermediate Analysis Section.

Subtests of two of the reading related tasks were used as measures of world knowledge — the Word Classes subtest of the CELF-R and the True/False subtest of the Working Memory Task (Gottardo, 1995). The mean score for the full SC SPI group on the Word Classes subtest of the CELF-R was 13.438 (S.D. = 8.692). This represents a standard score of 3 (age 16 years, 0 months to 16 years, 11 months). Using the norms for persons with no speech impairment (M = 10; S.D. = 3), the adults with SC SPI scored more than 2 S.D. below the mean of the able-bodied population. The results for the True/False subtest of the Working Memory Task (Gottardo, 1995) as they relate to world knowledge are reported in the section entitled Comparisons between SC SPI Reading subgroups and Gottardo (1995) Reading groups.
Histograms for Reading Related Tasks, Full SCSPS Group

Figure 3-2-3-A

Receptive Language — Standard scores

Figure 3-2-3-B

Expressive Language — Standard scores

Figure 3-2-3-C

TONI - Quotients (standard scores)

Figure 3-2-3-D

Total Working Memory Task - Percentage scores

Figure 3-2-3-E

Syntactic Error Judgement Task - Percentage Scores
Comparisons between Bliss Readers and Print Readers.

As noted in the Methodology section, the total SCSPI sample was broken into two groups — Bliss Readers and Print Readers — based on their performance on the phonological recoding tasks. (See Table 3-2-2.) The three levels of statistical analysis for the reading acquisition and reading related test data of the Bliss and Print Reader Groups are summarized in Tables 3-2-6, 3-2-7 and 3-2-8 and displayed in Figures 3-2-4, 3-2-5, 3-2-6-A and 3-2-6-B. Because a series of t tests was undertaken, and because nonparametric techniques were being used for some variables, the alpha level was kept to .01 to reduce the familywise error rate and to minimize the probability of a Type One Error (Keppel, 1991). A difference between the means of the Bliss Reader group and the Print Reader group was found to be statistically significant (p<.01) for the following measures: CVC-NC Word Task, Recognition Decoding Pseudoword Task (Ehri & Robbins, 1992), Phonemic Word Spelling Task (Vandervelden, 1992), Visual Analysis Retrieval Task, Primary Word Reading Task (Ehri & Wilce, 1985; Vandervelden, 1992), TONI, Syntactic Error Judgement Task (Gottardo, 1995) and Receptive Language (CELF-R). In all cases, the Print Readers scored higher. The largest differences were in the phonological processing tasks. Since five subjects did not undertake the phonological processing tests because the tasks were too difficult to attempt, the difference between groups in these tests must be recognized as larger than the analyses indicate.

A statistically significant difference between the performance of SCSPI Bliss Readers and SCSPI Print Readers, in favour of the Print Readers, was found in the Word Classes subtest of the CELF-R. As explained earlier, this measure was considered as a diagnostic indicator for world knowledge. Heterogeneity of variance precluded a comparison between the Bliss Reader and Print Reader SCSPI groups on the True/False subtest of the Working Memory Task (Gottardo, 1995), the second measure of world knowledge.
Table 3-2-6

Differences Between SC SPI Print Readers (N=16) (upper values) and SC SPI Bliss Readers (N=16) (lower values) on Reading Acquisition Tasks

<table>
<thead>
<tr>
<th>Variable</th>
<th>Descriptive measures</th>
<th>Parametric measures</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Median (IQR)</td>
<td>F-max F-max critical t test status</td>
</tr>
<tr>
<td>Vowel Name Recognition (N=32)</td>
<td>100.00 (0.00)</td>
<td>100.00 (0.00)</td>
<td>ceiling effect inappropriate see group means, Figure 3-2-4</td>
</tr>
<tr>
<td>Consonant Name Recognition (N=32)</td>
<td>100.00 (0.00)</td>
<td>100.00 (0.00)</td>
<td>ceiling effect inappropriate see group means, Figure 3-2-4</td>
</tr>
<tr>
<td>Consonant Sound Recognition (N=32)</td>
<td>100.00 (0.00)</td>
<td>100.00 (0.00)</td>
<td>ceiling effect inappropriate see group means, Figure 3-2-4</td>
</tr>
<tr>
<td>CVC-NC Word Task* (N=27)</td>
<td>77.50 (16.73)</td>
<td>75.00 (25.00)</td>
<td>unequal groups Ng=11; Np=16 5.493 t(25) p &lt; .0001</td>
</tr>
<tr>
<td>Recognition Decoding Pseudoword* (N=27)</td>
<td>23.64 (21.57)</td>
<td>20.00 (30.00)</td>
<td>unequal groups Ng=11; Np=16 8.232 t(25) p &lt; .0001</td>
</tr>
<tr>
<td>Primary Word Reading (N=32)</td>
<td>97.94 (3.80)</td>
<td>100.00 (3.00)</td>
<td>scores skewed negatively inappropriate see nonparametric, Table 3-2-8</td>
</tr>
<tr>
<td>Phonemic Word Spelling (N=27)</td>
<td>86.67 (10.98)</td>
<td>90.00 (22.00)</td>
<td>unequal groups Ng=11; Np=16 6.529 t(26) p &lt; .0001</td>
</tr>
<tr>
<td>Picture Identification Task (N=31)</td>
<td>97.44 (5.01)</td>
<td>100.00 (4.00)</td>
<td>scores skewed negatively inappropriate see nonparametric, Table 3-2-8</td>
</tr>
<tr>
<td>Visual Matching Task (N=31)</td>
<td>92.50 (14.38)</td>
<td>100.00 (10.00)</td>
<td>scores skewed negatively inappropriate see nonparametric, Table 3-2-8</td>
</tr>
<tr>
<td>Visual Analysis Retrieval (N=31)</td>
<td>77.50 (14.38)</td>
<td>80.00 (20.00)</td>
<td>1.26 4.115 t(29) p &lt; .0003</td>
</tr>
</tbody>
</table>

Note.
All means are presented in percentages.

The factors affecting the decision re use of t-test are given in F-max column. Unequal sample sizes are noted.

* The percentage average score of the CVC-NC Word Task and the Recognition Decoding Pseudoword Task served as the criterion variables for the Bliss Reader and Print Reader SC SPI Groups.
Table 3-2-7

Differences Between SC SPI Print Readers (N=16) (upper values) and SC SPI Bliss Readers (N=16) (lower values) on Reading Related Tasks

<table>
<thead>
<tr>
<th>Variable</th>
<th>Descriptive measures</th>
<th>F-max</th>
<th>Parametric measures</th>
<th>status</th>
<th>note</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD) Median (IQR)</td>
<td></td>
<td>t test</td>
<td>status</td>
<td></td>
</tr>
<tr>
<td>Receptive Language (CELF-R) (N = 32)</td>
<td>73.94 (16.43) 75.50 (22.00)</td>
<td>11.80</td>
<td>inappropriate</td>
<td>see nonparametric, Table 3-2-8</td>
<td></td>
</tr>
<tr>
<td>(standard score)</td>
<td>51.75 (4.78) 50.00 (0.00)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expressive Language (CELF-R) (N = 32)</td>
<td>78.31 (20.42) 71.00 (14.00)</td>
<td>6.77</td>
<td>inappropriate</td>
<td>see nonparametric, Table 3-2-8</td>
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</tr>
<tr>
<td>(standard score)</td>
<td>54.75 (7.84) 50.00 (11.00)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test of Nonverbal Intelligence (TONI)</td>
<td>84.69 (13.00) 87.00 (13.50)</td>
<td>1.51</td>
<td>3.796 t (29) p &lt; .0007</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(quotient score) (N = 31)</td>
<td>68.48 (10.57) 63.00 (16.50)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working Memory (N = 29)</td>
<td>56.63 (19.15) 49.00 (23.50)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Syntactic Error Judgement (N = 32)</td>
<td>79.81 (11.07) 81.50 (18.00)</td>
<td>1.46</td>
<td>4.633 t (30) p &lt; .0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>59.69 (13.39) 58.50 (22.50)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note.
Means for Working Memory and Syntactic Error Judgement scores presented in percentages.

The factors affecting the decision re use of t-test are given in F-max column, along with the calculated F-max for samples, when appropriate. Unequal sample sizes are noted.
Table 3-2-8

Nonparametric Analyses for Variables from Tables 3-2-6 and 3-2-7
Differences Between SCSPI Print Readers (N=16)
and SCSPI Bliss Readers (N=16)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mann Whitney U-test</th>
<th>Wald-Wolfowitz Runs Test</th>
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</thead>
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<tr>
<td></td>
<td>U value</td>
<td>Z value</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>p</td>
<td></td>
</tr>
<tr>
<td>Primary Word Reading (N=32)</td>
<td>15.00</td>
<td>3.06</td>
<td>difference</td>
</tr>
<tr>
<td></td>
<td># ties = 6</td>
<td>p = &lt;.0001</td>
<td>supported</td>
</tr>
<tr>
<td>Picture Identification (N=31)</td>
<td>66.00</td>
<td>2.189</td>
<td>difference</td>
</tr>
<tr>
<td></td>
<td># ties = 3</td>
<td>unacceptable level</td>
<td>not supported</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(p = .03)</td>
<td></td>
</tr>
<tr>
<td>Visual Matching (N = 31)</td>
<td>101.00</td>
<td>-.006</td>
<td>difference</td>
</tr>
<tr>
<td></td>
<td># ties = 3</td>
<td>unacceptable level</td>
<td>not supported</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(p = .03)</td>
<td></td>
</tr>
<tr>
<td>Receptive Language (CELF-R)</td>
<td>23.00</td>
<td>6</td>
<td>difference</td>
</tr>
<tr>
<td>(N=32) (standard score)</td>
<td># ties = 6</td>
<td>p = &lt;.0001</td>
<td>supported</td>
</tr>
<tr>
<td>Expressive Language (CELF-R)</td>
<td>23.50</td>
<td>10</td>
<td>see group means</td>
</tr>
<tr>
<td>(N=32) (standard score)</td>
<td># ties = 6</td>
<td>p = &lt;.0001</td>
<td>Figure 3-2-5</td>
</tr>
<tr>
<td>Working Memory (N=29)</td>
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<td>12</td>
<td>see group means</td>
</tr>
<tr>
<td></td>
<td># ties = 7</td>
<td>p = &lt;.0057</td>
<td>Figure 3-2-5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>unacceptable level</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(p = .02)</td>
<td></td>
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</tbody>
</table>

Note.
The Mann-Whitney U-test is the nonparametric version of the two group unpaired t-test but considers the ranks of scores rather than the scores themselves. The Wald-Wolfowitz runs test counts the number of runs present in the ranked data. A run is a sequence of consecutive observations in the ranked data coming from one or the other of the groups. The alpha level was kept to .01 for both analyses to reduce the probability of a Type One Error (Keppel, 1991).
All scores are percentages.

Figure 3-2-4

Differences between SCSP1 Print Readers (N=16)
and SCSP1 Bliss Readers (N=16)
Figure 3-2-5

Differences Between SCSPI Print Readers (N=16) and SCSPI Bliss Readers (N=16) on Reading Related Tasks

Note:
Scores for Receptive Language (CELF-R), Expressive Language (CELF-R) and TONI are standard scores (M=100; S.D.=15).
Scores for Working Memory Task and Syntactic Error Task are percentage scores.
Statistically significant differences were not found for the Consonant Sound Recognition, Expressive Language and Working Memory Tasks. Because these factors are potentially very important, however, it was decided to suspend judgement and for educational purposes to include the measures provisionally within the test assessment battery. (See Figures 3-2-6-A, 3-2-6-B and 3-2-6-C.) Table 3-2-9 provides a summary evaluation of all reading acquisition and reading related measures as to their relevance for inclusion in the Profile for the Acquisition of Reading (PAR). Eight measures were evaluated as appropriate for inclusion supplemented by the three measures included provisionally.

Figure 3-2-6-A

Scattergram
Consonant Sound Recognition Task

[Graph showing data points for Bliss reader and Print reader]
Figure 3-2-6-B
Scattergram
Expressive Language (CELF-R)

Figure 3-2-6-C
Scattergram
Working Memory Task

Note: Scores for Expressive Language (CELF-R) are standard scores (M=100; S.D.=15); scores for Working Memory Task are percentage scores.
### Table 3-2-9

**Summary Evaluation of Measures for Inclusion in PAR**

**Bliss Reading Group and Print Reading Group**

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<thead>
<tr>
<th>Difference between Means Supported</th>
<th>Difference between Means Not Supported</th>
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<td>Variable</td>
<td>analysis type</td>
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<td>CVC-NC Word Task</td>
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<tr>
<td>Recognition Decoding Pseudoword Task</td>
<td>P</td>
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<td>Visual Analysis Retrieval Task</td>
<td>P</td>
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<td>Test of Nonverbal Intelligence (TONI)</td>
<td>P</td>
</tr>
<tr>
<td>Syntactic Error Judgement Task</td>
<td>P</td>
</tr>
<tr>
<td>Primary Word Reading Task</td>
<td>NP</td>
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<tr>
<td>Phonemic Word Spelling Task</td>
<td>P</td>
</tr>
<tr>
<td>Receptive Language Measure (CELF-R)</td>
<td>NP</td>
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**Note:**

- **P** = Parametric technique
- **NP** = Nonparametric technique
- Visual inspection = Examination of data pattern of group means
- *Nonparametric analysis did not support inclusion.

'include provisionally' — Given pattern of results, decision was made to suspend judgement and provisionally include in Profile for the Acquisition of Reading (PAR), pending further research

'include' — Include in Profile for the Acquisition of Reading (PAR).

'exclude' — Not appropriate for inclusion in Profile for the Acquisition of Reading (PAR).
Since Communication Competence was measured by categorical variables, a chi-square test would be the appropriate statistical test to compare the Bliss and Print SCSPI Reader Groups. Because of the small sample size, however, the requirement of an expected frequency for each category of not less than 5 for df ≥ 2 could not be met. Visual inspection of the relevant bar graph suggests that the Print Reader group was rated slightly higher than the Bliss Reader group for Ability to Inform, Sentence and Grammar Ability and Functional Interaction. There appeared to be no difference between the groups for Motivation to Communicate. See Figure 3-2-7.

**Figure 3-2-7**

Communication Competence Measures
Comparison of Bliss and Print SCSPI Readers
Intermediate Level of Analysis

Comparing SC SPI Pre-Reader and Pre-Decoder subgroups.

As shown in Table 3-2-2, the SC SPI Bliss Reader group was further subdivided into a Pre-Reader subgroup and a Pre-Decoder subgroup according to beginning reading performance criteria. The creation of subgroups among the Bliss Readers was required because of the wide range of skill in letter-sound matching and phonological recoding exhibited by these subjects. Figure 3-2-8 shows performance separately for these two subgroups on a set of reading acquisition and reading related tasks. The tasks included are those identified through the Molar level of analysis for inclusion within the Profile for the Acquisition of Reading (PAR). The overall pattern of performance of the two Bliss Reader subgroups demonstrated differences in favour of the Pre-Decoding subgroup. For the Consonant Sound Recognition Task, the criterion measure used to split the Bliss Readers into two groups, a ceiling effect for the Pre-Decoding subgroup prevented either a parametric or a nonparametric analysis being conducted. Similarly for the Vowel Name Recognition Task and the Consonant Name Recognition Task, neither parametric nor nonparametric statistical analyses could be undertaken. The scattergrams for the letter name and sound recognition tasks however, showed a different performance pattern between the two Bliss Reader subgroups. (See Figures 3-2-9-A, 3-2-9-B, 3-2-9-C.) The results from the Visual Matching Task afforded a nonparametric analysis, however, no statistically significant difference was found (Mann-Whitney U-Test).

Five of the seven Pre-Readers were unable to do the phonological processing tasks of CVC-NC Word Task and Phonemic Word Spelling Task and six of the seven Pre-Readers were unable to do the Recognition Decoding Pseudowords Task. The results for these tests, therefore, were not included in the comparisons. Unpaired t-tests were computed for the remaining tests which could be undertaken by all subjects. There was only one variable from the unpaired t-test analyses — the Syntactic Error Judgement Task (Gottardo, 1995) — for which the difference in means between the two subgroups was statistically significant (p<.05). It favoured the Pre-Decoder subgroup.

A visual inspection of scatterplots for the two Bliss Reader subgroups shows large variability as well as lower scores associated with the performance of subjects in the Pre-Reading subgroup for the TONI and Working Memory Task (Gottardo, 1995). (See Figures 3-2-9-E and 3-2-9-F.) Interestingly, the only task in which the two groups
displayed a similar distribution of scores was the Primary Word Reading Task. (See Figure 3-2-9-D.)

**Figure 3-2-8**

**Differences Between Pre-Reader (N=7) and Pre-Decoder (N=9) Subgroups on Tasks Selected for Educational Application**

![Cell Line Chart](chart.png)

Note:
Above scores are percentages except for Receptive Language (CELF-R), Expressive Language (CELF-R) and TONI which are standard scores (M=100; S.D.=15).

CVC-NC Word Task, Phonemic Word Spelling Task and Recognition Decoding Pseudowords Task have been omitted because most of Pre-Readers were unable to do these tasks.
Figure 3-2-9-A

Scattergram
Consonant Sound Recognition Task
Bliss Reader Subgroups

Figure 3-2-9-B

Scattergram
Consonant Name Recognition Task
Bliss Reader Subgroups
Figure 3-2-9-C
Scattergram
Vowel Name Recognition Task
Bliss Reader Subgroups

Figure 3-2-9-D
Scattergram
Primary Word Reading Task
Bliss Reader Subgroups
Figure 3-2-9-E

Scattergram
Test of Nonverbal Intelligence (TONI)
Bliss Reader Subgroups

Figure 3-2-9-F

Scattergram
Working Memory Task
Bliss Reader Subgroups
In summary, the findings from several levels of analysis, indicated differences between the two Bliss Reader subgroups in the reading acquisition tasks of Vowel Name Recognition, Consonant Name Recognition, Consonant Sound Recognition, CVC-NC Word, Recognition Decoding Pseudoword, Phonemic Word Spelling Tasks and no differences in the Primary Word Reading, Visual Matching, Visual Analysis Retrieval and Picture Identification Tasks. In the reading related tasks, differences between the two Bliss Reader subgroups were observed for the Syntactic Error Judgement, TONI and Working Memory Tasks and no differences were shown in the Receptive and Expressive Language Tasks (CELF-R).

Analyses using unpaired t-tests for the sub-tests of the Clinical Evaluation of Language Fundamentals-Revised (CELF-R) that met the assumptions for a parametric analysis — Oral Directions, Word Classes, Formulated Sentences, Listening to Paragraphs — failed to show any statistically significant differences in performance scores on the language tests between the two Bliss Reader subgroups. For the subtest, Word Structure, it was noted that 3 subjects from the Pre-Reader subgroup were unable to do the test and that the scores overall were lower for the Pre-Reader subgroup than for the Pre-Decoder subgroup in both of the CELF-R Expressive Language subtests — Word Structure and Formulated Sentences. For the Receptive Language CELF-R subtests — Oral Direction, Word Classes and Listening to Paragraphs — the score distributions were similar for both the Bliss Reader subgroups.

Performance by both subgroups on the Receptive Language and Expressive Language measures was well below that of the nondisabled population. Using the norms for 16 year-olds (mean = 100 and standard deviation = 15), the mean Expressive Language standard scores for Pre-Readers was 53.43 (S.D. = 9.07; median = 50) and for Pre-Decoders was 55.78 (S.D. = 7.14; median = 50). The mean Receptive Language standard scores for Pre-Readers was 52.00 (S.D. = 5.29; median = 50) and for Pre-Decoders was 51.56 (S.D. = 4.67; median = 50). The two language performance means for both adult SCSPi Bliss Reader subgroups were thus lower than 98% of the non-disabled 16-year-old population when measured on a test standardized on the normal population. The relevance of these findings will be addressed in the Discussion section.
Comparing SCSPRI Primary Reader and Independent Reader subgroups.

The Print Reader group was also divided into two subgroups — Primary Readers and Independent Readers. Grade scores from the PIAT were used as shown in Table 3-2-2. The creation of subgroups among the Print Readers was required because of the wide range in reading comprehension skills within those subjects who demonstrated phonological recoding capabilities. Figure 3-2-10 shows the subgroup means for these two groups for a set of the reading acquisition and reading related tasks. The tasks included are those identified through the Molar level of analysis for inclusion within the Profile for the Acquisition of Reading (PAR). Due to a ceiling effect in the performance of both the Primary and Independent Reader subgroups in the letter name and sound tasks, the results from these tasks were omitted from Figure 3-2-10. For the remaining tasks, unpaired t-tests were used for all but the Expressive Language measure. This measure was excluded from the analyses due to heterogeneity of variance. No statistically significant differences were found from the analyses other than for TONI where a difference favouring the Independent Reader subgroup was found (t=2.392, p<.05).
Figure 3-2-10

Differences between Primary and Independent Reader Subgroups on Tasks Selected for Educational Application

Note: Above scores are percentage scores except for Receptive Language (CELF-R), Expressive Language (CELF-R) and TONI which are standard scores (M=100; S.D.=15).

For the Expressive Language measure from the Clinical Evaluation of Language Fundamentals-Revised (CELF-R), nonparametric analyses were conducted because variance heterogeneity precluded a parametric analysis. The Mann-Whitney U test found no statistical difference, but the Wald-Wolfowitz Runs test found a difference (p<.05) in favour of the Independent Reader group. The scattergram shown in Figure 3-2-11 shows the different distributions of the two subgroups for the Expressive Language measure. Three of the nine Independent Readers scored at the mean or higher using the norms for nondisabled 16 year-olds.
Performance by both Print Reader subgroups on the Receptive Language and Expressive Language measures were below that of the nondisabled population. Both these subgroups scored higher, however, than the subgroups of the Bliss Reader group. Related to this finding was the difference on the language measures between the Bliss Readers and the Print Readers reported in Table 3-2-8 and figure 3-2-5. Using the norms for 16-year-olds (mean = 100; standard deviation = 15), the mean Expressive Language standard score for Primary Readers was 69.43 (S.D. = 9.11; median = 71) and for Independent Readers was 85.22 (S.D. = 24.42; median = 80). The mean Receptive Language standard score for Primary Readers was 70.00 (S.D. = 14.71; median = 77) and for Independent Readers was 77.00 (S.D. = 17.86; median = 74). The means of the language measures for the Print Readers thus fell within 1 and 2 standard deviations from the mean of the nondisabled population. Analyses using unpaired t-tests for the sub-tests of the CELF-R that met the assumptions for a parametric analysis — Oral Directions, Word Classes, Formulated Sentences, Listening to Paragraphs, Word Structure — failed to show any significant differences in performance scores on the language tests between the two Print Reader subgroups.

For the grade score on the Peabody Individual Achievement Test (PIAT), nonparametric analyses were conducted because heterogeneity of variance condition
precluded a parametric analysis. Both the Mann-Whitney U-test and the Wald-Wolfowitz Runs test supported a statistically significant difference in grade level means ($p<.001$) between the Primary Reader ($M=2.53; S.D.=.36$) and the Independent Reader ($M=4.81; S.D.=1.83$) subgroups.

Results for the two informal tasks that were given to all Print Readers — (a) Spelling Word-Pair Task, requiring selection of correctly spelled word from word pairs (e.g., sheep/sheep); (b) Homophone Word-Pair Matching Task, requiring selection of a homophone of a word from nonconventionally spelled word and nonword pairs (e.g., saip/saif) — are shown in Figure 3-2-12-A. A t-test for nonpaired groups showed a statistically significant difference in means of percent of items correct between Primary Readers ($N=6; M=80.67; S.D.=14.65$) and Independent Readers ($N=9; M=96.33; S.D.=7.97$) for the Spelling Word-Pair Task ($p<.05$), favouring the Independent Readers. There was no statistically significant difference between the Primary Readers ($N=6; M=54.71; S.D.=13.54$) and Independent Readers ($N=9; M=64.22; S.D. 24.38$) for the Homophone Word-Pair Matching Task. The performance for both subgroups on the Homophone Word-Pair Matching Task demonstrated very limited ability to do this task. Since responses were given to paired items on both tests, 50% correct could have been achieved by chance.
An interesting difference between the Independent and Primary Reader subgroups occurred in comparing the results on the Homophone Word-Pair Matching Task and the PIAT grade level scores. A strong relationship was shown between these two measures for the Independent Reader subgroup. A Spearman rank correlation coefficient was computed and produced a rho of .85 (p=.02). This relationship, however, did not hold for the group of Print Readers as a whole. When Primary Readers were included in the analysis and Print Readers were analysed independently, no relationship was found for the Homophone Word-Pair Matching Task scores and the PIAT grade levels, or for the Spelling Pair Task scores and the PIAT grade levels.

The distribution of scores on the Homophone Word-Pair Matching Task for Independent Readers (range 28-100; mean 64.22; S.D. 24.38; median 61) indicated that this test could be a useful measure of phonological decoding ability for individuals who tend to score in the upper range of the other phonological tasks — the CVC-NC Word Task, Phonemic Word Spelling Task and Recognition Decoding Pseudoword
Task. These three tasks are more suitable for testing phonological recoding for the Pre-
Decoder and Primary subgroups. No analysis was undertaken for the relationship with
PIAT grade level for performance on the Spelling Pair Task as seven of the nine
Independent Readers scored at ceiling level for this test.

A t-test for nonpaired groups showed a statistically significant difference
between anarhric and dysarthric subjects in performance on the Homophony
Judgement Task in the Primary Reading group ($t=3.276$, $p=.02$). A scattergram of the
anarhric and dysarthric subjects in the Independent Reader subgroup showed slightly
lower scores by the anarhric subjects on the Homophone Word-Pair Matching Task.
Within the Independent Reader subgroup, however, a range of ability was found for
both anarhric and dysarthric subjects. See Figure 3-2-12-B.

**Figure 3-2-12-B**

Homophone Word-Pair Matching Task,
Independent Reader Subgroup,
Dysarthric and Anarhric Subjects

Univariate Scattergram
Comparing four subgroups on reading related tasks.

Figure 3-2-13 shows the means of the four SCSPI subgroups — Pre-Reader, Pre-Decoder, Primary Reader and Independent Reader — on the Test of Nonverbal Intelligence (TONI), Receptive Language (CELF-R), Expressive Language (CELF-R) and Syntactic Error Judgement (Gottardo, 1995). Though there certainly seem to be differences, particularly at the extremes, the small group sizes prohibited a statistical analysis to determine the significance of any differences between the groups. The pattern of results was consistently towards higher scores being associated with increased reading skill for all these measures.
Two subjects (one Pre-Reader and one Pre-Decoder) were not tested on the Working Memory Task (Gottard, 1995) due to time constraints. The performance of the subgroups for this task was examined by means of a scatterplot (Figure 3-2-14). Two distributions are evident — one for the Bliss Readers and one for the Print Readers. The pattern was similar to that found in the other reading related tasks, with the Pre-Readers (N=6; mean=34.75; S.D.=12.18; median=36.00) having the lowest Working Memory percentage correct scores, and scores generally increasing with each of the subgroups — Pre-Decoders (N=8; mean=41.67; S.D.=6.86; median=40.00),
Primary Readers (N=7; mean=52.43; S.D.=15.73; median=46.00) and Independent Readers (N=9; mean=59.89; S.D.=21.79; median=54.00).

**Figure 3-2-14**

*Scattergram, SCSPI Subgroups Working Memory Task*

Figure 3-2-15 shows the means for the four SCSPI subgroups for the 6-point spontaneous communication ratings (Jennische, 1996). Although the between-subgroup differences were small, overall higher rating levels for communication skills were associated with higher reading levels. The differences in rating levels for Motivation to Communicate were negligible for the four subgroups and there was no difference between the two Print Reader subgroups in Functional Interaction.
Figure 3-2-15

Cell Bar Chart
Communication Competence Variables

Note:
Variables were measured by Spontaneous Communication Rating Scale (Jennische & Lorstrom, 1996) (Appendix 3-2-C)

Comparisons relating to articulatory abilities and speech attempts.

Figure 3-2-16 presents histograms of the proportion of dysarthric and anarthric subjects in each of the four subgroups. Figure 3-2-17-A presents the proportion of subjects in each subgroup attempting speech. For the Print Reader subgroups, the split of subjects with anarthria and dysarthria was almost equal. For the Bliss Reader subgroups, a higher proportion of subjects had anarthria than dysarthria. For all subgroups except the Pre-Reader subgroup, there was an even proportion of subjects who tried to speak and those who did not. In the Pre-Reader subgroup, only one subject attempted to use speech as a component within his communication system. A comparison between the dysarthric and anarthric subjects as to Speech Attempts yielded, as would be predicted, 9 of the 11 dysarthric subjects trying to use speech often, and 18 of the 21 anarthric subjects never attempting to speak. (See Figure 3-2-17-B.)
No statistically significant differences were found between the anarthric and dysarthric subjects in performance on the CVC-NC Task, Decoding Pseudoword Task or the Phonemic Word Spelling Task (p = .01). Scattergrams were produced for the dysarthric (N=11) and anarthric subjects (N=21) for the Receptive Language (CELF-R) measure (Figure 3-2-17-C), Expressive Language (CELF-R) measure (Figure 3-2-17-D), Syntactic Error Judgement Task (Figure 3-2-17-E), the Working Memory Task (Figure 3-2-17-F) and the TORC Syntactic Similarities and General Vocabularies Subtests (Independent Readers, N=9) (Figure 3-2-17-G and H). No statistically significant differences were found between the two groups for any of these measures. The anarthria subjects performed at a slightly lower level on the Receptive and Expressive Language measures, the Working Memory Task and the TORC General Vocabulary subtest. No differences were observed, however, between the anarthric and dysarthric subjects on the syntax measures.

Figure 3-2-16
Histograms, Speech Capability

Bliss Readers

Pre-Reader Subgroup

Count

Dysarthria
Anarthria

Pre-Decoder Subgroup

Count

Dysarthria
Anarthria

Print Readers

Primary Reader Subgroup

Count

Dysarthria
Anarthria

Independent Reader Subgroup

Count

Dysarthria
Anarthria
Figure 3-2-17-A

Histograms, Reading Subgroups
Speech Attempts

Pre-Reading Subgroup  Bliss Readers  Pre-Decoding Subgroup

Count

tries to speak often  tries to speak often  tries to speak often
tries to speak a little  tries to speak a little  tries to speak a little
never attempts to speak  never attempts to speak  never attempts to speak

Print Readers

Primary Reader Subgroup  Independent Reader Subgroup

Count

tries to speak often  tries to speak often
tries to speak a little  tries to speak a little
never attempts to speak  never attempts to speak

Figure 3-2-17-B

Histograms, Dysarthric (N=11) and Anarthric Subjects (N=21)
Speech Attempts

Dysarthric subjects  Anarthric Subjects

Count

tries to speak often  tries to speak often
tries to speak a little  tries to speak a little
never attempts to speak  never attempts to speak
Figure 3-2-17-C

Scattergram, Dysarthric (N=11) and Anarthric Subjects (N=21)
Receptive Language

Univariate Scattergram

Figure 3-2-17-D

Scattergram, Dysarthric (N=11) and Anarthric Subjects (N=21)
Expressive Language

Univariate Scattergram

○ dysarthria
■ anarthria

Figure 3-2-17-E

Scattergram, Anarthric and Dysarthric Subjects (N=33)
Syntactic Error Judgement Task

Univariate Scattergram

Figure 3-2-17-F

Scattergram, Dysarthric (N=10) and Anarthric Subjects (N=30)
Working Memory Task

Univariate Scattergram

Figure 3-2-17-G

Scattergram, Independent Readers (N=9)
Anarthric and Dysarthric Subjects
TORC - Syntactic Similarities Subtest

Univariate Scattergram

Figure 3-2-17-H

Scattergram, Independent Readers (N=9)
Dysarthric (N=5) and Anarthric Subjects (N=4)
TORC General Vocabulary Subtest

Univariate Scattergram
Phonological coding in short term memory.

As introduced in Section II in the review of Foley's work (1989, 1993), sequences of similar-sounding letters are more difficult to retain in short term memory for the speaking population than sequences of dissimilar-sounding letters (Baddeley, 1986). This phenomenon is referred to as a phonological similarity effect. Figure 3-2-18 presents histograms of the four SCSPI subgroups, showing the small proportion of subjects whose performance shows this similarity effect, i.e., performance that resembles that of the speaking population. A similarity effect was observed for only one subject in the Pre-Reading subgroup, one subject in the Pre-Decoding subgroup, two subjects in the Primary Readers subgroup and two subjects in the Independent Readers subgroup. In all, only 22% of the subjects showed a similarity effect in the Phonological Recoding and Short Term Memory Task of this study. Because this finding differed from that of Foley (1989, 1993) and Bishop and Robson (1989a), further analyses were undertaken.

**Figure 3-2-18**

Histograms, Phonological Recoding and Short Term Memory

**Bliss Readers**

- Pre-Reader Subgroup
  - Count: 2.25, 1.5, 0.75, 0
  - N=1, N=2
  - similarity effect, no similarity effect

- Pre-Decoder Subgroup
  - Count: 9, 6, 3, 0
  - N=1, N=8
  - similarity effect, no similarity effect

**Print Readers**

- Primary Reader Subgroup
  - Count: 4.5, 3, 1.5, 0
  - N=2, N=4
  - similarity effect, no similarity effect

- Independent Reader Subgroup
  - Count: 8, 6, 3, 0
  - N=2, N=7
  - similarity effect, no similarity effect
The test results and ecological ratings were examined for the six subjects whose performance pattern on the Phonological Recoding and Short Term Memory Task did show a similarity effect. (The scores of all subjects for the Phonological Recoding and Short Term Memory Task are reported in the Molecular Analysis Results, Table 3-2-21). Except for one subject, their performance scores on the Decoding Pseudoword and Homophone Word-Pair Matching Tasks were above the mean of their subgroups. The one subject who scored lower than the mean of his subgroup on the Decoding Pseudoword Task had the lowest ecological rating of the six subjects. (See Table 3-2-10.)

Table 3-2-10
Scores for 6 subjects
Demonstrating Similarity Effect
in Phonological Recoding and Short Term Memory Task.

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<td>LM (D)</td>
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<td>90</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>44</td>
<td>74</td>
<td>71</td>
<td>67</td>
<td>95 (67)</td>
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<td>71 (82)</td>
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<td>100</td>
<td>100</td>
<td>92</td>
<td>94</td>
<td>108</td>
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<td>82 (92)</td>
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</tr>
</tbody>
</table>

Note: Receptive/Expressive Language & TONI are standard scores; all other scores are percentaged. (A/D)* = Anarthric or Dysarthric
The test results and ecological ratings were also examined for the four subjects in the Independent Reader subgroup whose performance pattern on the Phonological Recoding and Short Term Memory Task failed to show a similarity effect but displayed success with 4 letter sequences or higher, independent of the items similarity. (See Table 3-2-11.) The performance of these subjects was of interest since they had achieved above a grade 2.9 level of reading and had demonstrated short term memory abilities which appeared not to rely on phonological coding. Their task performance levels and ecological ratings were explored as to possible strategy use or past exposure to strategy use in other contexts. Other than their overall high performance on beginning reading skills (except for subject IB who had difficulty with both the Decoding Pseudoword Task and the Homophone Word-Pair Matching Task), the one measure in which they all scored in the average or above average range for the non-speech-impaired population was the Test of Nonverbal Intelligence (TONI), which relies heavily on visual perceptual and spatial skills. It was also noted that subjects IB, WX and IL had extensive experience with VOCAs that required either letter or Minsymbol encoding. This encoding experience could be interpreted as supportive of alternative strategy use in the Phonological Recoding and Short Term Memory Task. In fact, Subject WX described how he used his alpha-numeric display on his VOCA to associate a spatial location with each letter, remembering all the letter sequences by a spatial pattern. Subject TB showed high language, above average visual perceptual and spatial skills, a high ecological rating and was observed to be adept at strategy use in conversation.

Of the five Independent Readers not included in Table 3-2-11, two were included in Table 3-2-10 as showing a similarity effect. The three remaining Independent Readers demonstrated an inability to use either phonological coding in short term memory or compensatory strategies.

Table 3-2-11

<table>
<thead>
<tr>
<th>LD, (A/D)*</th>
<th>Phonemic Word Spelling</th>
<th>Primary Word Reading</th>
<th>Working Memory</th>
<th>Syntactic Error Judge</th>
<th>Receptive Language</th>
<th>Expressive Language</th>
<th>TONI Homophone Word-Pair</th>
<th>VOCA Ecological Rating (subgroup mean=92)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IB (A)</td>
<td>100</td>
<td>65</td>
<td>60</td>
<td>76</td>
<td>87</td>
<td>81</td>
<td>71</td>
<td>59</td>
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<tr>
<td>WX (A)</td>
<td>100</td>
<td>95</td>
<td>60</td>
<td>88</td>
<td>100</td>
<td>54</td>
<td>69</td>
<td>71</td>
</tr>
<tr>
<td>IL (A)</td>
<td>100</td>
<td>65</td>
<td>100</td>
<td>88</td>
<td>100</td>
<td>54</td>
<td>89</td>
<td>77</td>
</tr>
<tr>
<td>TB (D)</td>
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<td>100</td>
<td>88</td>
<td>100</td>
<td>88</td>
<td>97</td>
<td>96</td>
</tr>
</tbody>
</table>

Note:
Receptive/Expressive Language & TONI are standard scores; all other scores are percentages.
(A/D)* = Anarthric or Dysarthric
Results specific to the SCSPI Independent Reader subgroup on the TORC subtests.

The results of the SCSPI Independent Reader subgroup on the subtests of the Test of Reading Comprehension (TORC) are shown in Figures 3-2-19-A, 3-2-19-B, 3-2-19-C. The mean grade level for the General Vocabulary sub-test was a 5.5 (S.D. = 3.92; Median = 4.2), for Syntactic Similarities sub-test, 6.4 (S.D. = 6.4; median = 4.5) and for Paragraph Reading, 3.9 (S.D. = 1.7; median 4.0). The wide spread in scores is evident. The General Vocabulary scores ranged from grade 1.6 to 12. The range for Syntactic Similarities was grade 2.4 to 13 and for Paragraph Reading, grade 2.0 to grade 6.2.

Scattergrams, Subtests of Reading Comprehension (TORC) Independent Reader Subgroup

Note:
All results are given in grade levels
Comparing SC SPI Pre-Decoder subgroup and Kindergarten Low Reader group.

In order to compare groups at a similar initial reading level, comparisons were made between the SC SPI subgroup and Kindergarten group in which the subjects knew the letter-sound associations but were unable to perform the phonological recoding tasks (CVC-NC Word Task and Decoding Pseudoword Task) with an average percentage score of 50 or higher. Due to the large discrepancy in group sizes between the Kindergarten Low Reader group (N=66) and the SC SPI Pre-Decoder subgroup (N=9), comparisons of reading acquisition task results were undertaken by consideration of means, standard deviations and percentiles, and a visual inspection of scattergrams. (See Tables 3-2-12 and 3-2-13 and Figures 3-2-20, A to G.) No differences between the two groups were found for the Vowel Recognition, Consonant Name Recognition or Visual Matching Tasks. All three tasks demonstrated a ceiling effect for both groups. No differences that could not be explained by sampling error were found in the score distributions for the Consonant Sound Recognition Task (the criterion used for splitting the Bliss readers into 2 subgroups), the CVC-NC Word Task, the Phonemic Word Spelling Task and the Picture Identification Task (Figures 3-2-20-A, 3-2-20-B, 3-2-20-E and 3-2-20-F). Differences favouring the Pre-Decoder SC SPI subgroup were also found for Primary Word Task (Figure 3-2-20-C). The slight difference in favour of the SC SPI Pre-Decoder subgroup on the Decoding Pseudoword Task (Figure 3-2-20-D) can be explained by the two formats of the task that were needed. The recognition form of the task had to be given to the SC SPI subjects whereas the retrieval form of the task could be given to the Kindergarten subjects. As will be discussed later, the retrieval form of the task is a more developmentally advanced form of the task. Small differences favouring the Kindergarten Low Reader group were found for the Visual Analysis Retrieval Task (Figure 3-2-20-G). Overall, the differences were minimal between the Pre-Decoder SC SPI subgroup and the Kindergarten Low Reader group in performance on the reading acquisition tasks, with the difference between the means of the two groups often being less than the standard error of the mean of the smaller group. Two exceptions were the larger differences between the groups for Primary Word Reading and Visual Analysis Retrieval. In these instances, the scattergram representations of the distributions showed a higher than average performance of half the subjects in the SC SPI Pre-Decoder subgroup on the Primary Word Reading Task (Figure 3-2-20-C) and the lack of any Pre-Decoder scoring 100% in the Visual Analysis Retrieval Task (Figure 3-2-20-G).
Table 3-2-12

Means and Standard Deviations
Reading Acquisition Tasks
SCSPI Pre-Decoder Subgroup (N=9)
and Kindergarten Low Reader Group (N=66)

<table>
<thead>
<tr>
<th>Reading Acquisition Tasks</th>
<th>Pre-Decoders, SCSPI subgroup mean (SD)</th>
<th>Low Kindergarten group mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consonant Sound Recognition</td>
<td>97.22 (5.95)</td>
<td>95.45 (10.96)</td>
</tr>
<tr>
<td>Primary Word Reading</td>
<td>41.11 (39.38)</td>
<td>19.51 (14.41)</td>
</tr>
<tr>
<td>Phonemic Word Spelling</td>
<td>45.33 (25.61)</td>
<td>51.70 (28.18)</td>
</tr>
<tr>
<td>CVC-NC Word Task Recognition</td>
<td>37.22 (25.01)</td>
<td>33.64 (18.96)</td>
</tr>
<tr>
<td>Decoding Pseudoword Retrieval</td>
<td>22.22 (18.56)</td>
<td>•</td>
</tr>
<tr>
<td>Decoding Pseudoword Picture</td>
<td>9.078 (13.60)</td>
<td>97.63 (4.28)</td>
</tr>
<tr>
<td>Visual Analysis Retrieval</td>
<td>60.00 (15.12)</td>
<td>77.27 (17.50)</td>
</tr>
</tbody>
</table>

Figure 3-2-20-A

Scattergram, Consonant Sound Recognition
Pre-Decoder SCSPI Subgroup (N=9) and
Low Kindergarten Group (N=66)

Figure 3-2-20-B

Scattergram, CVC-NC Word Task
Pre-Decoder SCSPI Subgroup (N=9)
Low Kindergarten Group (N=66)
Recognition Decoding Pseudoword Task was given to SCSPI subjects.

Retrieval Decoding Pseudoword Task was given to Kindergarten subjects.
Table 3-2-13

Percentile Scores for Reading Acquisition Tasks
Pre-Decoder Bliss Reader SC SPI Subgroup
and
Low Kindergarten Group

<table>
<thead>
<tr>
<th>Percentiles</th>
<th>Consonant Sound</th>
<th>Primary Word</th>
<th>Phonemic Spelling</th>
<th>CVC-NC</th>
<th>Decoding Pseudowords</th>
<th>Picture Identification</th>
<th>Visual Analysis</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>SC SPI</td>
<td>Ktg</td>
<td>SC SPI</td>
<td>Ktg</td>
<td>SC SPI</td>
<td>Ktg</td>
<td>SC SPI</td>
</tr>
<tr>
<td>10</td>
<td>86.6</td>
<td>83.0</td>
<td>0.0</td>
<td>5.0</td>
<td>9.6</td>
<td>16.0</td>
<td>12.0</td>
</tr>
<tr>
<td>25</td>
<td>98.0</td>
<td>100.0</td>
<td>5.3</td>
<td>12.0</td>
<td>30.0</td>
<td>32.0</td>
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<tr>
<td>50</td>
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<td>100.0</td>
<td>30.0</td>
<td>17.0</td>
<td>44.0</td>
<td>50.0</td>
<td>25.0</td>
</tr>
<tr>
<td>75</td>
<td>100.0</td>
<td>100.0</td>
<td>76.5</td>
<td>23.0</td>
<td>61.0</td>
<td>76.0</td>
<td>57.5</td>
</tr>
<tr>
<td>90</td>
<td>100.0</td>
<td>100.0</td>
<td>94.8</td>
<td>35.0</td>
<td>80.8</td>
<td>87.6</td>
<td>71.0</td>
</tr>
</tbody>
</table>
Comparing SCSPI Primary Reader subgroup and Kindergarten High Reader group.

In order to make comparisons between groups at a similar print reading level, comparisons were made between the SCSPI subgroup and Kindergarten group in which the subjects were able to perform the phonological recoding tasks with an average percentage score of 50 or higher and were not reading beyond a grade 2.9 level. Due to the large discrepancy in group sizes between the Kindergarten High Reader group (N=41) and the SCSPI Primary Reader subgroup (N=7) and recognizing the difference in one of the criterion tasks used in establishing the groups (Recognition Decoding Pseudoword Task versus Retrieval Decoding Pseudoword Task), comparisons of reading acquisition task results were undertaken by consideration of means, standard deviations and percentiles, and a visual inspection of scattergrams. (See Tables 3-2-14 and 3-2-15 and Figures 3-2-21-A and 3-2-21-B). No differences were found for the Vowel Name Recognition, Consonant Name Recognition, Consonant Sound Recognition, Visual Matching, CVC-NC Word or Picture Identification Tasks. All of these tasks demonstrated a ceiling effect for both groups, the ceiling effect including every subject for the three letter name and sound tasks. Differences favouring the Primary SCSPI subgroup were found for the Primary Word Reading Task, notably in the medians (Table 3-2-15). By comparing the percentiles, the similarity of the shape of the distributions for all variables except the Primary Word Task is evident. As noted earlier, apparent differences in results on the Decoding Pseudoword Task between the two groups of nonprint readers (SCSPI Pre-Decoders and Kindergarten Low Readers) were attributed to the different testing formats being used. The differences between the means of the two groups for the Phonemic Word Spelling and Visual Analysis Retrieval Tasks were less than the standard error of the mean of the smaller group. Overall, the differences between the SCSPI Primary subgroup and the Kindergarten High Reader group, in performance on the reading acquisition tasks were inconsequential, except that all SCSPI scores on the Primary Word Reading task were 1 S.D. above the mean or higher. No SCSPI subjects scored above 92% on the Phonemic Word Spelling Task. This is compared to 11 Kindergarten subjects scoring 96% or higher on this task. (See Figures 3-2-21-A and 3-2-21-B.)
Table 3-2-14

Means and Standard Deviations
Reading Acquisition Tasks
SCSPI Primary Reader Subgroup (N=7)
and Kindergarten High Reader Group (N=41)

<table>
<thead>
<tr>
<th>Reading Acquisition Tasks</th>
<th>Primary SCSPI subgroup mean (SD)</th>
<th>High Kindergarten group mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consonant Sound Recognition</td>
<td>100.00 (0.00)</td>
<td>100.00 (0.00)</td>
</tr>
<tr>
<td>Primary Word Reading</td>
<td>97.14 (3.13)</td>
<td>57.90 (27.35)</td>
</tr>
<tr>
<td>Phonemic Word Spelling</td>
<td>84.00 (11.07)</td>
<td>87.12 (11.15)</td>
</tr>
<tr>
<td>CVC-NC Word Task</td>
<td>76.43 (14.64)</td>
<td>73.66 (15.08)</td>
</tr>
<tr>
<td>Recognition</td>
<td>85.71 (19.02)</td>
<td>*</td>
</tr>
<tr>
<td>Decoding Pseudoword Retrieval</td>
<td>*</td>
<td>74.15 (20.61)</td>
</tr>
<tr>
<td>Decoding Pseudoword Picture Identification</td>
<td>95.29 (6.60)</td>
<td>95.78 (7.01)</td>
</tr>
<tr>
<td>Visual Analysis Retrieval</td>
<td>80.00 (16.33)</td>
<td>84.88 (13.99)</td>
</tr>
</tbody>
</table>

Figure 3-2-21 Scattergrams
SCSPI Primary Readers and Kindergarten High Readers

Figure 3-2-21-A
Scattergram, Primary Word Reading
Primary Reader SCSPI Subgroup (N=7) and
High Kindergarten Group (N=41)

Figure 3-2-21-B
Scattergram, Phonemic Word Spelling Task
Primary Reader SCSPI Subgroup (N=7) and
High Kindergarten Group (N=41)
Table 3-2-15

Percentile Scores for Reading Acquisition Tasks
SCSPI Primary Reader Subgroup (N=7)  
and  
Kindergarten High Reader Group (N=41)

<table>
<thead>
<tr>
<th>percentiles</th>
<th>Consonant Sound SCSPI primary</th>
<th>Primary Word SCSPI primary</th>
<th>SCPI Ktgn high</th>
<th>SCPI Ktgn high</th>
<th>SCPI Ktgn high</th>
<th>SCPI Ktgn high</th>
<th>SCPI Ktgn high</th>
<th>SCPI Ktgn high</th>
<th>SCPI Ktgn high</th>
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<tbody>
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<td>10</td>
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<td>100.00</td>
<td>93.00</td>
<td>23.00</td>
<td>66.40</td>
<td>74.40</td>
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<td>60.00</td>
<td>60.00</td>
<td>40.00</td>
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<td>75.00</td>
<td>100.00</td>
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<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
<td>79.00</td>
<td>92.00</td>
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<td>100.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>
Summary of comparisons between two SC SPI subgroups and two Kindergarten groups.

From the analyses and comparisons that the data afforded, minimal differences were found between the SC SPI subgroup and the Kindergarten group most closely related with it in performance level — the most advanced SC SPI Bliss Readers (Pre-Decoders) with the Kindergarten Low Readers; the less advanced SC SPI Print Readers (Primary Readers) with the Kindergarten High Readers. To be noted were a group difference favouring the SC SPI subgroups in the Primary Word Reading Task and a difference favouring the Kindergarten Low Reader group over the SC SPI Pre-Decoder subgroup in the Visual Analysis Retrieval Task. Any other apparent differences could be explained by the sampling error that occurs with small samples or the difference in the test format.

Developmental Comparisons relating to the Phonological Recoding Tasks

In order to examine results for the phonological recoding tasks that could be considered from a developmental perspective, comparisons were made (a) between the SC SPI and Kindergarten subjects at similar reading levels as to performance on the three types of phonological recoding tasks, and (b) between the three SC SPI subgroups, and the Kindergarten Grade 1 and Grade 2 subjects from Vandervelden’s study (1992) as to letter position results on the Phonemic Word Spelling Task. As described earlier in reviewing Vandervelden and Siegel’s (1995) developmental hierarchy of phonological recoding skills, a partial to full developmental pattern of initial consonant, final consonant, then medial vowel processing within a general progression from recognition to spelling to decoding pseudowords, was evident in their results.

The means and standard deviations of the SC SPI Pre-Decoder and Primary subgroups and the Kindergarten Low and High groups for the phonological recoding task results that allow comparisons to be made as to developmental differences are shown in Table 3-2-16-A. The earlier development of a spelling phonological recoding task ability (the Phonemic Word Spelling Task) compared to a recognition phonological recoding ability demonstrated with new letter-sound conventions (the CVC-NC Task) was consistent across all groups. The results for the CVC-NC Task were positioned between the Phonemic Word Spelling Task and both versions of the Decoding Pseudoword Task for the SC SPI and Kindergarten nonreaders. The CVC-NC Task was shown to be easier to do, for nonreaders, than either form of the
Decoding Pseudoword Task. The CVC-NC Task thus provides an additional testing format to examine the early development of phonological recoding ability. It should be considered as having a developmentally limited relationship with reading level, as described within the section pertaining to the Interactive-Compensatory model. As such, its value is limited to persons at an early developmental stage in reading acquisition. Readers who had gained the ability to decode pseudowords found the CVC-NC Task to be equal in difficulty or more difficult than the Decoding Pseudoword Task in either the recognition or retrieval form.

Table 3-2-16-A

Means Table, Phonological Recoding
Developmental Comparisons between Nonreaders and Readers
SCSPI and Kindergarten Subjects

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<thead>
<tr>
<th>Task</th>
<th>Nonreaders</th>
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<th>Readers</th>
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<th></th>
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</thead>
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<td></td>
<td>SCSPI</td>
<td>Kindergarten</td>
<td>SCSPI</td>
<td>Kindergarten</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pre-Decoders</td>
<td>Low Readers</td>
<td>Primary Readers</td>
<td>High Readers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CVC-NC</td>
<td>37.22</td>
<td>33.64</td>
<td>76.43</td>
<td>73.66</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(25.01)</td>
<td>(18.96)</td>
<td>(14.64)</td>
<td>(15.08)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phonemic</td>
<td>45.33</td>
<td>51.70</td>
<td>84.00</td>
<td>87.12</td>
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<td></td>
</tr>
<tr>
<td>Word Spelling</td>
<td>(25.61)</td>
<td>(28.18)</td>
<td>(11.07)</td>
<td>(11.15)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recognition</td>
<td>22.22</td>
<td>*</td>
<td>85.71</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decoding</td>
<td>(18.56)</td>
<td></td>
<td>(19.02)</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pseudowords</td>
<td></td>
<td></td>
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<tr>
<td>Retrieval</td>
<td></td>
<td>6.97</td>
<td></td>
<td>74.15</td>
<td></td>
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</tr>
<tr>
<td>Decoding</td>
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</tr>
<tr>
<td>Pseudowords</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Standard deviation appears in brackets.

Test items from the Phonemic Word Spelling Task were analyzed as to position of correct letter-phoneme matching. Simple phonetic spellings and letter name spellings were counted as correct as interest was in the ability to produce phonetic...
spellings rather than in the correct spellings of words. (Test items appear in Appendices 3-1-B and 3-2-B.)

The means and standard deviations for letter positions in the Phonemic Word Spelling Task for each SCSP1 subgroup are shown in Table 3-2--16-B, along with the means and standard deviations obtained from Vandervelden (1992) and personal correspondence (Vandervelden, December, 1996), and the means and standard deviations from Kindergarten Groups tested in Study 1 of this thesis. The results of paired t-tests for differences in mean percent correct, between the SCSP1 subgroups in which all subjects were able to do the task (Pre-Decoder, Primary and Independent subgroups), were as follows: For the Pre-Decoder subgroup (Bliss Readers), the differences between the means reached significance, $p<.05$, between initial and final letter positions and between initial and medial vowel letter positions. For Primary (Print) Readers, the difference between means reached significance between initial and medial vowel letter positions only. For Independent (Print) Readers, no significant differences between letter positions were found. For all the groups the general pattern of the results for letter positions followed those of Vandervelden (1992).
### Table 3-2-16-B

**Means Table**  
**Letter Position Results**  
**Phonemic Word Spelling Task**  
SCSPI Reading Subgroups, Vandervelden (1992) Reading Groups and Study 1 Kindergarten Groups

<table>
<thead>
<tr>
<th>Reading Group</th>
<th>Total Score</th>
<th>Initial Letter</th>
<th>Final Letter</th>
<th>Medial Vowel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Decoder (Bliss) (N = 9)</td>
<td>45.33 (25.61)</td>
<td>70.00 (29.16)</td>
<td>32.22 (31.14)</td>
<td>22.22 (27.29)</td>
</tr>
<tr>
<td>Primary Reader (Print) (N = 7)</td>
<td>84.00 (11.08)</td>
<td>91.43 (9.00)</td>
<td>81.43 (16.76)</td>
<td>74.29 (19.02)</td>
</tr>
<tr>
<td>Independent Reader (Print) (N = 9)</td>
<td>84.44 (16.67)</td>
<td>97.78 (4.41)</td>
<td>86.67 (15.00)</td>
<td>82.22 (27.29)</td>
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<td>Kindergarten (Vandervelden, 1992) (N = 36)</td>
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<td>41.67 (40.83)</td>
<td>31.95 (39.56)</td>
<td>6.67 (17.24)</td>
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<td>Grade 1 (Vandervelden, 1992) (N = 36)</td>
<td>64.07 (26.59)</td>
<td>86.40</td>
<td>80.28</td>
<td>22.22</td>
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<td>Grade 2 (Vandervelden, 1992) (N = 36)</td>
<td>88.26 (13.95)</td>
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<td>96.94</td>
<td>53.33</td>
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<td>Full Kindergarten (Study 1) (N = 107)</td>
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<td>62.62 (40.45)</td>
<td>33.65 (30.91)</td>
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<td>High Readers (N = 41)</td>
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<td>91.22 (19.39)</td>
<td>59.51 (25.49)</td>
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<td>Low Readers (N = 66)</td>
<td>51.70 (28.18)</td>
<td>75.61 (29.67)</td>
<td>44.85 (40.01)</td>
<td>17.58 (21.77)</td>
</tr>
</tbody>
</table>

**Note:**  
*M* = mean of reading group; **SD** = standard deviation of reading group.  
Mean scores presented in percentages.  
*SD's not available.  
Means from Vandervelden (1992) obtained from Table 3.6, p.136.
The congruent results with Vandervelden (1992) on the Phonemic Word Spelling Task are demonstrated further in Figure 3-2-22 in which comparisons between (a) Pre-Decoder SCSPI subgroup and Kindergarten (Vandervelden), (b) Primary Reader SCSPI subgroup and Grade 1 (Vandervelden), and (c) Independent Reader SCSPI subgroup and Grade 2 (Vandervelden) are shown. The overall pattern of results with the SCSPI subjects was similar to that of the non-disabled children tested by Vandervelden (1992). A developmental pattern with higher performance on initial letters, followed by final letters, followed by medial vowels was apparent for both the SCSPI and Kindergarten subjects. The SCSPI subgroups, however, showed a smaller difference between final letter performance and medial vowel letter performance, indicating more consistent skill across the letter positions. The SCSPI subgroups also displayed a slightly higher level of letter processing than the Vandervelden results for the comparisons that were undertaken.

It is interesting to note that the Kindergarten results obtained at the end of the Kindergarten year, in the Study 1 investigation were significantly higher than the Kindergarten results reported in Vandervelden. There are two likely reasons for the wide discrepancy in the results of these two Kindergarten samples. (a) The Illinois educational program where the Study 1 subjects were taught placed a heavy emphasis on the explicit instruction of beginning reading skills. This approach is not adopted in most Toronto Kindergarten programs where the Vandervelden study was conducted. (b) The sample of 36 subjects for each of the 3 groups in the Vandervelden (1992) study included sub-samples containing 12 subjects each, from widely different geographical parts of the city. Two of the sub-samples were from inner city schools, one of which included subjects with English as a second language (ESL) (Vandervelden, personal correspondence, April 11, 1995).
In examining the Total Scores for the Phonemic Word Spelling Task, the SCSPI Pre-Decoder subgroup performed higher than the Vandervelden Kindergarten subjects, but lower than the Kindergarten subjects examined in Study 1. The SCSPI Primary Reader subgroup performed higher than the Vandervelden Grade 1 subjects and the SCSPI Independent Reader subgroup performed higher than the Vandervelden Grade 2 subjects.
Comparisons between SCSPI Reading subgroups and Gottardo (1995) Reading groups.

The availability of results from non-disabled subjects at the Grade 1,2,3 levels on the Working Memory and Syntactic Error Judgement Tasks (Gottardo, 1995) afforded informal comparisons between the SCSPI subjects and speaking subjects at similar levels of reading achievement.

The means and standard deviations in raw scores for the Working Memory Recall subtest, the Working Memory True/False subtest and the Syntactic Error Judgement Task for each SCSPI subgroup are shown in Table 3-2-17 and Figure 3-2-23, along with the means and standard deviations obtained from Gottardo (1995). The total Working Memory scores were not reported in Gottardo (1995) and thus comparisons could not be undertaken for this combined score as was done in comparing Bliss and Print Readers. A developmental pattern was apparent in the results of the SCSPI subgroups for both the subtests of the Working Memory task. For the Gottardo groups, there was a levelling off in both subtests between the results of Grade 2 and Grade 3. The Pre-Reader and Pre-Decoder SCSPI results were similar to those of Grade 1 and Grade 2 respectively in the Working Memory True/False subtest, but both SCSPI Bliss Reader subgroups performed at a level lower than Grade 1 in the Working Memory Recall subtest. Both the subgroups within the SCSPI Print Reader group had mean scores that exceeded the mean of the Grade 3 Gottardo results in the two Working Memory subtests.

In the Syntactic Error Judgement Tasks, the means of the Print Reader SCSPI subgroups exceeded the mean of the Grade 3 Gottardo subjects. The Pre-Decoder SCSPI subgroup mean was similar to that of the Grade 1, but the Pre-Reader mean score was less than that of the Grade 1.

Performance on the True/False subtest of the Working Memory Task (Gottardo, 1995) was considered independently in this thesis as a diagnostic indicator of world knowledge. Of interest in Figure 3-2-23 in relation to world knowledge is (a) the lack of difference between the SCSPI Bliss Readers and the Grade 1, 2 and 3 students, and (b) the higher performance of the SCSPI Print Readers over the Grade 1, 2 and 3 students.
Table 3-2-17

Means Table

Working Memory Subtests and Syntactic Error Judgement Task
SCSPI Reading Subgroups and Gottardo (1995) Reading Groups

<table>
<thead>
<tr>
<th>Reading Group</th>
<th>Working Memory Recall (Max = 42)</th>
<th>Working Memory True/False (Max = 42)</th>
<th>Syntactic Error Judgement (Max = 35)</th>
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<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
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<td>Pre-Reader (Bliss) (N = 4)</td>
<td>7.50 (5.97)</td>
<td>21.75 (4.19)</td>
<td>18.14 (4.14)</td>
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<td>Pre-Decoder (Bliss) (N = 9)</td>
<td>10.00 (5.04)</td>
<td>23.75 (1.91)</td>
<td>23.00 (4.12)</td>
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<td>Primary Reader (Print) (N = 7)</td>
<td>18.14 (7.54)</td>
<td>26.00 (5.89)</td>
<td>27.71 (4.07)</td>
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<td>Independent Reader (Print) (N = 9)</td>
<td>21.78 (10.07)</td>
<td>28.44 (8.38)</td>
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Grade 1 (Gottardo, 1995) (N = 21)

Grade 2 (Gottardo, 1995) (N = 21)

Grade 3 (Gottardo, 1995) (N = 44)

Note:
M = mean of reading group; SD = standard deviation of reading group.
Gottardo (1995) results from Table 12, p.68, and Table 1, p.44.
Results are shown in raw scores.
Means
Working Memory-Recall, Working Memory-True/False Subtests
Syntactic Error Judgement Task
SCSPI Subgroups and Gottardo (1995) Reading Groups

Note: Gottardo (1995) scores from Table 12, p.68 and Table 1, p.44.
Results are shown in raw scores.
Summary of Intermediate analyses.

In reviewing the results overall of the SC SPI subgroups, it was the skill configuration of (a) the Pre-Decoder, BlissReader subgroup, the subjects of which had many reading acquisition skills but were unable to decode and (b) the Primary Print Reader subgroup, the subjects of which had acquired decoding skills but were reading below a Grade 3 level that provided the salient information that was applied to the Profile for the Acquisition of Reading (PAR) developed for each of the four subgroups, presented in the molecular analysis that follows. The results pertaining to these two subgroups, in comparisons with other SC SPI subgroups and in comparisons with Kindergarten Groups from Study 1 are presented in Tables 3-2-18 and 3-2-19-A. Variables for which there were small and consistent differences and those which were not eligible for parametric or nonparametric analyses are listed along with those variables for which a statistically significant level of difference was found, as the purpose in identifying these variables was to consider them within an educational assessment.
Table 3-2-18
Differences Observed between SC SPI Subgroups
Reading Acquisition and Reading Related Tasks

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<th>BlissReaders</th>
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<td>Performance differences</td>
<td>Performance differences</td>
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<td>in favour of Pre-Decoders:</td>
<td>in favour of Independent Readers</td>
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<tr>
<td>• Consonant Name Recognition</td>
<td>• TONI *</td>
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<td>• Consonant Sound Recognition</td>
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<td>• CVC-NC Word Task</td>
<td>• Spelling Word-Pair Task *</td>
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<td>• Phonemic Word Spelling</td>
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<td>• Recognition Decoding Pseudoword</td>
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<td>• Working Memory</td>
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<tr>
<td>• Syntactic Error Judgement *</td>
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<tr>
<td>• CELF-R subtest - Word Structure</td>
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</tbody>
</table>

Across all SC SPI subgroups
increasing level of performance

* $p<.05$
** $p<.001$

From the comparisons between SC SPI subgroups and Kindergarten Groups of Study 1, the differences found between the Pre-Decoder subgroup and Low Kindergarten group persist in the comparison between Primary Readers and the High Kindergarten group, except for the different performance levels in the CVC-NC Word Task and the Picture Identification Task. Although parametric and nonparametric analyses to determine the statistical significance of differences between the subgroups could not be conducted, a consistent pattern of differences in favour of the higher functioning Print Reader subgroups was observed in the reading related tasks, communication skills and speech abilities. Similar findings were observed across subgroups in attempts to use speech and in motivation to communicate.
Table 3-2-19-A

Differences Observed between SC SPI Subgroups and Kindergarten Groups from Study 1, Reading Acquisition Tasks

| SC SPI Pre-Decoder Subgroup showed higher performance than Kindergarten Low Reader Group | SC SPI Primary Reader Subgroup showed higher performance than Kindergarten High Reader Group |
| • Primary Word Reading | • Primary Word Reading |

Kindergarten Low Reader Group showed higher performance than SC SPI Pre-Decoder Subgroup

• Visual Analysis Retrieval

There were no tasks on which Kindergarten High Reader Group showed higher performance than SC SPI Primary Reader Subgroup.

From the comparisons between the SC SPI groups of Study 2 and Kindergarten groups of Study 1 regarding the visual processing tasks, differences were found between the readers and nonreaders only in Visual Analysis Retrieval Task performance. The results for all groups were higher for the Picture Identification Task and the Visual Matching Task than for the Visual Analysis Retrieval Task. (See Table 3-2-19-B). The lower results on the Visual Analysis Retrieval Task by the SC SPI subjects compared to the Kindergarten subjects was not expected and is of interest. These results will be discussed in responding to Question 9, relating to visual processing.
Table 3-2-19-B

Summary Table, Means
Visual Processing Task Results

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<th>Group</th>
<th>Picture I.D.</th>
<th>Visual Matching</th>
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<td><em>High Reader Kindergarten</em></td>
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<td><em>Full SCSPI</em></td>
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<td><em>Bliss Reader SCSPI</em></td>
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<td><em>Print Reader SCSPI</em></td>
<td>97.44</td>
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Molecular Level of Analysis

Tables 3-2-20 and 3-2-21 present the results for each subject on the Reading Acquisition and Reading Related Tasks. In addition, the results for each subject from the Phonological Recoding and Short Term Memory evaluation and for those subjects able to undertake the Homophone Word-Pair Matching Task and are presented in Table 3-2-21.
Table 3-2-20

Subjects with SCSPRI
Reading Acquisition Tasks

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<th>Decode Pseudoword*</th>
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Note:
* "Decode Pseudoword", abbreviation for Recognition Decoding Pseudoword Task.
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<th>LD.</th>
<th>Receptive Language (standard score)</th>
<th>Expressive Language (standard score)</th>
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<th>Working Memory %</th>
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Profiles for the Acquisition of Reading (PARs).

Based on the results that differentiated the subgroups, summarized in Table 3-2-18, variables were selected for inclusion in the Profile for the Acquisition of Reading (PAR) developed for each of the four subgroups. Each PAR depicts the mean and standard error of the mean for the subgroup of interest, the subgroup one level higher in reading acquisition and (if not already presented) the Independent Reader subgroup, e.g., for the Pre-Reader PAR, the means of the Pre-Reader, Pre-Decoder and Independent Reader subgroups are displayed whereas for the Primary Reader PAR the means of the Primary Reader and Independent Reader subgroups are displayed. The PARs provide the format for creating each learner's Reading Profile by which the individual subject's scores are compared with those of his or her "reading group peers". This entails comparing the individual’s score with that of the average score of the subgroup in which their decoding skills place them, and using as additional referents the average score of the subgroup representing the next highest level of reading skills and the average score of the Independent Reader subgroup (subjects with the highest level of reading identified in this study). The four PARs are shown in Figures 3-2-24-A,B,C,D.
Learner's Reading Profiles.

Figures 3-2-25, A,B,C,D present examples of a PAR for each subgroup being used to produce a Reading Profile. The Reading Profiles demonstrate the unique pattern of performance of each subject on the test battery and the importance of responding to each individual's strengths and weaknesses in planning an instructional program. Recommendations appear in the Educational Application, Section 4, for the use within an instructional program of the Reading Profile along with the Ecological Checklist that is introduced in the next section. See Appendix 3-2-E for Case Examples from each SCSPJ subgroup. Reading Profile and Ecological Checklist is accompanied by descriptive information and identification of initial instructional objectives.
Ecological Analysis: Microsystem Level

Table 3-2-22 presents the ecological ratings for each variable for all SCSPI subjects, along with each subject's Ecological Composite Index (ECI) and communication ratings for ability to inform and functional interaction. Table 3-2-22 is accompanied by the ECI Key. Figures 3-2-26 through 3-2-35 present the results of an ecological analysis at the microsystem level through histograms, with the variables grouped into the following categories: (a-i) ratings by subjects of home and educational environments; (a-ii) ratings by thesis author of literacy expectations during subjects' formative years; (a-iii) place of residence during formative years; (b) indicators of environmental support for provision of assistive technology — access to computer, use of voice output communication aid (VOCA), and access to comprehensive Blissymbolics vocabulary during developmental years; (c) ratings of environmental attitudes as they relate to reading enjoyment and books, as indicated by subjects' reading frequency and rating of enjoyment derived from books; (d) degree of dependency upon others for physical and visual access to literacy-related components of the environment; and (e) subjects' self ratings of skill levels in independent reading, creative writing and spelling within communication, as indicators reflecting attitudes toward subjects' competencies by significant others in the immediate environment.
Table 3-2-22

Subjects with SCSPI
Ecological and Communication Ratings

| LD. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|-----|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|
|     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Pre-Readers |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| CE  | + | + |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| DP  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| JM  | + | + |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| TQ  |   | - |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| NU  | + | - |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| TB  |   | + |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| KE  |   | + |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Pre-Decoders |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| YE  | + | + | - |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| DK  |   | - |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| IC  | + | - |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| KD  | + | + | - |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| EF  |   | + | - |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| DS  | - | + | - |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| DW  | - | - | + |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| DD  |   | + |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| MS  | + | + |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Primary Readers |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| SB  | - | + | - |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| IN  | - | - | + |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| HU  | + | + | - |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| QU  | + | - | - |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| HI  | + | + | - |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| HB  | + | + | - |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| DV  | - | - | - |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Independent Readers |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| IL  | + | + | + |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| WX  | + | + | + |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| IB  | - | - | - |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| NQ  | + | + | + |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| LM  | + | + | + |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| EK  | + | - | - |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| MO  | + | + | - |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| ID  | - | + | - |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| TB  | + | + | + |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

|     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|     | + = positive  - = negative  * = no response  Communication Rating Scale 1-5  
|     | + for rating of 3 - 5  
|     | - for rating of 1 - 2  
|     | ECI — Ecological Composite Index — percentaged total positive ratings  

Table continued...
Ecological Composite Index (ECI)

Key

1. parent support (rated by subject)  
   10. enjoyment derived from reading  
      (rated by subject)

2. supportive residence during formative years (home versus institution)  
   11. frequency of reading  
      (at least weekly)

3. teacher support (rated by subject)  
   12. ability to get books independently

4. quality of literacy instruction  
   (rated by subject)  
   13. ability to turn pages independently

5. time spent in literacy instruction  
   (rated by subject)  
   14. visual acuity

6. literacy expectations during formative years  
   (rated by author)  
   15. independent reading ability  
      (rated by subject)

7. computer access

8. VOCA access

9. Display of over 200 symbols or words

Communication Ability Rating:
Information: ability to inform with use of the person's total communication
Interaction: ability to interact in a functional way

5=very good  4=good  3=good but limited  2=very limited  1=hardly any  0=none
Ratings of home and educational environments.

Ratings of home and educational environments by subjects were on a 5 point scale in response to the following question: "This is how I would rate the following people with regard to their help with my learning to read, write and spell." Several categories of potentially 'significant others' were included in the questionnaire. For the purposes of the ecological analysis, only the ratings of parents and teachers were considered. The results are shown in Figures 3-2-26 and 3-2-27-A. The missing responses within the Pre-Reader subgroup were due to the illness of one subject, a lack of understanding of the rating process by one subject and time limitations for two others. The distribution of ratings by the Independent Readers for parental help with literacy learning showed the highest proportion of high ratings. There was a balanced proportion of high and low ratings for the Pre-Decoder and Primary Reader subgroups. The rating of teacher help with literacy learning was highest by the Pre-Decoder and Independent Reader subgroups and lowest by the Pre-Readers. It was noted that the two subgroups at the higher level of their respective reading areas, Blissymbols and Print, gave the higher ratings to teachers.
Figure 3-2-26

Parent Support
Rated by Subject

Pre-Reader

Count

five  four  three  two  one

3  2  1

Pre-Decoder

Count

five  four  three  two  one

4.5  3  2  1

Primary Reader

Count

five  four  three  two  one

3  2  1

Independent Reader

Count

five  four  three  two  one

6  4  2

Figure 3-2-27-A

Teacher Support
Rated by Subject

Pre-Reader

Count

five  four  three  two  one

2.25  1.5  0.75

Pre-Decoder

Count

five  four  three  two  one

4.5  3  1

Primary Reader

Count

five  four  three  two  one

4.5  3  1

Independent Reader

Count

five  four  three  two  one

6  4  2
The statements regarding literacy program that were rated on a 5-point scale were as follows: "I received excellent reading, writing and spelling instruction as I was growing up" and "I had enough time in school devoted to learning to read, write and spell." The ratings of both literacy instruction and time allotted to a literacy program, presented in Figures 3-2-27-B and 3-2-27-C, showed a gradual increase in the rating levels assigned with each level of reading achieved.

Figure 3-2-27-B

Literacy Instruction Rated by Subject

Figure 3-2-27-C

Time given to Literacy Instruction Rated by Subject
Ratings of literacy expectations.

The ratings by the thesis author of the literacy expectations of both home and school during each subject's formative years (considered as birth to age eight) were based on direct knowledge of the educational programs or information derived from the Silverman et al Formative Evaluation Study (1978). The results are presented in Figure 3-2-28. Interestingly, the instances of nonsupportive environments were in the Pre-Decoder and Primary Reader subgroups. Low expectations in otherwise supportive environments were found only for subjects in the Pre-Reader and Pre-Decoder subgroups. For all the Independent Readers there were expectations of achievement and supportive environments during their formative years. For all the Primary Readers who came from supportive environments in their formative years (4 of the 7 subjects), there were expectations of literacy acquisition by their family and school.

Figure 3-2-28

Literacy Expectations, Formative Years
Rated by Author
Place of residence during formative years.

The place of residence during the subject's formative years are shown in Figure 3-2-29. Within the Pre-Reader and Primary Reader subgroups there were almost equal numbers of subjects who lived in an institution as lived at home. Within the Pre-Decoder subgroup, a larger number of subjects lived at home. Within the Independent Reader subgroup, all the subjects lived at home during their formative years. It was noted as well that the two subgroups at the higher level of their respective reading areas, Blissymbols and Print, had the highest proportion of subjects living at home during their formative years. In comparing the Bliss Readers and the Print Readers, the ratio of subjects living at home during their formative years to those raised in an institution was 11/5 for Bliss Readers and 13/3 for Print Readers. The pattern of these results, as shown in Figure 3-2-29, shows a higher reading achievement for those subjects living at home during their formative years.

Figure 3-2-29
Residence, Formative Years
Assistive device indicators of environmental support.

The indicators of environmental support through provision of high and low communication technology, i.e., (i) access to computer, (ii) use of voice output communication aid (VOCA), and (iii) access to comprehensive Blissymbolics vocabulary during developmental years, are presented in Figures 3-2-30, 3-2-31 and 3-2-32. The proportion of subjects having access to a computer and using a VOCA were higher in the subgroups with higher reading skills. All the Independent Readers had a computer as a writing device and all but two had personal VOCAs. (One of these two subjects did not require a VOCA as his dysarthric speech could be understood.) All the Primary Readers also had computers but for one subject. It is known that a computer was purchased following completion of the data collection and this subject did gain access to a computer. For the Pre-Reading subgroup, the numbers were almost evenly divided between those having a computer and those not, and there were more subjects without VOCAs than with them. A third of the Pre-Decoder subgroup did not have a computer. For the Pre-Decoder and Primary Reader subgroups, there were almost equal numbers without VOCAs as with them.

Figure 3-2-30

Access to Computer for Independent Writing

Figure 3-2-31

Use of VOCA
In examining access to comprehensive Blissymbol vocabularies, all subjects in the Independent Reader subgroup, with the exception of the one non-Bliss alumnus, had used displays with over 200 Blissymbols at some point in their development, with over half of the subjects having had displays with over 500 Blissymbols. For the Print Readers, all but two subjects had used displays with over 200 Blissymbols at some point in their development. In the case of one of the Print Reader subjects who had a small number of Blissymbols, her transition to speech had been successful prior to her learning more symbols. In the case of the other Print Reader subject, the educational program had under-evaluated her learning ability. Neither her communication nor her literacy program met her needs, as demonstrated by her reported learning to decode words at age 25 after many years of self study "encouraged by her brothers to never stop trying!". In the Pre-Reader subgroup, half of the subjects were using displays with between 200 and 500 Blissymbols and 2 subjects had less than 200 Blissymbols. Only one subject had a display with over 500 Blissymbols. In the Pre-Decoder subgroup, over half of the subjects were using displays with over 500 Blissymbols and the majority of the remaining subjects had displays with between 200 and 500 Blissymbols. For all subjects in the Blissymbol Reader subgroups, support was being continued to their Blissymbol use through the maintenance of their current displays, but with little attention to vocabulary expansion.
Subject ratings of reading enjoyment.

Subject ratings of enjoyment derived from books and frequency of reading are presented in Figures 3-2-33-A and 3-2-33-B. The subject was asked to rate reading enjoyment on a five-point scale. The question relating to frequency of reading was worded as follows: "How often do you read for your own interest and enjoyment, i.e., when reading is not a school assignment?" Response options were "daily, about once or twice a week, less than three times a month, less than once a month". It should be noted that these questions were interpreted by many subjects as "being read to", hence the interesting responses from the Bliss Reader subgroups. The results in Figure 3-2-33-A reflect a rating of interest and enjoyment in books rather than a rating of enjoyment in independent reading. A comparable level of interest and enjoyment was shown across all subgroups, but with subjects in the Independent Reader group accessing books more frequently since they could do so directly, without assistance.

Over half of the subjects in all the subgroups rated the enjoyment they got from reading or being read to as moderate or higher, yet all of the subgroups had a substantial proportion of the subjects reading less than 3 times monthly. There was a trend toward more frequent reading as subjects became print readers, thus being able to read independently. In the Independent Reader subgroup more than half the subjects read daily, although even in this group, one third of the Independent Readers reported reading less than once a week. Only one subject in each of the other subgroups read daily. In the Primary Reader subgroup, half of the subjects read at least weekly. In the Pre-Decoder subgroup, over half of the subjects read less than once a month. In the Pre-Reader subgroup, but for one subject reading daily, the remainder were split between being read to weekly and less than once a month.

Figure 3-2-33-A

Enjoyment Derived from Reading
Figure 3-2-33-B

Frequency of Reading

Degree of dependency for physical and visual access to literacy related materials.

The four subgroups were compared on three variables relating to physical and visual access to literacy related materials in the environment. Physical access was assessed by (a) documenting type of mobility to determine if reading materials could be accessed independently and (b) a self evaluation of ability to turn pages independently. Visual access was assessed through determining from subjects if they had any visual difficulties including the need to wear glasses in order to see print or Blissymbols.

Figures 3-2-34-A and 3-2-34-B present histograms of the four subgroups relating to the physical capabilities of mobility (ability to independently get to books) and ability to turn pages of books independently. The groups were similar in that the majority of the subjects used wheelchairs independently and could access books at strategically located heights. Three subjects in the Bliss Reader subgroups were either confined to bed many hours or were dependent in their wheelchairs. One subject was wheelchair dependent in the Primary Reader subgroup. All the Independent Readers were either wheelchair independent or ambulatory. It is of interest that the only two ambulatory subjects in the study were both Independent Readers.

The proportion of subjects able to independently turn pages increased in the subgroups with individuals at higher reading levels. In the Pre-Reader subgroup most subjects were unable to turn pages. In both the Pre-Decoder and Primary Reader subgroups, the subjects were evenly split between those who were able and those who
were not able to turn pages. The Independent Reader subgroup had a majority of subjects able to turn pages.

Figure 3-2-34-A

Ability to Get Books Independently (Mobility)

Figure 3-2-34-B

Ability to Turn Pages Independently
Figure 3-2-34-C presents the split within each subgroup of subjects with regard to visual difficulties. Difficulty was evaluated by the subject's response to the questions, "Do you have any visual difficulties?" and "Do you require any of the following special print to read - bold, large, small, other?" An additional provision was applied in coding visual difficulty. If a subject required glasses and required assistance in order to wear them, this variable was coded "yes"; whereas if a subject required glasses but could put the glasses on and off himself or herself, the variable was coded "no". Figure 3-2-34-C presents the positive and negative response to having a visual difficulty. In the Ecological Ratings in Table 3-2-22, a visual capability was rated rather than a difficulty, yielding a positive rating for the purposes of the Ecological Composite Index when the individual had no reported visual difficulty.

The Primary Readers and Pre-Readers were split evenly between those who had visual difficulties and those who did not. The Pre-Decoder group had more subjects with visual difficulties than without; the Independent Readers had only one subject with visual difficulties. The one Independent Reader with visual difficulties responded that he required bold print and that this has been provided to him in his reading program.

**Figure 3-2-34-C**

**Visual Difficulties**

![Graphs showing visual difficulties](image)

Note: In reporting this variable in Table 3-2-22, visual capability was rated rather than visual difficulty. Thus positive responses in Figure 3-2-34-C appear as negative responses in Table 3-2-22, and negative responses in Figure 3-2-34-C appear as positive responses in Table 3-2-22.
Self ratings regarding reading acquisition competencies.

Figures 3-2-35-A, 3-2-35-B, and 3-2-35-C present histograms of the self ratings regarding competence in independent reading, creative writing and spelling within communication, of the four subgroups. These self ratings were viewed as reflecting attitudes of significant others as perceived by the subjects, and therefore they were considered as contributing to the Ecological Composite Index. The question to which subjects were responding was: "Rate yourself on the following reading, writing and communication skills: independent reading, creative writing (e.g., poems, short stories, etc.), spelling for communication purposes."

The proportions of positive ratings for reading and spelling were higher for the two Print Reading subgroups than for the Bliss Readers. All the subjects in the Print Reader subgroups rated themselves average or above in spelling for communication purposes.

For creative writing, *all of the groups* showed ratings across all levels, with self ratings for creative writing higher than demonstrated reading acquisition skills for most members of the two Bliss Reader subgroups. For Bliss Readers, creative writing involves a collaborative process. They dictate their ideas through pointing to symbols and/or letters on their Blissymbol boards, many of which contain the alphabet and afford the use of spelling as a strategy to supplement the Blissymbols. An assistant then edits the content and produces the written output. For subjects who could not write independently, the higher ratings for creative writing than for reading and spelling were interpreted as indicating environmental support being provided for literacy acquisition through collaborative writing, even though specific literacy skills were lacking.

Figure 3-2-35-A

Independent Reading Ability (Rated by Subject)
Figure 3-2-35-B

Creative Writing Ability (Rated by Subject)

Figure 3-2-35-C

Spelling Ability During Communication (Rated by Subject)

Comparison across subgroups in Ecological Composite Index Rating.

Figure 3-2-36-A shows histograms of the distribution of the Ecological Composite Index (ECI) ratings for the four reading groups. Figure 3-2-36-B presents a bar graph of the reading subgroup means for the ECI. Both figures demonstrate the increase in the number of supportive ecological factors, as reflected in the ECI, with an increase in reading skills. The results of an unpaired t-test comparing the Bliss Readers (N=12) and Print Readers (N=16) showed a statistically significant mean difference in ECI between these two groups of 30% (5/17 score points) (p=.0001). The ECI means for each Reading subgroup were as follows: Pre-Readers, 38%; Pre-Decoders, 51%; Primary Readers, 63%; Independent Readers, 84%. ECI scores were not calculated for
2 Pre-Readers and 2 Pre-Decoders, as complete records relating to formative years could not be obtained for these subjects.

The ratings of the two Independent Readers, subjects IB and EK, whose ECI rating fell below 70% were examined individually. They shared four negatively-rated factors in common. They both rated the time devoted to literacy instruction as inadequate, they lacked enjoyment in reading, and they rated their abilities in independent reading and creative writing as poor. The supportive factors that they both shared were high literacy expectations during their formative years, supportive communication technology through large Bliss displays, reading frequently, being able to get books independently and rating themselves as capable in spelling within communication (which is interpreted as indicating persons in their environment who provide positive feedback relating to spelling ability).

Figure 3-2-36-A

Histograms, Reading Subgroups, Ecological Composite Index
An Ecological Checklist, based on the probes within the Ecological Composite Index, was added to the Profile for the Acquisition of Reading (PAR) for each reading subgroup. Probes which were dependent upon the subject evaluating his/her own competency in reading related skills were omitted, as the checklist was designed for students at any age level. In addition, the Ecological Checklist included space to provide ratings of both current situation and the situation during subject's formative years, as applicable.
Comparisons between dysarthric and anarthric subjects in Ecological Composite Index Rating.

Figure 3-2-37 shows an equal number of anarthric and dysarthric subjects with an ECI rating of 60% or higher. Given the number of anarthric subjects (N = 19) for whom an ECI could be determined, however, the eight anarthric subjects with a rating of 60% or higher represent only 42% of the anarthric group. Within this same group, there were eight subjects with a rating below 50%, whereas only one dysarthric subject had a rating below 50%. Figures 3-2-38-A and 3-2-38-B show the distribution of Ecological Composite Indices for the four reading subgroups for anarthric and dysarthric subjects. It is evident from a visual inspection of the scattergrams that the subjects with higher ECIs were primarily Print Readers for both the anarthric and the dysarthric subjects. Only two of the subjects with ECIs over 60% were Pre-Decoders and none were Pre-Readers. All the Pre-Readers for whom an ECI could be determined had an ECI rating of less than 50%.

Figure 3-2-37
Scattergram, Anarthric and Dysarthric Subjects, Ecological Composite Index

![Scattergram, Anarthric and Dysarthric Subjects, Ecological Composite Index](image-url)
Figure 3-2-38-A

Scattergram, Anarthric Subjects, Ecological Composite Index Rating

Reading Subgroups

Figure 3-2-38-B

Scattergram, Dysarthric Subjects, Ecological Composite Index Rating

Reading Subgroups
Comparisons between subjects born in the fifties and later in Ecological Composite Index Rating.

Figure 3-2-39 shows a wide range of scores for subjects born during the fifties and those born in the sixties and seventies. The ECI for those born in the fifties (N=9) had a mean of 52% (S.D. =18; standard error = 6) and a range of 29 to 82. The ECI for those born in the sixties and seventies (N=19) had a mean of 67% (S.D. =22; standard error = 5) and a range of 29 to 100. The scattergram shows a slightly higher distribution for the ECI ratings of subjects born after the fifties with 68% of the ratings being 60% or higher. For the subjects born during the fifties, only 33% of the ratings were 60% or higher.

Figure 3-2-39

Scattergram, Ecological Composite Index Comparison, SCSPI Subjects Born in the Fifties and After

Note: There was no ECI for two of the subjects born in the fifties due to incomplete records.
A summary of salient ecological factors and reading related scores for subjects born in the fifties is shown in Table 3-2-23. Several observations can be made from the results of the subjects born in the fifties who participated in this investigation: (1) Only the subjects from a goal-oriented home situations in which there were expectations of literacy supporting the subject's ability in reading related factors, as shown for subjects LM, IB and TB, achieved independent reading. (2) All subjects who grew up in institutions remained without a formal communication system until they were adults (defined as age 17 or over in this study) except for one subject, HU, who was born in 1959 and was introduced to Blissymbols at age 16 along with a "functional" reading program. Prior to age 16, HU had received no educational program. (3) When there were limitations either to reading related factors or literacy expectations from the home or institution, the majority of subjects remained at the Bliss Reading level. The exceptions were subjects HU and DV who achieved literacy at the Primary level. For both these subjects their receptive language and TONI levels were as high or higher than subjects who, with a goal oriented home environment, achieved independent reading. (4) The one subject who had a supportive and goal oriented home setting (subject DD) and who demonstrated limited ability in reading related activities, remained at the Pre-Decoding level. No information could be obtained relating to educational support for this subject.
Table 3-2-23

<table>
<thead>
<tr>
<th>Subject I.D.</th>
<th>Year of birth</th>
<th>Communication Initiated</th>
<th>residence early years</th>
<th>literacy expectations</th>
<th>Reading Level</th>
<th>ECI</th>
<th>Receptive Language</th>
<th>Syntactic Error</th>
<th>TONI</th>
<th>Working Memory</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP</td>
<td>1952</td>
<td>adult</td>
<td>institution</td>
<td>low</td>
<td>Pre-Reader</td>
<td>29%</td>
<td>50</td>
<td>49</td>
<td>80</td>
<td>39</td>
</tr>
<tr>
<td>TQ</td>
<td>1951</td>
<td>adult</td>
<td>institution</td>
<td>low</td>
<td>Pre-Reader</td>
<td>35%</td>
<td>50</td>
<td>49</td>
<td>61</td>
<td>*</td>
</tr>
<tr>
<td>JM</td>
<td>1955</td>
<td>adult</td>
<td>home</td>
<td>low</td>
<td>Pre-Reader</td>
<td>41%</td>
<td>50</td>
<td>40</td>
<td>61</td>
<td>*</td>
</tr>
<tr>
<td>DD</td>
<td>1955</td>
<td>adolescent</td>
<td>home</td>
<td>goal oriented</td>
<td>Pre-Decoder</td>
<td>*</td>
<td>50</td>
<td>69</td>
<td>*</td>
<td>37</td>
</tr>
<tr>
<td>IC</td>
<td>1951</td>
<td>adolescent</td>
<td>home</td>
<td>low</td>
<td>Pre-Decoder</td>
<td>41%</td>
<td>50</td>
<td>60</td>
<td>61</td>
<td>37</td>
</tr>
<tr>
<td>DW</td>
<td>1955</td>
<td>adult</td>
<td>institution</td>
<td>low</td>
<td>Pre-Decoder</td>
<td>*</td>
<td>50</td>
<td>74</td>
<td>69</td>
<td>39</td>
</tr>
<tr>
<td>HU</td>
<td>1959</td>
<td>adolescent</td>
<td>institution</td>
<td>low</td>
<td>Primary Reader</td>
<td>65%</td>
<td>87</td>
<td>91</td>
<td>88</td>
<td>87</td>
</tr>
<tr>
<td>DV</td>
<td>1953</td>
<td>adult</td>
<td>institution</td>
<td>low</td>
<td>Primary Reader</td>
<td>47%</td>
<td>80</td>
<td>71</td>
<td>87</td>
<td>46</td>
</tr>
<tr>
<td>LM</td>
<td>1953</td>
<td>primary</td>
<td>home</td>
<td>goal oriented</td>
<td>Independent Reader</td>
<td>77%</td>
<td>71</td>
<td>74</td>
<td>95</td>
<td>44</td>
</tr>
<tr>
<td>IB</td>
<td>1959</td>
<td>adolescent</td>
<td>home</td>
<td>goal oriented</td>
<td>Independent Reader</td>
<td>53%</td>
<td>59</td>
<td>71</td>
<td>87</td>
<td>81</td>
</tr>
<tr>
<td>TB</td>
<td>1955</td>
<td>primary</td>
<td>home</td>
<td>goal oriented</td>
<td>Independent Reader</td>
<td>82%</td>
<td>96</td>
<td>97</td>
<td>112</td>
<td>88</td>
</tr>
</tbody>
</table>

Note:
- adult = age 17 years and older
- adolescent = age 10 to 16 years
- primary = up to 9 years of age
Ecological Checklist.

Based on the results of the ecological probes, an Ecological Checklist was developed to accompany the Profile for the Acquisition of Reading (PAR) within the educational assessment process. The items of "place of residence during formative years", and subject ratings of "reading ability", "writing ability" and "spelling ability during communication" were eliminated. "Literacy expectations by the school" were added. "Independence in getting to books" and "independence in turning pages" were combined. The changes were made in order to shorten the checklist while maintaining the salient information. Because this form was intended for use for individuals of all ages, subject evaluations were eliminated and a provision was made for information to be obtained for both the individual's formative years and current situation.

Comparisons should not be made between the percentage score that can be derived from the Ecological Checklist and the ECIs obtained during this investigation. The Checklist percentage score is offered as a rating to indicate a general level of ecological support experienced by the individual. Used in this way, it can help in drawing attention to the experiences that may have influenced the current performance level of the student. A sample Ecological Checklist appears in Figure 3-2-40. A completed Ecological Checklist for one subject from each SCSPI subgroup appears with each case example in Appendix 3-2-E.
## Ecological Checklist

Indicate "yes" or "no" as to whether there has been environmental support in the following areas:

<table>
<thead>
<tr>
<th></th>
<th>Support</th>
<th>During Formative Years</th>
<th>Current</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Parent support (rated by subject)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Teacher support (rated by subject)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Literacy instruction (rated by subject)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Time for literacy (rated by subject)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Family expectations re literacy achievements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>School expectations re literacy achievements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Access to computer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Use of VOCA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Use of over 200 symbols or words</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Enjoyment in reading</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Frequent reading (daily or weekly)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Independence in getting to books and turning pages</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Summary of ecological analyses.

The microsystem level of ecological analysis was the primary ecological focus in Study 2, as this was the level most relevant to the development of a checklist to be included in an educational application. Due to the small numbers in the subgroups and the inability to use either parametric or nonparametric statistical procedures, the results provided but a small advancement over speculation. Nonetheless, at this stage of our documented knowledge in this area, the comparisons between subgroups offered a beginning indication of variables worthy of consideration within an instructional program and in further research studies.

While differences were small there were nonetheless indications from the overall pattern of responses of a relationship between (a) living at home during one's formative years with expectations that literacy will be achieved and (b) higher reading achievement. As well, the results showed that groups with higher literacy achievement, had greater parent and educational support during the individual's formative years, increased access to assistive technology, greater support to reading, higher subject ratings of competencies, more independence in mobility and greater access to print, i.e., fewer visual difficulties, the ability to turn pages independently. A statistically significant difference was found between the Ecological Composite Index for the Bliss Reader group and the Print Reader group in favour of the Print Readers. An Ecological Checklist to be used along with the Profiles for Reading Acquisition (PARs) in educational applications was developed from a selected number of the ecological probes included in this investigation.
Discussion

The results of Study 2 in conjunction with the findings of earlier AAC literacy studies enable a preliminary step to be taken in responding to the questions asked at the outset of this investigation. Interpreted through the lens of the author's teaching experience, the findings provide a base of information from which an educational application can be developed and research questions can be refined.

It should be noted that no attempt was made in this investigation to replicate previous work. The design of this thesis was determined by its primary objective — to develop an assessment and mediation-based instructional methodology for adults with SCSP to further develop their reading skills. Several confounding factors must be acknowledged in comparing the results of Study 2 with the findings of Foley (1989, 1993), Dahlgren Sandberg (1996) and Smith (1989, 1992). Among the studies, (a) different sets of variables were examined, (b) different tests were included to measure these variables, (c) different criteria were used to define anarthria and dysarthria, (d) procedural adaptations to meet the needs of subjects varied from study to study, and (e) different types of statistical analyses were undertaken. The comparisons suggest, nonetheless, theoretical premises that should be questioned and they offer insights for educational intervention. The findings of the present investigation lack the status of a replication study. Important observations can be made, however, as a result of the multi-tiered approach to data analysis and the theoretical, empirical and experiential knowledge base which constituted the investigation.
Interpretation of Results

The present study provides further empirical evidence of the overall lower reading performance of subjects with SCSP. As discussed in the Theoretical Infrastructure, this finding has been documented in previous studies. The pattern found in this thesis of higher reading levels occurring with stronger ecological support offers new insights, however, regarding the reading performance of persons with SCSP. It can be argued that the association of higher ecological ratings with higher achievement in reading, language and cognitive measures supports an explanation for the generally lower reading level of persons with SCSP based on external causes. The areas contributing to the ecological rating, notably the instructional program, literacy expectations, and access to print materials can be posited as primary factors related to reading level. This interpretation is better supported than one that attributes the lower reading achievement to the personal limitations of the learner with SCSP.

It was recognized at the outset that processing speed, identified by Adams (1990) as critical to reading proficiency, might present an obstacle for persons with SCSP. The unique development of persons with SCSP, as illustrated in Figure 2-3, was considered a potential causal factor affecting processing speed and hence limiting reading achievement. Lower processing speed and limited reading achievement were indeed demonstrated in the performance of the subjects with SCSP in this investigation. Two sets of findings, however, suggest a different explanation for their overall lower performance. First, the ecological results indicate that the quality of instructional support was related to reading level. Second, the comparisons on the battery of reading acquisition and reading related tasks between adult subjects with SCSP and speaking subjects at similar reading levels failed to yield substantive performance differences (See Table 3-2-19-A). The only significant differences were (a) in favour of the Subjects with SCSP for the Primary Word Reading Task and (b) in favour of the Kindergarten Low Readers for the Visual Analysis Retrieval Task. These results can be accounted for by (a) the additional exposure to sight words by the subjects with SCSP (from the words accompanying their Blissymbols on their communication displays, and (b) the high motivational status of the Blissymbols due to their novelty for the Kindergarten subjects and the ease with which they could be learned by those Kindergarten subjects who lacked decoding skills.
In informal comparisons between the SCSPI subjects and the nondisabled Vandervelden (1992) subjects at similar reading levels, the same overall pattern of phonological recoding results was found. The only differences were in favour of the SCSPI subjects and could be attributed to a longer period of time having been spent at a primary level of reading. In the informal comparisons between the SCSPI subjects and the nondisabled Gottardo (1995) subjects, the lower performance of SCSPI Bliss Readers on the Working Memory Recall subtest could be viewed as further support for a Matthew effect rationale. The higher performance on the two Working Memory subtests by the SCSPI Print Reader group compared to the nondisabled Grade 3 subjects is also consistent with a Matthew effect rationale.

Although the comparison groups were not matched as to reading level within this study, the argument that follows from a reading-level match design can be applied to the current results. As explained by Stanovich (1986), referencing Bryant and Impey (1986) and Prior and McCorriston (1985), the claim that subjects

reveal a qualitatively distinct syndrome reflecting the breakdown of a specific mechanism that is the cause of their reading problems will only be sustained when it is demonstrated that the performance patterns observed do not merely reflect a depressed overall level of reading skill — in short, that normal children reading at the same level do not show similar performance patterns [italics added].

(p. 374)

Since the results failed to show any difference in performance other than on the two variables discussed above, a claim that the speech and physical impairments of the subjects with SCSPI were causal factors in their reading performance levels cannot be sustained. The ecological results, on the other hand, offer support to an interpretation that proposes a practice effect and Matthew effects as factors influencing subjects' performance. Limited exposure to reading instruction is viewed as leading to reduced attention being directed to print resulting in little practice. This is posited as contributing to lower reading performance, partly as a result of slow processing speed. Thus, the limited opportunity to be involved in the reading process and the reciprocal effect this has upon other cognitive abilities offer an alternative explanation for the lower overall performance of the subjects with SCSPI — based upon exogenous rather than endogenous factors.
One caveat regarding the comparisons between Kindergarten subjects and adults with SCSPI must be acknowledged in considering the above interpretation. As explained earlier, a different form of the Decoding Pseudoword Task was used for the two groups. The SCSPI subjects were given a recognition version of the task and the Kindergarten subjects were given a retrieval version. Since the Phonological Recoding Task served as one of the criterion measures for establishing the comparison groups, a difference could have existed in the level of phonological recoding ability of the two groups — with the SCSPI subjects performing at a lower level than the Kindergarten subjects. This possibility could not be tested empirically since the Retrieval Decoding Pseudoword Task could not be administered to subjects with SCSPI. As discussed above, the only differences between the two types of subjects were in the Primary Word Reading Task, in favour of the subjects with SCSPI, and the Visual Analysis Retrieval Task, in favour of the Low Reader Kindergarten group. If it had been possible to divide the groups using performance level on the Retrieval Decoding Pseudoword Task as a measure within the criterion variable, the result, if anything, would have involved the dividing level between the SCSPI Bliss Readers and Print Readers being higher than it was in the analyses used. Any differences that might have been identified through such a comparison between the two subject groups, therefore, would have been in favour of the SCSPI subjects. The use of two versions of the Decoding Pseudoword Task can therefore be discounted as influencing the results in any way that would weaken the argument against speech and physical impairments of the subjects with SCSPI being primary causal factors in their reading performance levels.

Comparisons with Other AAC Literacy Research

The different perspectives of those conducting AAC literacy research is evident in the objectives of their various studies. The primary focus for Foley (1989, 1993) was phonological recoding and short term memory and differences between the capabilities of anarthric and dysarthric SCSPI adult readers in reading related variables. Dahlgren Sandberg's (1996) aim was to describe the reading and spelling abilities of children and adolescents with SCSPI, compare them with other populations and examine the relationships between reading and spelling abilities and cognitive and environmental factors. Smith's (1989, 1992) objective was a better understanding of auditory and visual perception and speech production ability as it related to reading acquisition for children with SCSPI. Due to the many challenges inherent in testing and
the wide variability of performance, Smith decided her objective could best be achieved through case studies. Koppenhaver (1991) examined classroom literacy instruction.

The conclusions reached by this author have much in common with some of the views expressed by previous AAC literacy researchers. Contributing ideas are acknowledged from (a) Foley in identifying phonological decoding as an area of weakness for persons with anarxia and suggesting a possible relationship with instructional methods, (b) Smith, in recognizing the importance of the Matthew effect, (c) Koppenhaver and Yoder in emphasizing ecological factors, particularly the learning environment, (d) Berninger and Gans in demonstrating the value of common performance patterns and (e) Dahlgren Sandberg in demonstrating that a spoken productive language is not necessary for developing phoneme awareness.

Some differences with previous AAC literacy researchers, however, are apparent. A greater emphasis is placed by this author upon exogenous constructivist learning and the importance of explicit instruction than is currently supported in the AAC literature. Greater attention is given to reading acquisition and reading related skills and the reciprocal nature of their development. As well, a different perspective is brought to information relating to family and school expectations — how this information is obtained and the far-reaching influence it could have upon the learner with SCSP.

In some instances, results similar to other authors have been given a different interpretation by the present author. One example of this is found in comparing the conclusions of this investigation with the work of Dahlgren Sandberg. She concluded that home literacy experiences in the groups she studied "at best had a marginal influence on reading development" (1996, Study 4, p. 1). Dahlgren Sandberg interpreted findings that the subjects with cerebral palsy who were readers owned more books and visited the library more often than the nonreaders as consequences of being able to read. Her information regarding literacy expectations were derived from a parent questionnaire. The pattern of ecological results in the present investigation led to another line of argument. The cumulative effect of a number of positive ecological influences, rated through the Ecological Composite Index (ECI), was viewed as a determinant of reading acquisition — providing the context within which reading acquisition could develop. Critical components of that early positive environment were subject's rating of teacher support, quality of instruction, time spent in literacy instruction and principal investigator's rating of family expectations for literacy during the subject's formative years.
The current findings are consistent with the author's premise that the potential for persons with SCSP to master literacy has been greatly underestimated. The results support a position that for many children with SCSP early reading skills will develop. It is posited, however, that they require the child to be supported by a nurturing microsystem that includes expectations for literacy achievement and an exogenous constructivist approach to reading instruction. Explicit instruction in phonological recoding and a rich print environment, is viewed as facilitating phonological, memory, language and intellectual skills and affording new educational experiences. Stanovich (1986), in his seminal article relating to Matthew effects in reading, summarized his position with words that apply aptly to the current results:

Of key importance are the concepts of reciprocal relationships — situations where the causal connection between reading ability and the efficiency of a cognitive process is bidirectional — and organism-environment correlation — the fact that differentially advantaged organisms are exposed to nonrandom distributions of environmental quality.

Stanovich, 1986, p. 360
Issues Relating to Key Questions

The results of comparisons with findings of other AAC literacy studies are further discussed along with the results of the present investigation within the context of the following responses to the key questions posed in the Theoretical Infrastructure.

Articulatory ability: Responding to Question 1.

Is there a difference in (a) reading level, (b) phonological coding in short term memory, and/or (c) phonological recoding ability attained by those subjects with anarthria (total loss of speech function) and subjects with dysarthria (partial loss of speech function), in favour of the dysarthric group?

The results of Study 2 are consistent with those of Foley in finding, in general, higher reading skills for the dysarthric subjects than for the anarthric subjects. As shown in Figure 3-2-16, there was a higher proportion of the total anarthric subjects in the Bliss Reader subgroups (62%) than in the Print Reader subgroups (38%) and the reverse situation, with a higher proportion of the total dysarthric subjects in the Print Reader subgroups (73%) than in the Bliss Reader subgroups (27%).

The findings of Study 2 are in contrast, however, with Foley's (1993) results and the results of Bishop and Robson (1989) with regard to the use of phonological coding in short-term memory by persons with SCSP. Bishop and Robson found subjects with dysarthria and anarthria appeared to have normal use of such coding as compared to non-speech-impaired controls. Foley found, in her sample of 12 subjects, all the dysarthric subjects and the two anarthric subjects with long-term experience with voice output communication aids (VOCA) used phonological coding and that subjects with anarthria who did not appear to use phonological coding had deficits in identifying printed words.

Study 2 of this investigation had a wider range of reading levels than were included in Foley's study. A comparison could not be made with the subjects of Bishop and Robson as reading levels were not reported in their study. Only 6 of the 32 subjects (22%) in Study 2 showed a similarity effect in their performance on the Phonological Recoding and Short Term Memory Task. A difference was noted between the anarthric and dysarthric subjects. Only two (10%) of the anarthric subjects (N=21) displayed a similarity effect; whereas four (36%) of the dysarthric subjects (N=11) displayed a similarity effect. A difference in performance was also found between the Bliss Readers and the Print Readers. One of the three Pre-Readers who were able to do the
task showed a similarity effect. One of nine subjects (11%) showed a similarity effect in the Pre-Decoder Bliss Reader subgroup. Four of fifteen (27%) showed a similarity effect in the Print Readers.

The small group (N=6) who presented a similarity effect included subjects from all reading levels, with a diagnosis of both anarthria and dysarthria, and demonstrated the full range of phonological processing abilities from an inability to decode pseudowords to a score of 100% in the Homophone Word-Pair Task. (See Table 3-2-10.) These results lead to a questioning of a relationship of phonological coding in short term memory with articulatory ability or with reading acquisition.

The performance of anarthric and dysarthric subjects on the Homophone Word-Pair Task was compared with the results of Foley. It must be noted that Foley undertook more extensive phonological testing than was feasible in Study 2. She was able to differentiate between the performance of anarthric and dysarthric subjects on tasks requiring (a) accurate performance on tasks requiring only phonological recoding and (b) on tasks requiring both lexical access and accurate phonological recoding. In Foley's study, the anarthric subjects had more difficulty than the dysarthric subjects when they had to first identify an irregularly spelled word as a sight word and then compare that word's phonological representation with the auditory image generated from a nonword item. The Homophone Word-Pair Task given to the Print Readers and five of the Bliss Readers in Study 2, required one less step than the Foley test, but did require matching a generated phonological code with an item in the mental lexicon.

The results for Print Readers on the Homophone Word-Pair Task were consistent with the phonological recoding findings of Foley. A slightly higher level of performance on the Homophone Word-Pair Task in favour of the dysarthric subjects was observed in the Independent Reading group (Figure 3-2-12-B). The difference between the anarthric and dysarthric subjects was not, however, statistically significant. In the Primary Reading group, a statistically significant difference was obtained between the anarthric and dysarthric subjects, in favour of the dysarthric subjects. Overall, the anarthric Print Readers exhibited lower scores than the dysarthric subjects on the Homophone Word-Pair Task, and the scores for all SCSP1 subjects were in general depressed.

Due to the small number of Bliss Readers performing the phonological recoding tasks, statistical comparisons could not be undertaken between the anarthric and dysarthric subjects in this group. The lower performance of anarthric Bliss Readers on the phonological recoding tasks was evident, however, with only 3 of the
13 anarthric Bliss Readers able to attempt the tasks. The scores of these three subjects were at the 30% or lower level on the Phonemic Word Spelling Task, the CVC-NC Word Task and the Recognition Decoding Pseudoword Task.

It is interesting to note that only two anarthric subjects (DK and IL) scored well above the chance level (83%) on the Homophone Word-Pair Task. They were both long-term users of VOCAs. It should also be observed that five other subjects (HU, QU, WX, IB and NQ), who were also long-term users of VOCAs, scored at chance levels, 33%, 56%, 61%, 28% and 50% on the Homophone Word-Pair Task.

The higher performance on the Homophone Word-Pair Task by some adults with anarthria who used VOCAs lead to speculation that VOCA usage could play a supportive role in phonological recoding. Foley drew attention to a possible relationship between these two variables. It is evident, however, from the performance of the five subjects who used VOCAs but who were not successful on the Homophone Word-Pair Task that many other factors must be considered as well. As with all of the factors contributing to reading acquisition, it would appear that the contribution that VOCA experience might bring to reading is dependent upon support from other contributing factors.

The Homophone Word-Pair Task was identified as a useful measure of phonological recoding ability for readers beyond the grade 2.9 level (Independent Readers). A strong relationship (rho .85, p=.02, Spearman rank correlation) was found between homophony judgement (as measured by the Homophone Word-Pair Task) and reading ability (as measured by PLAT grade level) for this subgroup. For the less advanced reading subgroups, the CVC-NC Word Task, Decoding Pseudoword Task and Spelling Word-Pair Task were identified as more appropriate measures of phonological recoding ability. The mixed findings with regard to similarity effect (Table 3-2-10) render the Phonological Recoding and Short Term Memory Task an inappropriate diagnostic measure relating to reading acquisition.

From the foregoing discussion regarding articulatory ability, the condition of anarthria initially might appear to be a primary determinant of reading difficulty. This conclusion, however, would be an over-simplification of the interplay of several factors. The different proportion of anarthric and dysarthric subjects within the Print Reader group provides an example of how preliminary analyses can be misleading. Within the Print Readers, the anarthric subjects comprised 8 of the 19 anarthric subjects in the study (42%), whereas the dysarthric subjects comprised 8 of the 13 dysarthric subjects in the study (62%). Although the proportion of dysarthric subjects
acquiring print literacy surpassed that of the anarthric subjects, there was an equal split between those with anarthria and those with dysarthria who achieved at least grade 3 level. These results demonstrate a potential for a substantial proportion of persons with anarthria to acquire phonological recoding and to progress to the grade 3 level. Since anarthria had not prevented these subjects from progressing beyond the stage when phonological recoding is the primary determinant, alternative factors needed to be considered. The question was asked as to what differentiated these eight anarthric Print Readers from the thirteen anarthric subjects who remained Bliss Readers. Ecological support and Matthew effect (Stanovich, 1986) offered another line of reasoning.

The results from the Ecological Probe for both anarthric and dysarthric subjects (See Figures 3-2-37, 3-2-38-A and 3-2-38-B) showed (a) stronger environmental support associated with dysarthria and (b) a pattern of higher reading achievement (as indicated by Reading Group level) associated with stronger environmental support irregardless of articulatory ability. Three of the four anarthric subjects who became Independent Readers had an ECI rating of over 90%. Two of the four anarthric Independent Readers gained a reading comprehension quotient on the TORC over 70. In both cases these subjects had supportive early reading instruction. The two anarthric Independent Readers with TORC reading quotients under 50 did not begin reading instruction until adulthood. Although one subject had a high ecological rating and one had a low rating, the ratings had been based primarily on their current ecological situation. Neither subject had had educational support to reading as a youngster.

The anarthric Independent Readers provide interesting examples of the influence of ecological support and of reading experience. Within the context of a strong ecological support system, anarthria was not an inhibiting factor in the beginning stages of reading acquisition. The results of Study 2 indicate, however, that even with ecological support being provided and reading abilities progressing past grade 2.9, the phonological recoding skills of persons with SCSPi do not match those of able-bodied persons. The results in the Homophone Word-Pair Task attest to the continuing depressed ability for both anarthric and dysarthric subjects in a task requiring the matching of a generated phonological code with an item in the mental lexicon. This author posits that the restricted reading experience of persons with SCSPi limits the reading progress derived from the reciprocal relationships between reading abilities and the efficiency of phonological processes. This rationale is more aligned with the empirical findings than assumptions that SCSPi impedes reading and that anarthria exacerbates the condition.
A line of argument has been presented that moves from an articulatory limitation rationale for the difficulties in reading acquisition for persons with SC SPI to an ecological and reading experience rationale. The impact of SC SPI and further, the effect of anarthria, upon family and educational support, language and literacy learning opportunities and the expectations of the individual, family and school regarding literacy acquisition would seem to be better viewed as initiating a series of restricting external events rather than as directly causing reading difficulties. The attitudes engendered by SC SPI may well be the primary factor that influences expectations for reading acquisition and sets in motion a complex of inter-related behaviours and beliefs, resulting in limited reading experiences and eventually in reduced levels of reading proficiency. Retarded reading performance that in the past has been attributed to SC SPI and to anarthria may be found to relate to ecological conditions and reading experiences which in turn restrict an understanding of the potential of persons with this diagnosis.

Phonological recoding ability: Responding to Question 2.

Is there a difference between persons with SC SPI and persons with no speech impairment in ability to perform phonological recoding tasks (as distinct from phoneme awareness tasks)?

In responding to Question 2, the distinction made by Vandervelden and Siegel (1995, in press) between phoneme awareness and phonological recoding has been used. Phoneme awareness refers to the ability to analyze spoken words and syllables into their constituent phonemes; phonological recoding is a superordinate term to encompass a set of gradually developing skills related to making use of the systematic relationship between letters and phonemes, the most advanced of which is the decoding of pseudowords.

The results of this investigation indicated no significant difference in ability to perform the phonological recoding tasks between adults with SC SPI and nondisabled children at similar reading levels. Comparisons were made at two levels of reading acquisition: (1) between the SC SPI Pre-Decoder subgroup (N=9) and the Kindergarten Low Reader group (N=66) and (2) between the SC SPI Primary Reader subgroup (N=7) and the Kindergarten High Reader group (N=41). As shown in Tables 3-2-12, 3-2-13, 3-2-14, 3-2-15, the SC SPI subjects showed the ability to perform (a) two recognition phonological recoding tasks — the CVC-NC Word Reading Task and the
Recognition Decoding Pseudoword Task — and (b) a spelling phonological recoding task — Phonemic Word Spelling Task. The SC SPI subjects could not be tested on the Retrieval Decoding Pseudoword Task which was used for the Kindergarten children due to their speech impairment.

On the two phonological recoding tasks which were the same for both the SC SPI and Kindergarten subjects — Phonemic Word Spelling Task and CVC-NC Word Task — no difference in performance level was found that could not be explained by sampling error. The findings of this investigation, therefore, would support the observation of Dahlgren Sandberg (1996) who found no significant differences in phonological ability between the disabled and nondisabled groups in her studies. As reported earlier, however, the tasks used by Dahlgren Sandberg for her comparisons to determine phonological ability were of three types — phoneme awareness tasks, a phoneme synthesis task and a spelling task — none of which involved phonological recoding. Although she found no difference at the phoneme awareness level, Dahlgren Sandberg did find lower reading performance for her subjects with SC SPI than for her speaking control subjects and attributed this to difficulty with active manipulation of information at the phonemic level. For the comparisons between SC SPI and speaking subjects within the present investigation, active manipulation of information at the phonemic level was considered to be operationalized in the CVC-NC Word Task.

The introduction of the new CVC-NC Word Task in both Study 1 and Study 2 afforded a different interpretation of the performance of adults with SC SPI with regard to the manipulation of information at the phonemic level. The CVC-NC Word Task provided a recognition task that required the subject to manipulate information at the phonemic level for which instruction was given during the test situation. No difference was found between subjects with SC SPI and Kindergarten children in performance on the CVC-NC Word Task when instructions were adapted to their age level.

This author would conclude, therefore, that there need be no difference between persons with SC SPI and persons with speech in ability to manipulate information at the phonemic level, i.e., to perform phonological recoding tasks, if adequate instruction has been given. This infers that there is also no difference between persons with SC SPI and speaking persons in the prerequisite skill of phoneme awareness. Support is thus provided for the observation of Dahlgren Sandberg with regard to phoneme awareness. The findings of Study 2 differ from those of Dahlgren Sandberg, however, with regard to phonological recoding. Further support for the capability of persons with SC SPI
with regard to phonological recoding is presented in the Response to Question 3. Additional discussion regarding the role of the environment in reading acquisition is included in the Response to Question 7.

The inclusion of ecological factors is recommended in future studies relating to individuals with SCSP in order to determine the relationship between (1) the level achieved in spelling and reading and (2) literacy expectations and quality of instruction. Of particular interest would be the type, the amount, and the consistency of instruction that has been given to persons with SCSP during their formative years as well as the time period over which the instruction extended. Two skill areas worthy of research attention are spelling without an auditory stimulus and phonological recoding. With regard to the former, opportunities for practice in writing using a computer would be an important factor to examine. For the latter skill area, the amount of explicit instruction given and the attention given to the conscious analysis of and comparisons between both Blissymbols and printed words would be of interest.

**Early development in phonological recoding: Responding to Question 3.**

*Do the results for nonreading adults with SCSP in phonological recoding tasks show a different developmental pattern from the results of nonreading children in late Kindergarten?*

Developmental comparisons were made (a) between the SCSP Pre-Decoder subgroup and the Kindergarten Low Reader group and (b) between the SCSP Primary Reader subgroup and the Kindergarten High Reader group. Analyses were conducted to determine (1) the relationship between performance results on the Phonemic Word Spelling Task (spelling phonological recoding) and the CVC-NC Task (recognition phonological recoding requiring speech-to-print matching with a nonconventional orthography that was taught within the task) and (2) the pattern of performance within the Phonemic Word Spelling Task with regard to letter position responses.

The frame of reference used was derived from the study of Vandervelden (1992) with Kindergarten, Grade 1 and Grade 2 children, in which the analysis revealed a general progression from (a) recognition (speech-to-print) tasks to (b) spelling (from spoken stimulus), to (c) decoding pseudowords (retrieval task) and a partial to full developmental pattern of initial consonant, final consonant then medial vowel processing within the Phonemic Word Spelling Task. Two adaptations to the approach
followed by Vandervelden were made in this investigation to accommodate to the inability of subjects with SCSPI to do the Decoding Pseudoword task in its retrieval form. The following innovations were introduced: (a) a recognition (speech-to-print) form of the Decoding Pseudoword task was administered and (b) the CVC-NC Word Task, a recognition task that required the learning of nonconventional print, was introduced.

The developmental pattern that emerged for both the SCSPI subgroups and the Kindergarten groups was (1) Phonemic Word Spelling ability preceded CVC-NC Word (recognition task) ability (Table 3-2-16-A) and (2) the acquisition of initial consonant, followed by final consonant then medial vowel processing within the Phonemic Word Spelling Task (Table 3-2-16-B). The latter results relating to letter position were consistent with the findings of Vandervelden. The former results, however, differed as to the order of task difficulty that would be predicted from Vandervelden's findings — recognition (speech to print), spelling, pseudoword decoding. The additional processing demands of learning new letter-sound relationships made the CVC-NC Task, while a recognition task, nonetheless more difficult than Vandervelden's recognition task which involved conventional letter-sound relationships. The CVC-NC task provided a new and useful measure on the phonological recoding developmental continuum for nonreaders — appearing after spelling phonological recoding and before the decoding of pseudowords in either the recognition or retrieval format. It offered a recognition task that required the active manipulation of information at the phonemic level.

No direct comparison could be made between the results of the SCSPI and Kindergarten subjects on the Decoding Pseudoword Task since different versions of the task were given in Study 1 and Study 2. An interesting observation could be made, however, in comparing the results of the Decoding Pseudoword Task in both formats with those of the CVC-NV Task for the SCSPI and Kindergarten subject groups. The results for the recognition CVC-NC Task (in which instruction was given for the new letter-sound conventions) showed it to be less difficult than either form of the Decoding Pseudoword Task for the nonreaders in both subject groups (Pre-Decoder SCSPI and Low Kindergarten subjects). The subjects who were readers and therefore had increased phonological recoding ability (SCSPI Primary Readers and Kindergarten High Readers) demonstrated results in both forms of the Decoding Pseudoword Task that were either superior to or equal to the results in the CVC-NC Task. It can be speculated that as the individual becomes more proficient in applying conventional
letter-sound relationships, the ability to apply nonconventional letter-sound associations becomes relatively more difficult.

The lack of any indication of a developmental difference between adult SC SPI subjects and Kindergarten subjects in phonological recoding gives further support to the finding discussed in responding to Question 2. It would appear from this investigation that adults with SC SPI can acquire the phonological recoding abilities needed in reading acquisition. What has not been studied and what remains for further investigation in future studies is the type of instruction and the time required to develop the phonological recoding abilities demonstrated in this investigation.

**Language: Responding to Question 4.**

Is there a difference in language comprehension between persons with SC SPI and persons with no speech impairment?

(a) Is there a performance difference on the standardized CELF-R language assessment subtests between persons with SC SPI and the norms for persons with no speech impairment?

(b) Is there a performance difference on the Syntactic Error Judgement Task (Gotardo, 1995) between persons with SC SPI and nondisabled children at similar levels of reading ability?

(c) Is there a performance difference on the standardized CELF-R language assessment subtests and the Syntactic Error Judgement Task (Gotardo, 1995) between SC SPI Bliss Readers and SC SPI Print Readers?

As described in the Introduction and Theoretical Infrastructure, this thesis rests on a view of reading acquisition as a component within a language and literacy model (McNaughton, 1992a, 1992b; McNaughton & Lindsay, 1995) influenced by the writing of Snow (1991) and Keating (1990), presented in Figure 2-4. Integral to this model is the interaction of the Visual, Social, Auditory, Motor and Symbolic components of language with each component having its own path of development and its own set of social and linguistic facilitators. The language-related tasks considered in this response to Question 4 fall within the Symbolic Representation component of language depicted in the Language and Literacy Pathway Model. The other components of the model are considered within the responses to the following questions: Visual, Question 9; Social, Question 7; Auditory, Questions 1, 2 and 3; Motor, Question 7.
Comparisons with regard to the Symbolic Representation component of language were made (a) between the SCSP1 adult subjects and the norms of the non-speech-impaired population by means of standardized language assessment subtests from the Clinical Evaluation of Language Fundamentals-Revised (CELF-R) (Semel, Wiig, & Secord, 1987), (b) between the SCSPI adult subjects and children of similar reading levels in Grades 1, 2 and 3 by means of the Syntactic Error Judgement Test of Gottardo (1995) and (c) between the SCSPI Bliss Readers and SCSPI Print Readers by means of the CELF-R measures of Expressive Language and Receptive Language and the Syntactic Error Judgement Task (Gottardo, 1995).

The results of the comparison respond to the questions relating to language as follows:

(a) A large performance difference occurred in the standardized CELF-R language assessment subtests between the adults with SCSPI and the non-speech-impaired population norms. The majority of subjects with SCSPI (75%) fell at or below 2 SD's from the mean for the normal population, age 16 years, for both receptive and expressive language subtests. (See Table 3-2-5 and Figures 3-2-3-A, 3-2-3-B.) These results were not taken as accurately reflecting the symbolic representation ability of the subjects with SCSPI, however, due to many potentially contaminating factors. The design of the CELF-R test battery places persons with SCSPI at a disadvantage resulting from additional physical and memory demands of responding without speech, less academic experience, vocabulary limitations, and differences in communication interaction and instructional opportunities.

(b) No difference that could not be attributed to sampling error was found in performance on the Syntactic Error Judgement Task between the subjects with SCSPI and children with similar reading ability in Grades 1, 2 and 3 (Gottardo, 1995). (See Table 3-2-17 and Figure 3-2-23.)

(c) A difference was found between SCSPI Print Readers and SCSPI Bliss Readers in the CELF-R measures of Expressive Language and Receptive Language (Table 3-2-8) and in the Syntactic Error Judgement Task (Table 3-2-7), in favour of the Print Readers. The latter difference was replicated in the findings of Gottardo (1995) with elementary school children, between Grade 1 and Grades 2, 3 (Figure 3-2-23).

Several observations of relevance educationally can be made from the foregoing results. The inadequacy of tests standardized on the non-speech-impaired population for assessing individuals with SCSPI was reinforced. This renders the results of comparisons between SCSPI and non-disabled subjects using the CELF-R subtests.
invalid. Comparisons between groups within the SCSP sample made possible by using these standardized tests, however, performed a useful function. In comparing the readers and nonreaders within the SCSP sample, differences in both expressive and receptive language measures were observed in favour of readers. This raises again the importance of reading acquisition instruction for persons with SCSP whose expressive language experiences are limited as compared to speaking persons.

While the decision to test syntax within this thesis was derived from the mainstream reading research literature, it is important to realize that there is little consensus in this literature with regard to a conceptualization of the relationship between syntactic processing and reading ability. One view holds that reduced syntactic ability in poor readers reflects a genuine deficiency of linguistic endowment (delay in development of complex linguistic structures), termed the structural lag hypothesis (Bentin, Deutsch, & Liberman, 1990; Byrne, 1981; Fowler, 1988). Another position, supporting the processing limitation hypothesis, attributes reduced syntactic ability to deficits in phonological processing (Crain, 1989; Gottardo, 1995; Liberman & Shankweiler, 1985; Mann, Cowin, & Schoenheimer, 1989; Shankweiler, 1989). With another perspective, Tunmer (1989) theorized that phonological and syntactic awareness are both essential for acquiring phonological recoding skills and that syntactic awareness makes an independent contribution to listening comprehension performance. Within his model, syntactic awareness ability was considered vital to reading acquisition.

Gottardo's (1995) results supported the phonological processing limitation hypothesis. Her findings indicated "that phonological processing was a consistent and unique predictor of reading performance across grades 1, 2 and 3. On the other hand, syntactic processing was only a unique correlate of pseudoword reading ability in Grade 1 children" (Gottardo, 1995, p. ii).

It is important, as the findings of this thesis are interpreted, to realize that the link between syntactic processing (as measured by syntactic awareness skills) and reading ability is "unclear and the centre of debate" (Gottardo, 1995, p. 13). For the exploratory purposes of the present study, an interpretation of the performance results on Syntax Error Judgement Task relies upon the Matthew effect explanation of Stanovich (1986). It is recognized, however, that the significance of the findings suffer both from the limited scope of the testing that was undertaken and from the lack of theoretical agreement in the mainstream reading research on this topic. Interesting
results, nevertheless, were found as the performance levels of SCsPI subjects and nondisabled subjects were compared.

No difference in performance on the Syntax Error Judgement Task was shown between SCsPI subjects and speaking subjects at the same reading level. This finding further supports a reciprocal relationship between reading acquisition and language skills. As well, it demonstrates the language achievement that is possible by persons with SCsPI, albeit exhibited at an older age level. The use of a recognition task revealed a similar developmental difference for both the SCsPI and non-disabled groups. As reading level increased, so did scores in the Syntax Error Judgement Task, with a levelling off as the SCsPI subjects became Primary Readers and Independent Readers and as the non-disabled subjects became Grade 2 and Grade 3 students. (See Table 3-2-17 and Figure 3-2-23.) The importance of testing procedures that are appropriate for both SCsPI and non-disabled subjects was reinforced.

The comparisons between the SCsPI subjects in this investigation and non-disabled subjects (Gottardo, 1995) at similar reading levels (a) demonstrated a positive relationship between reading level achieved and the ability to symbolically represent language and (b) failed to demonstrate a negative relationship between ability to symbolically represent language and lack of functional speech. These findings are consistent with a position that (a) Blissymbol usage can provide a base for the development of symbolic representation of language and (b) reading acquisition strengthens the symbolic representation of language when it is built upon a Blissymbol language base, as it does when built upon the foundation provided by speech. The educational implications are that literacy expectations for individuals who use Blissymbols effectively for communication should not be negatively influenced by the results of standardized language measures.

It should be noted that the results in this thesis were congruent with the within-group analyses of reader and nonreader disabled subjects by Dahlgren Sandberg with regard to language. Although the tests used in this thesis to measure verbal comprehension/receptive language differed from those used by Dahlgren Sandberg, they appear to have tapped a similar capability. Dahlgren Sandberg tested verbal comprehension by (a) sentence comprehension through a story being read to the subject and the selection of a picture that matched each sentence being required and (b) syntactic knowledge through the subject matching mature and beginning syntax with the appropriate person (child or mother) in a photograph. In this thesis, Receptive Language (verbal comprehension) was tested through the Oral Direction, Word
Classes and Listening to Paragraph subtests of the CELF-R and syntax was tested separately in the Syntactic Error Judgement Task (Gottardo, 1995). In both investigations, the verbal comprehension/receptive language performance results were lower for subjects with SCSPI than for the nondisabled population.

Working Memory: Responding to Question 5.

Is there a difference in performance on a verbal working memory task between persons with SCSPI and nondisabled persons, and among persons with SCSPI at different reading levels?

As speculated earlier in this thesis, in presenting the assumption underlying Question 5, the belief that persons with SCSPI having difficulty in working memory tasks appears to rest on the concept of limited cognitive resources. It presupposes that persons with SCSPI have additional verbal processing demands placed upon them and as a result they have less functional working memory capacity. This is attributed to reduced capacity for storing information resulting from the processing demands consuming more of the available capacity.

p. 96.

The application to reading acquisition of a limited resource conceptualization of working memory was derived from reading models of the seventies, e.g., the model of LaBerge and Samuels (1974). Working memory was viewed as including both storage and processing functions. The two functions were conceived as trading off against the other so that a computationally demanding processing task would consume more of the available capacity, leaving less capacity for storing information. This view formed the theoretical underpinning for the study by Daneman and Carpenter (1980) in which they hypothesized that skilled readers have larger functional working memory capacities than less skilled readers. The reading span test they developed required the simultaneous processing and storage of information in working memory. The rationale underlying the test was that the comprehension processes used in reading the test sentences would consume less of the working memory resources of the better readers.
They would thus have more residual capacity to perform the second task required in the test, storage of sentence final words.

As Fodor’s (1983) modularity theory began to influence reading researchers, a refinement became possible in the relationship between resource conceptualization and reading. The issue of resource usage began to be separated away from speed and obligatory executions in reading and there was movement toward questions of representation quality and encapsulation. Stanovich (1990) identified a major theoretical trend in developmental reading theory, that viewed "word recognition as becoming increasingly encapsulated (informationally) as processing efficiency develops " (p. 83). Thus, informational encapsulation, rather than resource usage, was emphasized as the defining feature of word recognition. Informational encapsulation assumes that "the operation of a processing module is not controlled by higher-level operations or supplemented by information from knowledge structures not contained in the module itself" (Stanovich, 1991a, p. 428). Stanovich (1990) referred to a related theoretical shift outside the reading area, e.g., Logan's (1988) instance theory of automatization in which nonautomatic performance is limited by lack of domain-specific knowledge rather than scarcity of resources.

The changing conceptualization with regard to working memory and reading is reflected in a study by Daneman and Tardif (1987) in which they conducted extensive individual difference analyses. They expressed concern about the complexity of the processes involved in the reading span test and the resulting difficulty in interpreting their findings. Stanovich (1990, p. 90) quotes them as concluding that: "The findings of the larger study showed a high degree of domain specificity.... Reading is limited by a system specialized for representing and processing verbal or symbolic information only... The picture suggests the need for abandoning the notion of a general and central limitation on information processing, a central executive" (Daneman & Tardif, 1987, pp. 501-502).

The new emphasis upon information encapsulation rather than resource usage for the phonological recoding associated with word recognition in the early stages of reading acquisition has important implications for the interpretation of the reading performance of persons with SCSP. Viewing the essential phonological recoding skill as modular and dependent on the quality of lexical representations places attention upon the development of high-quality representation in memory that allows autonomous access. The emphasis shifts from capacity use to explicit knowledge that contributes to phoneme awareness and phonological recoding. This recent evolving of a new
conceptualization, only since the mid-eighties, can explain how an assumption persisted
that related the lower reading achievement of persons with SCSPI with limited
memory resources. Superficially, it was easy to make an association between greater
processing demands in verbal working memory caused by a severe speech impairment
and difficulties with phonological recoding. Information encapsulation of the
phonological recoding process, however, provides a conceptual base for refuting the
application of a limited capacity theory to the skill acquisition involved in beginning
reading.

Although the results of the testing of verbal working memory in the present
study cannot be applied to issues relating to phonological recoding within word
recognition, they can be examined with reference to higher cognitive and language
processes, i.e., to the relationship of working memory capacity to reading
comprehension. At the higher processing level, the capacity theory of Just and
Carpenter (1992) can be applied. This theory proposes a dynamic allocation of a
constrained cognitive capacity. It predicts that individual differences in a single
component process could generate differences in total capacity and hence constrain
comprehension. It is well to remember Stanovich's (1980, 1984) interactive-
compensatory model in this context, as presenting theoretical support for a positive
implication of dynamic resource allocation.

The distinction between (a) information encapsulation as the defining feature of
word recognition and (b) limited resources as a useful construct describing higher
cognitive processing has been important to introduce. The distinction serves as a
theoretical underpinning for the following remarks regarding the results on the verbal
working memory task being directed to reading comprehension and not to reading
acquisition.

The subtest and full test scores of the Working Memory Task (Gottardo, 1995)
were examined to determine if there was a potential relationship between functional
verbal working memory processing and a severe speech impairment and between
functional verbal working memory processing and reading level of persons with
SCSPI. The following performance results were found:

(a) A full range of performance by anarchic subjects was found in the full test
scores of the Working Memory Task; however, in comparing anarchic and dysarthric
subjects, the former presented lower scores (Figure 3-2-17-F).

(b) The SCSPI Bliss Readers, while performing at a level similar to Grade 1
and Grade 2 nondisabled children in the True/False subtest of the Working Memory
Task (Gottardo, 1995), performed lower than Grade 1 nondisabled children in the Recall subtest of the Working Memory Task. In contrast, the SC SPI Print Readers performed higher than Grade 3 children in both subtests of the Working Memory Task (Table 3-2-17).

(c) The results for the full Working Memory Task for the SC SPI subgroups showed an increase in performance level along with higher reading ability (Figure 3-2-14).

The demonstrated full range of Working Memory Task scores for anarthric subjects and the gaining of high scores by subjects at both anarthric and dysarthric articulatory levels, failed to support the assumption that additional verbal processing demands due to a speech impairment result in less functional verbal working memory capacity. The increased performance level in both the Recall and True/False subtests concomitant with higher reading ability in the SC SPI subjects was consistent, rather, with a relationship between verbal working memory and reading achievement.

The difference between the SC SPI Pre-Reader and Pre-Decoder subjects and the Grade 1 subjects in the Recall subtest of the Working Memory Task lends further support to a relationship between verbal working memory and reading achievement. The results indicate that those SC SPI adult subjects who had not mastered phonological recoding performed at a lower level than beginning readers (Grade 1 nondisabled children) on a listening comprehension task requiring working memory. On the other hand, SC SPI adult subjects who have mastered phonological recoding outperformed Grade 3 children. It is interesting to note that the results on the Working Memory True/False test and the Syntactic Error Judgement task were consistent with this finding. Performance on both these tasks showed similar patterns of increased performance for the SC SPI adult subjects and the nondisabled children as they progressed in reading level. (See Table 3-2-17.) Overall, these findings lend further support to a relationship between receptive language or listening comprehension with reading comprehension and can be interpreted as complementing those pertaining to the ability to symbolically represent language, previously discussed in response to Question 4.

The relationship of verbal working memory performance scores with higher reading ability can be interpreted in several ways. Verbal working memory abilities can be viewed as influencing reading acquisition; reading ability can be viewed as influencing working memory abilities; or a reciprocal relationship between these two variables can be assumed. Rather than speculating on the direction of a causal effect, the
interpretation placed upon the results in this investigation is that of a reciprocal relationship between verbal working memory and reading ability. There are many precedents in mainstream reading research for assuming a reciprocal relationship between reading ability and the cognitive skills related to reading (e.g., Backman, 1983; Ehri & Wilce, 1980; Stanovich, 1986; Walberg et al., 1984). Smith (1992) gave special attention, as well, to this approach in her case study of the reading abilities of two nonspeaking students.

An approach that views reading and cognitive related variables as reciprocal and facilitative yet separate, as with all the components of the Language and Literacy Pathway (McNaughton, 1992a, 1992b; McNaughton & Lindsay, 1995), is compatible with an acceptance of modular processing for phonological recoding. In early reading acquisition, information encapsulation and lexical representation quality are primary factors relating to phonological recoding. Once phonological recoding has been acquired, reading comprehension and verbal working memory abilities can be viewed as interacting with each other as they develop (Figure 3-2-14). As such, they can be viewed as developing within an endogenous constructivist approach. This does not preclude, however, an exogenous constructivist approach to the acquisition of phonological recoding skills. In early reading acquisition, explicit instruction provides the domain specific information for the high-quality representation in memory required in modular processing.

In summary, (a) the findings of the empirical investigation fail to support a connection between verbal working memory difficulties and different degrees of articulatory impairment, (b) a theoretical argument is presented to refute the belief that verbal working memory as tested in this study plays an important role in reading acquisition, and (c) the empirical findings can be interpreted as demonstrating a reciprocal relationship between verbal working memory performance and reading comprehension.

World Knowledge: Responding to Question 6.

Is there a measurable difference in world knowledge between persons with SCSPI and nondisabled persons, and among persons with SCSPI at different reading levels? i.e., Using performance on the Word Classes subtest of the CELF-R and on the True/False subtest of the Working Memory Task (Gottardo, 1995):
(a) Is there a difference in performance on the Word Classes subtest of the CELF-R between the subjects with SCSPI and the norms for persons with no speech impairment?

(b) Is there a difference in performance on the True/False subtest of the Working Memory Task (Gottardo, 1995) between the subjects with SCSPI and persons with no speech impairment?

(c) Is there a performance difference between persons with SCSPI at different levels of reading ability on the Word Classes subtest of the CELF-R and the True/False subtest of the Working Memory Task?

(a) The result of the full group of SCSPI subjects on the Word Classes subtest of the CELF-R was a mean standard score of 3. This score represents performance lower than —2 S.D. of the mean of the nondisabled population, age 16 years. A difference in world knowledge between persons with SCSPI and the norms for persons with no speech impairment was therefore supported.

(b) Comparisons on the True/False subtest of the Working Memory Task between the adults with SCSPI and persons with no speech impairment was made with the students in Grades 1, 2 and 3 tested by Gottardo (1995). This was the only comparison group for which data was available. These comparisons showed the SCSPI Print Readers scoring above the Grade 3 students, and the SCSPI Bliss Readers scoring at the level of the Grades 1 and 2 students (Figure 3-2-23).

(c) A statistically significant difference on the Word Classes subtest of the CELF-R between Bliss Readers and Print Readers (t=5.988, p<.0001) was found, demonstrating a difference in world knowledge between the two groups in favour of the Print Readers. Heterogeneity of variance precluded a statistical comparison being conducted using the results of the True/False subtest of the Working Memory Task. The pattern of scores for this subtest across the SCSPI subgroups, however, showed an increase in world knowledge with higher reading levels (Figure 3-2-23).

These findings are consistent with persons with SCSPI having more restricted world experiences than able-bodied persons. The findings also support the view of a reciprocal relationship between literacy and world knowledge. The SCSPI Print Readers exceeded the SCSPI Bliss readers on the two world knowledge measures used in this investigation. Nonetheless, as measured by the Word Classes subtest of the CELF-R, the world knowledge of the SCSPI Print Readers was still much lower than the norm for 16-year-olds without disabilities. The results of these analyses further
support an interpretation of reciprocity between reading acquisition and reading related measures — in this instance, between reading acquisition and world knowledge.

Ecological factors: Responding to Question 7.

Is there a relationship demonstrated between ecological rating and reading level achieved?

There was no single requisite ecological factor rated positively for all Print Readers and negatively for all Bliss Readers. Several strong factors emerged, however, to demonstrate a relationship between ecological rating and reading level achieved. An important finding was a cumulative affect: the larger the number of positive ecological influences experienced by an individual, the higher the reading level reached. The Ecological Composite Index (ECI) provided a means of portraying a statistically significant difference between the Bliss Readers and Print Readers.

Through examining the histograms for the subgroups on all of the ecological factors (Figures 3-2-26 through 3-2-35), several combinations of predictive factors emerged. There was a sharp contrast in favour of the Independent Readers between this subgroup and Pre-Readers in teacher support, quality of literacy instruction, time spent in literacy instruction, ability to turn pages independently, and family expectations for literacy during their formative years. It is interesting that there was an increase in positive teacher rating for the Pre-Decoding subgroup over the Pre-Reading subgroup, suggesting that some educational attention had been given to initiating literacy instruction for the subjects who became Pre-Decoders. The overall negative ratings for quality and time given to literacy instruction and family expectations for most members of this subgroup, on the other hand, suggested that lack of consistent follow-through or of a comprehensive program could be offered as a possible explanation for the subjects remaining at a Pre-Decoding level.

Time spent in literacy instruction remained a negatively rated factor for Primary Readers (Figure 3-2-37-C). In addition, more than half of the Primary Readers rated the quality of literacy instruction negatively and none of the subjects rated the quality of literacy instruction as "high" (Figure 3-2-27-B). The Independent Readers were the only subgroup to have a positive rating for all members for both supportive home residence during their formative years and family literacy expectations. The Independent Readers also were the only subgroup in which all members had computer access in addition to the ability to access reading materials independently.
The Independent Readers' access to an AAC system for expressive language was also high. All the Blissymbol users (N = 8) in this subgroup had access to a display of over 200 symbols, with most of the subjects (N = 5) having used a display of over 500 symbols. The one subject in the study who had never used Blissymbols (subject TB in the Independent Reader subgroup) reported that his speech was understood by his family. He credited this access to spoken conversation in addition to private tutoring as providing him with the opportunity to develop a rich expressive language. His Expressive Language score was the highest of all subjects (standard score =129).

It is interesting to note as well that the Pre-Reading subgroup had but one subject who attempted to use speech frequently. In the Pre-Decoder, Primary Reader and Independent Reader subgroups, 43%-44% of the subjects attempted to use speech during the assessment. This was interpreted as demonstrating that speech sometimes proved to be effective for these subjects. The most likely situation where this would occur would be in the home. Support to this interpretation was found in the relationship between Place of Residence during Formative Years and Speech Reliance. One subject who "tried to speak often" and another subject who "tried to speak a little" were brought up in institutions. The remaining ten subjects who "tried to speak often" grew up in home situations. It should be noted that while attempts to use speech during assessment could indicate that a subject successfully used speech in the home situation, the reverse cannot be inferred. As an example, subject TB made no attempt to use speech with the investigators. He explained to the researcher that as a young child he relied extensively on speech. As an adult, however, he discriminated between those who would understand his speech and those who would not, and adjusted his communication mode accordingly. It should also be noted that Attempts to Use Speech showed no relationship with scores attained in Expressive or Receptive Language.

At the microsystem level (Bronfenbrenner, 1979), the findings of this investigation support the position of Lundberg regarding the importance of early childhood family experiences (Figures 3-2-26, 3-2-28, 3-2-29). As well, the ratings relating to Quality of Literacy Instruction and Time Spent in Literacy Instruction (Figures 3-2-37-B, 3-2-37-C) are consistent with Koppenhaver and Yoder (1993) when they reported less literacy instruction for children with severe physical disabilities than for their nondisabled peers. The findings of the current study relating to quality of literacy instruction and time spent in literacy instruction are also consistent with the
results of the Lindsay, Cambria, McNaughton and Warrick (1986) survey in which teacher's goals were shown to not include literacy instruction.

In comparing the results of this investigation with those of Light, Koppenhaver, Lee and Riffle (1992) who found that 48% of the parents expected their children to achieve functional literacy, the findings were similar. Positive literacy expectations were held for 53% of the total number of subjects participating in Study 2. When the results of Study 2 were broken down between those subjects who achieved print literacy and those who did not, positive literacy expectations had been held for 21% of those who remained Bliss Readers and positive literacy expectations had been held for 81% of those who became Print Readers.

The positive relationship between independent ability to turn pages and reading level achieved deserves special attention. This finding depicts a critical difference between persons with SCSP and nondisabled individuals as to opportunities for numerous early independent reading experiences. It is interesting to note that Share (1995), in reviewing the research literature and arguing that phonological recoding is the *sine qua non* of reading acquisition, comments as follows in his closing paragraph:

> The strong claim made here regarding the indispensability of phonological recoding may seem trivial in the sense that the ability to turn pages is also a *sine qua non* of successful reading acquisition. But page-turning skill is not a source of difficulty for most learners; the abstract nature of the speech units mapped by an alphabet is.

> Share, 1995, p. 201.

In mainstream reading acquisition research, independent access, for most individuals, can be taken for granted. In AAC reading acquisition research, it is a critical variable. Both independent access and explicit instruction to support the acquisition of phonological recoding are considered within the computer mediated communication (CMC) approach described in the Educational Application proposed in this thesis. An increased understanding of the ecological factors influencing each individual's reading performance is derived from an Ecological Checklist. The specific areas relating to phonological recoding and requiring explicit instruction are derived from the individual's Reading Profile.

While not addressed directly through data collection within this investigation, the type of communication programs to which most of the subjects were exposed
during their formative years is known by the author from her involvement in the Formative Evaluation Study of Blissymbol Users undertaken in the mid-seventies (Silverman, McNaughton, & Kates, 1978). In addition, factors related to the mesosystems, exosystem and macrosystem influencing the development of the subjects of this thesis in the seventies is known by the author from her experience in the field of AAC.

It is of interest that the subjects who were born in the fifties and thus were raised before the advent of formal augmentative and alternative communication (AAC) systems showed almost equivalent numbers of Print Readers and Bliss Readers. In looking more closely at their results (Table 3-2-23), it was evident that the influence of the microsystem outweighed that of the other ecological levels. Home support, literacy expectations, opportunities for reading experiences, along with quality of literacy instruction, played strong roles in reading acquisition.

The most important change to occur for many of the subjects in this study was the downsizing of institutions in the early seventies and the introduction of services to prepare for community integration. This had ramifications at the mesosystem and exosystem ecological levels that made possible the introduction of communication programs to adults who had been born in the fifties. As shown in Table 3-2-23, five of the adults born in the fifties did not have communication programs initiated until they were adults and four of them began formal communication programs as adolescents. Of the three subjects born in the fifties who achieved independent reading, two of them (LM and TB) learned to communicate using print in their primary years, one in a special education classroom and one with tutoring at home three days a week. One subject (IB) was introduced to a formal communication system as a young adolescent and became an Independent Reader. He began using Blissymbols at age 12 and was introduced to a functional reading program for four years in his teens. It was not until he was age twenty-seven that he was able to participate in an adult literacy training program — a program that he still attended at the time of this study.

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7 A Functional reading program typically consists of a basic sight vocabulary designed to meet the activities of daily living, social interaction and safety needs of the individual.
Reading related variables: Responding to Question 8.

Is the pattern of results in reading related and reading acquisition tasks similar for adults with SCSPi who have not yet acquired the ability to decode and able-bodied children at the onset of reading (late Kindergarten)?

As is apparent from Table 3-2-12 and responses to preceding questions, the differences in performance on reading related and reading acquisition tasks between Kindergarten children and SCSPi adult Bliss Readers were minimal. The exceptions were performance in the Primary Word Reading and Visual Analysis Retrieval Tasks. The differences in Primary Word Reading can be explained by the many years of exposure to the words accompanying the Blisymbols on the users' communication displays and the "reading readiness" or "functional reading" activities included in many Blisymbol instructional programs (Silverman, McNaughton & Kates, 1978). Related anecdotal experience was reported in Section II in describing the first Blisymbol instructional program in the seventies (Silverman, McNaughton & Kates, 1978). After two years of Blisymbol instruction, which included early reading readiness activities,8 three of the four students who were using 340 Blisymbol displays recognized over 75% of the words appearing over the symbols on their displays. They demonstrated no phonological recoding abilities. As shown in this study, there can be a wide discrepancy between sight word recognition and phonological recoding skills. It is important that the results of the Primary Word Reading Task not be considered in isolation.

The differences between Kindergarten children and SCSPi adults in performance on the Visual Analysis Retrieval Task are discussed in response to Question 9 that follows. The most notable difference, that is relevant in comparing SCSPi adults and Kindergarten children at the onset of reading, is the low mean score of SCSPi Bliss Readers \( (M = 57.33) \) compared to Kindergarten High Readers \( (M = 84.88) \), Kindergarten Low Readers \( (M = 77.27) \) and the SCSPi Print Readers \( (M = 77.53) \). Since both the Kindergarten groups were new to the task of learning Blisymbols, it was expected that their performance would be lower than that of Bliss

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8 The "reading" activities included in this program are described in the section entitled Experience Derived from Blisymbol Programs in the Rationale for Educational Application, Theoretical Infrastructure. No attention was directed to phonological decoding within this program.
users. Yet the performance of the Kindergarten subjects was similar to SCSPri Print Readers and exceeded that of the SCSPI Bliss Readers.

Of relevance for reading instruction is the recognition that the ability to analyze Blissymbols into components cannot be inferred from Bliss usage. Rather, the development of this ability seems to require guidance in directing attention to the visual components of the Blissymbols. If beginning reading programs are to take advantage of the shared Type Two symbol structure of both Blissymbols and print, it would seem that explicit instruction is needed. This instruction would direct attention to the analysis of Blissymbols into their semantic components and draw on this experience as attention is directed toward the analysis of words into their phonemic components.

The small number of differences in reading related tasks between Kindergarten children and SCSPri adult Bliss Readers seems best explained by the argument already presented in response to Questions 4, 5 and 6 in which differences were observed in favour of the nondisabled population. A reciprocal relationship is posited between reading acquisition and the reading related factors. Explicit instruction is needed by many individuals in order to acquire beginning reading skills. For both the Kindergarten Low Readers and the SCSPri adult Bliss Readers, this instruction was lacking, albeit for different reasons. Many Kindergarten children were not developmentally ready to attend to the phonemic features of words required for reading acquisition. Many SCSPri adults lacked the opportunity to have their attention so directed. Without explicit instruction in skills related to reading acquisition, the reciprocal relationships between reading acquisition and reading related abilities had not had the opportunity to develop.

The similarity of results between adults with SCSPri and children who are nondisabled on reading related and reading acquisition tasks would seem to indicate that the same educational intervention would be appropriate for the two groups. This author agrees with such a conclusion if the intervention is "the best it can possibly be". Being the best, however, requires every advantage being taken of current knowledge and technology and attention being directed toward each learner's individual strengths and weaknesses. In teaching persons with SCSPri, recognition must be given to (a) possible weak areas resulting from limited exposure to print, e.g., language, working memory, world knowledge, (b) the adaptive cognitive strategies that an individual with SCSPri develops in order to communicate effectively and (c) the increased time and effort that is required in order to develop the skills that contribute to reading acquisition.
Possibly the most important factor is the time requirement of persons with SCSPI. With physical bodies that behave in uncontrolled and unpredictable ways, the simplest and most routine activities can take extensive lengths of time and effort. Communication with any form of augmentative communication takes much longer than speech. Progress in reading acquisition can be slower compared to able-bodied individuals due solely to the extensive time and effort required to participate in reading related activities and to produce written and interpersonal communication. Instructors may not be prepared for a longer time frame or to utilize adaptive technology to minimize the demands placed upon the person with SCSPI. In such instances, a set of responses and attitudes can develop that result in a premature and negative assessment of the learner's ability. Instruction and expectations can be redirected away from literacy, and critical explicit instruction can be withdrawn.

An important area for future study is the time and effort required by different children with SCSPI to acquire the necessary skills for reading acquisition. The results of this current investigation indicate that the skills required for reading can be learned. Explicit instruction is needed, however, along with expectations of success and a time frame that is appropriate for the individual.

Visual processing: Responding to Question 9.

Do the results on visual processing tasks indicate a potential relationship between type of visual processing undertaken in the use of the individual's GRS and performance on tasks related to reading performance?

Four sets of analyses were examined regarding a potential relationship between visual processing and reading performance. This resulted in the following observations:

1. Among the 104 Kindergarten subjects in Study 1 for whom test results were analysed, a difference was found between the distribution of scores for the Visual Analysis Retrieval Task and those of the other two visual tasks (Figure 3-1-7).

2. Among the 104 Kindergarten subjects in Study 1 for whom test results were analysed, a relationship, albeit a weak one, was found for performance on the Visual Analysis Retrieval Task with performance on the Phonemic Word Spelling Task, the Phoneme Segmentation Task (Yopp-Singer, 1988), the Decoding Pseudowords Task (Vandervelden, 1992) and CVC-NC Word Task (Table 3-1-9).

3. Differences were found between (1) Kindergarten High and Low Readers and (2) SCSPI Print and Bliss Readers in performance on the Visual Analysis
Retrieval Task (Type Two symbol processing). No differences in either the Kindergarten or SCSPR subject groups were found between the readers and nonreaders in performance on the Picture Identification or Visual Matching Tasks (Type One symbol processing).

4. Within the reader and nonreader groups in both the Kindergarten and SCSPR subjects, performance was higher for the two tasks tapping Type One symbol processing — Picture Identification Task and Visual Matching Task — than for a task requiring Type Two symbol processing — Visual Analysis Retrieval Task.

5. Within the Kindergarten sample of Study 1, in which the number of subjects was large enough to warrant computing Pearson product moment correlations, a statistically significant relationship, albeit small, was found in the Low Readers and not in the High Readers, for the Visual Analysis Retrieval Task with the Phonemic Word Spelling Task — the phonological recoding task at the lowest developmental level.

The findings from these analyses were interpreted as indicating (1) that a different type of processing is required in a picture identification task or a visual matching task than is required in a visual analysis retrieval task; (2) that a relationship was demonstrated between performance in the Visual Analysis Retrieval Task and reading level achieved; whereas no relationship was found between performance on the Picture Identification and Visual Matching Tasks and reading level achieved; (3) that the visual analysis retrieval ability comes later in development than either picture recognition or visual matching; (4) that a relationship between performance on the Visual Analysis Retrieval Task and phonological recoding is more likely to occur at an early developmental level within reading acquisition. All these observations are supportive of a possible developmentally limited relationship occurring between the processing operationalized by the Visual Analysis Retrieval Task and phonological recoding.

It is interesting to note that the largest differences in performance level for the Visual Analysis Retrieval Task occurred between the Bliss Readers (M = 57.33) and the other three groups (Low Kindergarten Readers, M = 77.27; High Kindergarten Readers, M = 84.88; SCSPR Print Readers, M = 77.50). These findings indicate that the Bliss Readers were less skilled in analyzing the Blissymbol test items into their component parts in order to retrieve them than the other groups. As well, it was observed that the Kindergarten children who had yet to acquire phonological recoding ability (Low Readers), the Kindergarten High Readers, and the SCSPR adult readers
(who had used Bliss prior to reading print) were all able to learn a visual analysis retrieval task with Blissymbols.

The question must be asked, why the Bliss Readers experienced more difficulty in the Visual Analysis Retrieval Task than the other three groups. The explanation that can be suggested in this investigation is that these Bliss users either never broke free of the holistic processing of Blissymbols or they returned to the holistic processing of their symbols after having analytically processed the symbols at an earlier stage in their development. Concomitant with their limited ability to analytically process Blissymbols, they demonstrated an inability to analytically process print. They lacked the ability to treat letters and phonemes as abstractable and manipulable components of printed language. The most likely reason that can be offered for these subjects remaining at a holistic processing stage for both Blissymbols and print relies on the ecological results in this investigation. A statistically significant difference was found in the ecological composite index (ECI) between the Bliss Reader and Print Reader groups. In addition, there were three specific areas in which differences were noted. The Bliss Readers had lower ratings than the Print Readers for family/school literacy expectations during formative years and gave the lowest ratings to literacy instruction and teacher support. It is unfortunate that information was not available as to the manner in which subjects had been taught Blissymbols. Documentation as to the attention given to the components of symbols as they relate to decoding the symbols to arrive at their meaning would have been valuable.

The results related to visual processing provide support to the position of McNaughton and Lindsay (1995) that (a) there is a need to distinguish between two types of representational structures in AAC graphics and that (b) there are differences in ability to process Type One and Type Two AAC graphics. In addition, the results point to the need for consideration of the visual processing factors characterized by Type One and Type two symbols as being developmentally limited and hence only observable in the earliest stage of reading acquisition.

No causal connection can be inferred from the relationship that was demonstrated between visual analysis retrieval performance and reading ability. The pattern of the results, however, which showed holistic processing ability preceding analytic processing ability and higher analytic processing ability occurring with the more advanced reading groups provides an interesting parallel with the findings of mainstream reading researchers (e.g., Byrne, 1992; Byrne & Carroll, 1989; Ehri, 1992; Ehri & Wilce, 1987b). The developmental model of reading acquisition which
emphasizes the progression from holistic to analytical processing is particularly relevant with regard to the findings for the visual processing of AAC graphic symbols.

The results of this study indicate a potential relationship between type of visual processing undertaken in the use of the individual's GRS and performance on tasks related to reading performance and reading level achieved. In addition they support the need for continued research into the contributing role in reading acquisition that may be played by explicit instruction in the analytical processing of Type Two symbols. Documentation in future research is needed regarding the type of instruction that accompanies the introduction and use of both Blissymbols and print for the findings in this investigation have shown that they both can be processed either holistically or analytically after many years of exposure. Much more information is needed regarding the impact instruction may have upon the type of processing that takes place. If there is an effect upon reading acquisition to be realized from the use of Type Two symbols, the results of this current study suggest that type and quality of instruction will be a strong factor.

Intelligence: Responding to Question 10.

Are the performance results in the Test of Nonverbal Intelligence (TONI) related to reading level?

The results on the Test of Nonverbal Intelligence (TONI) showed a pattern of increased performance level with increased reading level (Figure 3-2-13). The distribution of scores for the full SCSP1 sample had a bimodal distribution with a statistically significant difference ($p < 0.0007$) between SCSP1 Print Readers and SCSP1 Bliss Readers in favour of the Print Readers (Figure 3-2-3-C). The mean quotient score for the Print Readers ($M = 84.69; S.D. = 13.00$) lies approximately 1 S.D. below the norm mean of the nondisabled population (age 30-0 to 49-11 years); the mean quotient score for the Bliss Readers ($M = 68.48; S.D. = 10.57$) lies approximately 2 S.D. below the norm mean of the nondisabled population (age 30-0 to 49-11 years) (Table 3-2-7).

The interpretation of the results follows the same argument as for language, working memory and world knowledge. A reciprocal relationship between nonverbal intelligence, as measured with TONI, and reading acquisition is argued as being the most appropriate explanation for the lower TONI scores associated with lower reading performance. The same caution is offered with regard to interpreting TONI results as with working memory, language or world knowledge scores. Low performance on any
of these reading related variables should not be taken as an indication of inability to benefit from reading intervention. Ecological support must be examined as the possible primary factor influencing performance on both reading acquisition and reading related tasks. Within the context of this thesis, the Ecological Checklist must be given equal consideration with the Reading Profile in any decisions relating to educational intervention.

It should be noted that the inclusion of TONI within the Reading Profile should not be viewed as support of nonverbal intelligence being used as the sole measure of intelligence. The argument presented in Section II with regard to the inadequacy of the Raven's Progressive Matrices Test used by Dahlgren Sandberg is applied by this author to the TONI as well. The TONI was selected as it had been used by Foley (1989, 1993) and because it could be administered without adaptation to persons with SCSP. It is viewed as providing an indication of visual perception and spatial organizational abilities. Its inclusion and the lower scores achieved by persons with SCSP (M = 75.97, quotient score; Table 3-2-5) serve as an indication of the lower performance of persons with SCSP in these areas.

Implications of Results for Future Research

The theoretical framework provided by the Language Pathway to Literacy (McNaughton, 1992a, 1992b; McNaughton & Lindsay, 1995) (Figure 2-4) and the Model of Symbolic Representational System Learning (McNaughton & Lindsay, 1995) (Figure 2-3) are offered as components of a conceptual base from which many questions can be generated. Studies including comparisons with the findings from both mainstream reading research and previous AAC literacy studies are recommended. It is hoped that future research will continue to address a broad range of specific reading related skill levels and specific ecological support factors for persons with SCSP.

The responses to the Key Questions set forth within the Goals of Study 2 evoke the need for refinements to the questions to be asked in future research. In place of the emphasis upon articulatory ability as a determinant of reading acquisition, a shift is proposed to areas of ecological support, specifically with regard to family and school expectations and the nature of instruction. Of heightened interest to this author are the life and educational experiences of those who remain Bliss Readers and how they differ from those of individuals who acquire print literacy — both individuals with SCSP and individuals who are able-bodied.
A greater understanding is needed regarding the attitudinal support provided by the family and school and the specific features of instruction required by individuals whose lives follow a different path due to SCSPI. The results of the current study demonstrate that many persons with SCSPI have the native abilities to bring to the educational process. This author would now argue that limitations in the area of phonological recoding are more likely caused by inadequate instruction than by physiological impairments. Influential exogenous factors must be given greater attention in studies related to the limited reading acquisition of persons with SCSPI.

Greater understanding is needed of the reciprocal relationships within the context of SCSPI between specific ecological factors and the developmental patterns of reading acquisition and reading related variables. Both extended time requirements and compensatory strategies require research attention. More needs to be known regarding a potentially slower pace of reading acquisition resulting from differences integral to the lives of persons with SCSPI. In addition, more information is needed regarding the cognitive strategies that can be developed by persons with SCSPI to apply to reading acquisition. Lastly, the effect of different types of explicit instruction for persons with SCSPI in the area of phonological recoding must be examined. Educational strategies that can relate to and maximize the unique skills AAC users bring to the reading acquisition process need to be evaluated. Paramount in all future studies is the recognition and documentation of the unique capabilities of individuals who have SCSPI. The value of future investigations in this area will be twofold: The findings will contribute to the development of knowledge within the broad field of reading acquisition; the expanded knowledge will contribute to further improvements in instruction for those with SCSPI.

Implications of Results for Instruction

Differences in ecological ratings (Figures 3-2-26 to 3-2-35) and in performance on the test battery among the SCSPI subgroups (Table 3-2-18) provide a framework for an instructional program. A distinction has been made in the role played by the ecological and reading acquisition factors and that played by the reading related factors. Although somewhat contrived, the ecological and reading acquisition factors are
treated as determinants\(^9\) of reading progress whereas reading related factors are considered to have a reciprocal relationship with reading acquisition, as discussed in the preceding section relating to future research. The ecological and reading related factors are viewed primarily as contributing to an understanding of the why of the individual's performance. The reading acquisition measures, on the other hand, are treated as skills to be developed through explicit instruction and the provision of appropriate experiences.

The salient reading acquisition measures differentiating the two subgroups of Bliss Readers (Pre-Readers and Pre-Decoders) were the Consonant Name and Sound Tasks, the Phonemic Word Spelling Task, the CVC-NC Word Task and the Recognition Decoding Pseudoword Task. The performance levels on these tasks identify the target skills for explicit instruction at the onset of reading acquisition.

Performance on the Consonant Name and Sound Tasks were the earliest developing measures to differentiate the Pre-Readers from the Pre-Decoders. This suggests that explicit instruction relating to consonant names and sounds would be appropriate for Pre-Readers wishing to undertake literacy instruction. Since the subjects were adults who for many years had had either sporadic instruction or no instruction, care would need to be taken that the context for instruction was appropriate and that interest and attention could be maintained. Interaction with peers in activities that (a) focus attention on letter names and sounds in the context of the initial letters of words in the Blissymbol standard vocabulary, (b) offer explicit comparisons between the components of their Blissymbols and the components of the words that accompany them and (c) recognize and respect their Blissymbol accomplishments, would be the first recommendation for this group. The Educational Application, proposed in Section IV offers an approach which accommodates these recommendations.

It is interesting to note that the Low Kindergarten Readers performed better than the Pre-Decoders on the Visual Analysis Retrieval Task, indicating that the Bliss Readers were likely processing Blissymbols as gestalts. As shown in Table 3-2-19-B, the performance scores of the Bliss Readers on the Visual Analysis Retrieval Task were the lowest of any group in Studies 1 or 2. If the Bliss Readers are not processing

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\(^9\) It is recognized that a reciprocal relationship occurs between ecological factors and reading achievement and among the several reading acquisition factors, just as it occurs between reading related factors and reading acquisition; however, for the purposes of developing a reading instructional program, an emphasis has been placed on the causal role in reading progress played by ecological factors and reading acquisition skills.
their Blissymbols analytically, then it would seem appropriate as a first step toward decoding words, to focus on analysing Blissymbols. In this way Bliss users can gain practice first in analysing units of the graphic system with which they are most familiar. Explicit instruction that focuses attention on the components of their first written language as a reference when the components of print are being reintroduced offers an approach that has the potential for supporting the Bliss Reader in acquiring conscious, analytic knowledge of print.

The comparative results with regard to Primary Word Reading has important implications for the reading instruction of Bliss users, particularly in the planning stage. As noted from the results summarized in Tables 3-2-12 and 3-2-14, the SCSPI Pre-Decoder subgroup with similar results to the Kindergarten Low Reader group and the SCSPI Primary Reader subgroup with similar results to the Kindergarten High Reader group, for the Consonant Sound Recognition, Phonemic Word Spelling and CVC-NC Word Tasks, both show significantly higher scores on the Primary Word Reading Task. This phenomenon is discussed in the preceding Response to Question 8 concerning reading related variables. If Primary Word Reading were taken as the only means of testing for reading level, the SCSPI individual's reading ability would be at risk for being over-rated. The sight word acquisition does not reflect the individual's phonological recoding ability. It is interesting to speculate two possible reasons for the lack of appropriate instruction as shown in the ecological ratings. In some instances, instructors may have believed that the individuals with SCSPI were unable to learn decoding skills and hence focused attention on developing a functional sight word vocabulary; in other instances, instructors may have been mislead into believing the the individuals with SCSPI already possessed the basic phonological recoding skills because of their high performance on sight word tasks.

For the Print Readers, the salient reading acquisition measure differentiating them from the Independent Readers was the Spelling Word-Pair Task. The results on this task indicate a continuing need for explicit instruction relating to phonological processing even when individuals are reading at the grade 2-3 level. Furthermore, explicit instruction is needed even as most individuals reach the Independent Reading level (defined in this investigation as grade 3 or above). Results on the Homophone Word-Pair Match Task show no statistically significant difference between the Primary Readers (N=6; M=54.71; S.D.=13.54) and Independent Readers (N=9; M=64.22; S.D. 24.38). (See text preceding Figure 3-2-12-A.) Two-thirds of the Independent Readers and all but one of the Primary Readers scored below or at chance level (Table 3-2-21).
The strong relationship between the results on the Homophone Word-Pair Task and the PIAT grade level scores (rho of .85; p=.02) further reinforced the importance of phonological processing to reading performance. All but three subjects in this investigation experienced difficulty with phonological recoding. The need for explicit instruction in phonological recoding for persons with SC SPI at all stages of reading acquisition is evident.

The implications of the similar reading acquisition performance patterns of adults with SC SPI and nondisabled children are discussed in the response to Question 8. As described in that section, it seems appropriate that the direction and content of the educational intervention for adults with SC SPI borrow much from the "best" instructional programs for children. Special consideration was recommended, however, regarding (a) possible weak areas resulting from limited exposure to print, e.g., language, working memory, world knowledge, (b) the adaptive cognitive strategies that an individual with SC SPI develops in order to communicate effectively and (c) the increased time that is required in order to develop the skills that contribute to reading acquisition.

The educational application that follows is a proposed design for a best practices instructional program for adults with SC SPI based on the empirical evidence obtained in this investigation. In applying research findings to an educational application, two cautions must be offered: (1) The results of a group's performance should not dictate the direction of a particular instructional program for an individual and (2) the information derived from performance on a particular task within a test battery should be used as but one of several indicators of an individual's broader capability. Related to the first point, the finding that ecological factors play an important role in the reading performance of persons with SC SPI does not preclude individuals having specific problems, e.g., in visual, phonological or intellectual processing. It does mean, however, that attention should be directed to both exogenous and endogenous factors in attempting to understand the etiology for reading difficulties in any individual with SC SPI.

Stanovich, in lecturing to educators, illustrates the second point above with a very helpful analogy. He compares a score obtained on a particular test to the result obtained by a physician in testing a knee reflex. The patient's reaction to a knee tap contributes to the physician's diagnosis of the patient's total state of health. Its relevance is dependent upon many circumstances, however, and it is but one of several indicators of the patient's general physical condition. Neither a poor reflex nor the result on a
single reading skill test should be considered a behaviour to be directly treated. Rather, both outcomes provide one of many signals which together can lead to a plan for intervention.

The research findings and the results from probing an individual's performance on a battery of tasks serve as directional markers to guide the educator's observations. In planning an individual's educational program, the most critical information is derived from the areas (a) in which the individual's performance deviates from that of the group and/or (b) in which the individual's performance on a particular task appears inconsistent with performance on other related tasks.
SECTION IV

EDUCATIONAL APPLICATION

It is not working knowledge of phonemes that is so important but conscious, analytic knowledge. It is neither the ability to hear the difference between two phonemes nor the ability to distinctly produce them that is significant. What is important is the awareness that they exist as abstractable and manipulable components of the language. Developmentally, this awareness seems to depend upon the child's inclination or encouragement to lend conscious attention to the sounds (as distinct from the meanings) of words.


The letters AAC take on new meaning in the context of this proposed educational application. In considering the skills essential to the onset of reading print, they become reminders of the key words guiding mastery of word recognition — Attention, Analytic and Conscious. Adams (1990) was referring to children as she emphasized the importance of conscious and analytic knowledge of the abstractable and manipulable components of language and of conscious attention being directed to the sounds as distinct from the meanings of words. Her statement can be applied equally as well, however, to the reading acquisition of adults with SCSPi as they progress from abstracting and manipulating the meaning components of Blissymbols to consciously attending to the phonemes of words.

The findings in Study 2 support the premise that most persons with SCSPi who have now reached adulthood, have been limited in the encouragement they have received to "lend conscious attention to the sounds (as distinct from the meanings) of words." Given the range of test scores and ecological conditions of the subjects with SCSPi in this thesis, it is reasonable to speculate that (a) if the knowledge relating to reading acquisition included in the theoretical infrastructure of this investigation had been available to their instructors, (b) if educator and family attitudes had been such that reading was recognized as achievable for persons with SCSPi, and (c) if sufficient time and explicit instruction had been directed toward achieving a conscious analytic
knowledge of the skills involved in word recognition, the reading levels acquired by the subjects of this study would have been much higher.

For Bliss Readers wishing to become Print Readers, and Print Readers trying to advance their reading skills, the communication and cognitive advantages and the enjoyment to be derived from achieving fluency with print are worth a major investment of time and effort. As stated at the outset of this thesis, adults with SCSPI who wish to continue their literacy learning deserve methods of teaching reading that are "the best they can possibly be". The following proposed instructional program, based on the findings of this investigation and the author's teaching experiences, is one contribution to the development of such methods.

**Implementing an Instructional Reading Program**

For efficacious learning to occur, procedures must be in place to ensure that both the learners with SCSPI and those involved in supporting their instruction have (a) ongoing access to reliable information relating to Blissymbol reading, print reading acquisition and instructional methodology, (b) an understanding of the current skill levels and ecological factors influencing the learner and (c) the conviction that reading acquisition is possible through building an instructional program on an interactive compensatory model. In addition, there must be a strong commitment on the part of learners and their instructors to a process in which the instructor mediates the acquisition and constructing of new knowledge by the learner. For individuals with SCSPI in educational settings with trained instructors and resource personnel, an assessment report referencing the learner's Reading Profile and Ecological Checklist can serve as a catalyst for the establishment of an effective instructional program. A sample Assessment Report for subject KE, a student integrated in a Southern Ontario secondary school, is presented in Appendix 3-2-F. For individuals unable to access a formal educational system an innovative instructional program is proposed. Case examples of initial instructional priorities based on the Reading Profile and Ecological Checklist of one subject from each of the four SCSPI subgroups are presented in Appendix 3-2-E.
Writing and Reading with the Internet and Bliss (WRIB)

For adult Bliss Readers who are unable to access any established educational program, Writing and Reading with the Internet and Bliss (WRIB) is proposed as an option. WRIB offers the framework for an instructional program in which volunteers constitute the instructional team and in which computer mediated communication (CMC), utilizing BlissInternet software, provides a virtual venue.

In introducing WRIB to potential users, the homophone "rib" is suggested as a mnemonic. The primary functions of the human rib cage provide useful reminders of the features of WRIB. (a) The ribs, through the action of muscles, move upwards and outwards and respond to our need for oxygen. They increase the volume of our chests so our lungs can expand to breathe in air and sustain life. WRIB, through the action of its team members, responds to the individual's need for intellectual growth. It increases the person's literacy capacity which in turn expands the ability to learn and enrich cognitive "life". (b) The rib cage provides a structure to support and shield internal organs vital to our survival. WRIB provides a structure to support and maintain the individual's literacy and cognitive abilities.

For the implementation of WRIB, a team composed of four participants is required: Learner, Mediator-Partner, Peer Tutor and Resource Teacher. Each has a critical role within the instructional program:

The Learner undertakes to:
— establish the Instructional Team
— devote two daily half-hour periods (or as feasible) to working with the Mediator-Partner
— work independently on follow-up activities
— interact regularly by means of BlissInternet with Peer Tutor
— initiate remedial action when problems develop

The Mediator-Partner undertakes to:
— interact one-on-one with the Learner in two daily half-hour periods (or as feasible) in the Learner's home or work setting
— study instructional materials and references recommended by Resource Teacher
— co-ordinate involvement of team members
— assist the Learner in trouble shooting when technical, scheduling or team problems arise

The Peer Tutor undertakes to:
— interact with the Learner using CMC on a regular basis
— share an enjoyable social relationship
— participate in reading activities with the Learner
— suggest strategies that have been effective in the peer tutor's own reading development

The Resource Teacher undertakes to:
— conduct preliminary testing and complete a Reading Profile, Ecological Checklist and initial instructional plan
— orient the Learner, Mediator-Partner and Peer Tutor to their roles
— provide training to the Mediator-Partner and Peer Tutor
— provide ongoing assistance in implementation of the instructional plan
— support the activities of the team members as needed
— provide measures for ongoing assessment of progress

For all members of the WRIB team the key learning emphasis is Attention being directed to Analytic and Conscious processing within tasks that are relevant to the Learner progressing from Bliss reading to print reading. For the Mediator-Partner and Peer Tutor this involves analysing the skills already acquired by the learner (in processing both Blissymbols and print), the components of new learning tasks, and the errors exhibited as tasks are performed. By attending to this type of analysis and sharing the results with the Learner and other members of the team, each can contribute his or her unique perceptions and understanding of the Learner's strengths and weaknesses and of the metalinguistic and metacognitive factors that could be involved. The Learner can contribute a subjective account regarding the task requirements and hopefully will bring a desire to consciously understand what is involved in successfully performing the task. The Mediator-Partner brings observation of the task being undertaken and a growing ability to analyse the steps taken by the Learner. The Peer Tutor brings knowledge derived from previous personal experience on similar tasks. The Resource Teacher brings the ability to generalize and offer suggestions based on experience in teaching Blissymbols and reading and a knowledge of the literature on
reading acquisition. By collaborating in an ongoing analysis of the Learner's performance, all team members grow in their capacity to perform their role.

Assistance will be needed by the Learner with regard to the selection of Mediator Partner and Peer Tutor. The provision of consultation with regard to the selection of team members is included in the role of the Resource Teacher. The primary criteria for the Mediator-Partner are an analytic ability, a willingness to work within a team, an interest in gaining knowledge about Blissymbols and reading acquisition, a love of learning, and a desire to help others acquire new skills.

In choosing a Peer Tutor, the Learner will need to select (a) someone he or she would like as a friend and (b) a print reader with a similar reading profile. From this investigation, it was evident that most print readers, except for those at an advanced level across all their reading skills, experienced difficulties in word recognition. By assisting a Bliss reader with similar challenges, the Peer Tutor can devote further attention to an area where more analytic experience, additional practice and increased understanding at a conscious level will be beneficial to his or her own reading fluency.

Developing an Individualized Plan

Each instructional program will be unique since it will reflect the Learner's individual profile and ecological situation as well as the capabilities of the instructional team. Initially, attention will be focussed on the preliminary recommendations of the Resource Teacher after her analysis of the learner's Reading Profile and Ecological Checklist. Learners' performance levels in a battery of reading acquisition and reading related skills will be derived from their Reading Profiles and potential factors that could be influencing their literacy learning will be suggested based on information contained in the Ecological Checklist. The activities that are included within the ongoing program will be governed by a set of principles specific to print acquisition by Bliss Readers. All of the principles rely on a mediation approach and a constructivist view of learning as described in the section entitled, *Rationale for Educational Application*.

The principles of WRIB are as follows:

- The Learner's ability to read Blissymbols constitutes the knowledge base through which analytic knowledge will be developed and conscious attention to the abstractable components of language will be encouraged.
—The Learner’s experience with the language structure of Blissymbolics constitutes the knowledge base through which syntactic and grammatical competencies can be further developed.

—The reading materials will be based upon ongoing BlissInternet conversations — in Blissymbols, orthography, or a combination of both — ensuring that the Learner is engaged in authentic reading and writing tasks at the level suited to his zone of proximal development.

—Instruction that directs attention to the analysis of print as a contributing factor toward phoneme awareness will begin by comparing the units of Blissymbols with the units of words. The relationship of Bliss components with meanings and the relationship of print components with sounds will be emphasized and contrasted.

—Instruction in word recognition tasks will be explicit and analytic and will include, as deemed appropriate, provision of instructor-guided, graduated hints and individualized tasks of increasing levels of difficulty.

—Activities toward reading comprehension competencies that tap background knowledge and metacognitive abilities will be guided by the Learner’s interests and will draw on the Learner’s experience with the system features of Blissymbolics.

—Explicit instruction will be directed toward the refinement of syntactic and metalinguistic skills by comparing the grammatical and structural capabilities of Blissymbolics with those of English.

—Reciprocal teaching and modeling will be utilized, involving both the Mediator-Partner and Peer Tutor as they work with the Learner, and involving the Resource Teacher as she provides demonstration lessons for the Mediator-Partner and Peer Tutor.

—Discussion and explanation will be regular features of the instructional program.

—Diagnosis and recording of Learner’s skills by the Mediator-Partner, guided by the Resource Teacher, will be ongoing and will be shared and discussed with Learner, Peer Tutor and Resource Teacher.

—All members of each WRIB team will be encouraged to engage in discussion and social interaction with the members of other teams for peer learning and support.

The specific activities supportive of phoneme awareness and contributing to word recognition will be recommended by the Resource Teacher and related to the Blissymbol vocabulary used by the Learner as well as the topic areas being discussed in the Learner’s interaction with the Peer Tutor. A metalevel approach to instruction in
phonemic awareness, demonstrated by Cunningham (1990) to be more effective than a skill and drill approach, will be followed. Cunningham explicitly emphasized "the interrelations between phonemic awareness and the process of reading, motivation to use phonemic awareness in decoding, and specific strategic behaviors to implement phonemic awareness" (p. 441). Attention will be directed toward syllables and onsets-rimes prior to phonemes if either of these levels are shown to be within the Learner's zone of proximal development. Throughout these activities, reference will be made to Blissymbols to demonstrate the Bliss (semantic) equivalent for each level of analysis.

The initial program priorities for four subjects, one from each SC SPI subgroup are included in Appendix 3-2-E along with their Reading Profile and Ecological Checklist. This information forms the context for the first interactions between the Learner and the Mediator-Partner which will be of a nature best described by Clay in her Reading Recovery Program as "roaming around the known." With WRIB, some "travelling with companions" along the electronic highway will be added to the process.
SECTION V

GENERAL DISCUSSION

Common sense, creativity, ethics, intuition, memory and reason. These can be exploited individually as a justification for ideology; or imprisoned in the limbo of abstract concepts. Or they can be applied together, in some sort of equilibrium, as the filters of public action.


John Ralston Saul, in his 1995 Massey Lecture expressed the need for knowledge of the larger picture rather than tiny narrow bands of specialist information. He lauded persons with broad knowledge of both the present and the past, freed from ideologies, embracing doubt and advancing carefully. Saul's message pertained to a much broader topic than that of this thesis — "a civilization tightly held at this moment in the embrace of a dominant ideology: corporatism" (p. 2). Nonetheless, his ideas are relevant to the current investigation.

Challenging the Ideology

For several decades, ever since efforts began to be made to understand the development of persons with severe speech and physical impairments, the ideology has persisted within the medical and educational establishments and the community at large, that an inability to speak prevents individuals from learning to read. Of strong relevance and even greater impact, this ideology has been accepted by many individuals with SCSPPI themselves! In more recent years, as more "exceptions" became apparent, the belief has shifted to a doctrine that those with exceptional intelligence can learn to read, but that the majority of persons with SCSPPI are incapable of advanced literacy. For the latter group, functional communication with picture boards is given the highest priority in programme planning and literacy objectives are frequently deferred or minimized. Whether literacy difficulties are more aptly attributed to the individual's
inability to learn or to inadequate instructional support is often ignored. The belief continues that most persons with SCSPSI are unable to learn to read.

Many examples that reinforce this ideology have been evident within a North American educational culture that has advocated a whole language approach since the seventies. Educational practice that resists explicit instruction in word acquisition skills has served to strengthen the belief that individuals with SCSPSI are limited in their ability to learn to read. Due to their limited world and language experiences and the reduced opportunities for taking independent initiatives, individuals with SCSPSI have fewer ways of compensating for lack of appropriate instructional support. With the prevailing attitude that they will have great difficulty in learning to read being held both by the individuals with SCSPSI and those who interact with them, there has been little incentive or opportunity to strive toward achievements that could demonstrate the opposite — that reading acquisition is possible for a large proportion of this population.

This thesis challenges the ideology that the inability to produce functional speech inhibits reading acquisition for those with less than exceptional intelligence. Support has been drawn from history, theory, teaching experience, mainstream reading research, empirical investigation and ecological observation for a position that attributes limited reading acquisition by many persons with SCSPSI to lack of appropriate instruction and minimal reading opportunities. The instructional program, Writing and Reading with the Internet and Bliss (WRIB) is proposed as a provisional structure for providing explicit instruction in word acquisition skills and increased opportunities for interesting writing and reading experiences. By so doing, WRIB can support the ongoing development of literacy competencies.

**Study Limitations**

It is recognized that there are many aspects of this investigation that can be improved and expanded upon in future studies. Whatever its limitations, it is hoped that the study will not be found lacking in a balanced application of common sense, creativity, ethics, intuition, memory and reason as filters of action.

Each of the theoretical, empirical and experiential resources that were tapped to provide the foundation for Writing and Reading with the Internet and Bliss (WRIB) must be viewed critically and its limitations acknowledged. The reliance on research undertaken with nondisabled children for the theoretical scaffolding and for the group
comparisons with adults with SCSPi must always be considered cautiously in interpreting and applying the results. The small numbers and the adaptations required in administering the tests to a SCSPi population limit the generalizations that can be made. The need to rely on recognition-type phonological tasks limited the developmental levels that could be measured. This in turn restricted the information that could be derived from comparisons between subjects with SCSPi and nondisabled subjects. The investigator faced the dilemma of selecting tasks which could be performed by subjects with SCSPi, but in so doing precluding comparisons at different developmental stages with nondisabled subjects, e.g., tests to discriminate between the recognition and retrieval stages of phonological recoding. Furthermore, the constraints upon the types of statistical analyses that could be conducted, imposed by restricted score ranges and lack of homogeneity of variance, weakened the validity of the empirical findings. Lastly, the experiential contribution to the questions being investigated and to the interpretation of results increased the risk of introducing selective memory of anecdotal information and uncontrolled bias.

The above risk factors were acknowledged and every attempt was made to reduce the factors that would interfere with securing adequate and proper data or that would engender the misinterpretation of the results. In developing the theoretical infrastructure, a broad examination of several theoretical domains was undertaken. In the empirical studies, a multi-tiered analysis approach was used and stringent criteria were applied in the selection of statistical techniques. The author's longitudinal and experiential knowledge was tapped as judgements were required. This knowledge was applied to test adaptations for subjects with SCSPi and to the interpretation of results. Documentation of subject performance and educational practice was referenced whenever possible, e.g., McNaughton, 1973, 1985, 1991; Silverman, McNaughton, & Kates, 1978.

**Future Research**

Notwithstanding the precautions that have been taken, it is recognized that much further research is needed. Future investigations will either lend support or provide counter evidence to the set of findings from this thesis. Longitudinal studies would make a valuable contribution to the knowledge base relating to the reading acquisition of persons with SCSPi. They could be designed to permit cohort SCSPi group comparisons. They would enable analyses to be undertaken with subjects serving as
their own controls. Collaborative international projects and the inclusion of subjects from non-English-speaking and other English-speaking countries would provide increased numbers of subjects and make a wider range of statistical analyses applicable. All of the preceding measures would strengthen the validity of the results.

**Evaluating the Current Study**

For the present, this thesis is viewed as one of several preliminary steps — to be added to the work of Berninger and Gans (1986a, 1986b), Blischak (1994), Dahlgren Sandberg (1996), Foley (1989, 1993), Kopenhaver and Yoder (1992), Schonell (1956), Silverman, McNaughton and Kates (1978) and Smith (1989, 1992). The instructional program derived from the findings of the current investigation must remain dynamic and open to modification as new knowledge is acquired. Only thus will this investigation have succeeded in contributing to improved instructional practice for persons with SC SPI.

Having proposed an Educational Application for adults based on the theoretical and empirical knowledge presented in this thesis, the developmental question must be asked as to whether or not individuals can learn the analytical skills necessary for word acquisition after childhood. This topic has lead to speculation by several authors. As reviewed by Morais, Alegria and Content (1987), a position has been "entertained" by Mattingly (1984) and Mann (1986) that the capacities underlying segmental ability atrophy to some extent after childhood. The results of a study by Morais, Alegria and Content (1987), however, would refute this position. They found that ex-illiterate adults (illiterate adults in Portugal who had not attended school before adolescence and who had learned to read and write later on in special classes) were able to develop segmental analysis abilities as adults. Morais et al. concluded that after age four or five, there is no critical period for acquiring segmental analysis skills. They reinforced the view, however, that "the ability to deal explicitly with the segmental units of speech is not acquired spontaneously in the course of cognitive growth, but demands specific training" (p. 416).

Corroboration for the findings of Morais et al. (1987) was found by this author in the form of anecdotal information collected during this investigation. One subject related that she was 25 years of age when she had the breakthrough of understanding the role of the alphabetic code. Another subject attributed his breakthrough in applying
the letter-sound relationships to the unlocking of words to a single year of training received when he was 19 years of age. Another woman was age 14 when, self-initiated, she began to attend to the sounds that could be identified in words and relate them to print. In each instance, it was the determination on the part of those with SCSPI to never give up and the responsiveness of their environment to their continuous learning, whatever the time frame, that made reading acquisition possible.

A caution is required regarding the generalization of the findings or educational recommendations from this thesis to other than Bliss users and Bliss alumni. Accommodations would have to be made to compensate for the lack of the language infrastructure provided by Blissymbolics and of the visual analysis experience afforded by the structure of the Type 2 Blissymbols. This being said, the approach presented through WRIB would have many features that could be of value to other AAC users. The dynamic assessment and mediation within a multi-dimensional constructive approach has wide application. Of interest would be the adaptations required and the results obtained in introducing components of WRIB to (a) individuals who use voice output communication devices with picture displays and (b) individuals who use picture boards.

As with all worthwhile scientific enterprises, more questions were raised than were answered. This is to be expected, given the complexity of the learning to read process and the challenges inherent in research relating to persons with SCSPI. Nonetheless, steps were taken toward the further development of reading skills of persons with SCSPI: (a) a response was made to some of the theoretical issues facing researchers in this area; (b) a multi-tiered approach to analysis was demonstrated; (c) an Educational Application based on the knowledge derived from the investigation was developed.

The Goal to be Realized

A Canadian advocate for refugees who are applying for Canadian citizenship recently commented in a television interview that what refugees needed most in their chosen country was dignity and hope. The same need applies very much to persons with SCSPI. They also seek refuge and strive to belong. For them the "chosen country" is the world of the able-bodied whose culture is based on literacy. The dignity of persons with SCSPI can be fostered by the respect and acceptance their literacy
competencies are given, whether their skills be in Blissymbolics or traditional orthography. To the extent that persons with SCSP are given methods of teaching reading that are the best they can possibly be, they will have hope of inclusion in the literacy-based community.

The length of this thesis attests to the many insights to be derived through studying the abilities of persons with SCSP. The style and content reflect the attempt to bridge the divide between research and educational practice. It is hoped this work will have an impact upon the reading instruction of those for whom it was written and that it will be judged by them as offering both dignity and hope. They deserve no less.
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APPENDICES
Appendix 2-A

Definitions for Processing Levels,
Kemp, 1979, pp. 28-30, p. 51

Decoding
Decoding is the act of attaching a series of sounds to words in print; the identification of collective symbols.

Recoding
Recoding is an on-going manipulation of semantic and syntactic cues in the search for meaning; transformation of author's deep structures to reader's deep structures through author's and reader's surface structures.

Encoding
Encoding is the synthesis of meaning and print, when the reader interprets the graphic message automatically, fitting it into his knowledge of the text up to the point of reading and even beyond it as he anticipates the story line or the sequence of thought units; crystallisation of meaning by the reader.

Kemp's Model of the language basis of reading (Kemp, 1979, p. 51)
Appendix 2-B

Reading Level Rating Guide
(Silverman, McNaughton & Kates, 1978, p.202)

TO ASSESS READING LEVEL
Assign point score for each statement. Begin with Level 0; discontinue when you have rated "0" for every item within a level.

<table>
<thead>
<tr>
<th>% of Points - KEY</th>
<th>Level 6+</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>If student is above level 6, enter appropriate statements here:</td>
</tr>
<tr>
<td>1</td>
<td>Level 1</td>
</tr>
<tr>
<td>2</td>
<td>Level 2</td>
</tr>
<tr>
<td>1</td>
<td>Level 3</td>
</tr>
</tbody>
</table>

Grade 2

Primer

Identifies 90% of Gr. 2 sight vocabulary.

Progressing in advanced word-analysis skills.

Independently identifies most new words, using context & many word-attack skills.

Reading widely, with ease at Gr. 2 level.

6 Other (if required)

Pre-Primer

Identifies 90% of pre-primer sight vocabulary.

Matches 3 & 4 letter words displayed in different fashion.

Distinguishes auditorily all beginning consonants and some blends.

Utilizes the sentence as a meaningful unit.

Other (if required)

Late Kindergarten/Early Grade 1

Shows interest in print and in learning to read.

Visually discriminates letter & gross word differences.

Aware of fine differences in letter sounds and in word patterns.

Ability to generalize now applied to stories; predicts outcome, notes inconsistencies, makes inferences.

Other (if required)

Early Kindergarten

Attends to detail, interprets stories visually and orally presented.

Recognizes gross differences in visual stimuli, e.g. shapes.

Aware of gross characteristics of words.

Uses past experiences to generalize beyond immediate situation.

Other (if required)

Pre-School

Appears to derive some meaning from pictures and books.

Demonstrates interest in listening to stories, records etc.

Shows interest in matching games and puzzles.

Participates in social and/or imaginative play activities, e.g. role playing.

Other (if required)

Level 1

Functioning at concrete stage; must see or touch actual object to derive meaning.

Sensory-motor activities occupy total time.

TOTAL ______
Appendix 3-1-A

Permission Letter and Consent Form, Study 1

To: Parents and Guardians

From: Shirley McNaughton C.M., M.Ed.
Ontario Institute for Studies in Education,
University of Toronto, Canada

As part of my doctoral program I am conducting two studies in Effingham Community Unit #40 to investigate beginning reading skills in kindergarten children. The first study involves assessing early reading skills. The second study involves computer training and testing of early reading-related tasks. Only a limited number of children can be included in the studies. Participants will be chosen from those children for whom consent is given, through a random selection procedure.

The training features a puppet within a multi-media presentation and is designed to be interesting and motivating to kindergarten-aged children. All the research activities will take place in the school building and each child will be trained and tested individually. Sessions will typically last for 20 minutes each day. The total time to be spent in the project by each child will range from three to four hours, extending over a three to four week period.

In any reporting of the research findings, the identity of individual children will be protected through the use of coded identification numbers and pseudonyms. Because the information gained about each child could contribute to the planning of his or her Grade One reading program, parents are given the option of having a summary of their child's results placed in their child's school record folder. The results would then be available to the parents and educational staff, with supplementary information pertaining to the interpretation of the findings being given to the school speech pathologist. If this option is not desired, all information pertaining to a child's performance will remain with the researcher and kept confidential. A report on the overall results of the research program will be sent in the fall to the parents of all children who participate in the study.

I have worked as a teacher and administrator in the educational field in Toronto, Canada, for over twenty-five years. Much of this time has been spent with children and adults who are nonspeaking and who require augmentative and alternative communication in order to communicate. My work was honoured in 1989 through my being named a Member of the Order of Canada (C.M.), the highest honour bestowed by the Government of Canada. The goal of my research is to share my findings with other educators to further our understanding of how children learn to read, and to offer additional support to children and adults who are nonspeaking.

I hope you will give permission for your child to be considered for participation in this research program by completing the attached form and returning it to your child's teacher by May 2.

Thank-you!

Shirley McNaughton C.M., M.Ed.
Consent Form
for Beginning Reading Research

conducted by Shirley McNaughton C.M., M.Ed.
April/May 1994 Effingham Community Unit #40

Child's Name ..................................................................................................................

Birthdate ......................................................................................................................

I give my consent for my child to participate in the research relating to beginning reading skills being conducted during April and May, 1994, with children at Effingham Community Unit #40.

I understand (1) that in all published results of this research, the confidentiality of participants will be protected through the use of coded identification numbers and pseudonyms; (2) that this research meets the accepted professional standards for the conduct of research within Applied Psychology and Special Education and has been approved by the Ethical Review Committee of the Ontario Institute for Studies in Education, University of Toronto, Canada; (3) that I may withdraw my child from the study at any time and all data collected for my child will be destroyed.

Please sign consent:

................................................................. .........................................................
Signature of parent or guardian Date

................................................................. .........................................................
................................................................. .........................................................
................................................................. .........................................................
................................................................. .........................................................
................................................................. .........................................................
................................................................. .........................................................
................................................................. .........................................................
................................................................. .........................................................

Please also sign one of the two options below:

I wish a summary of my child's performance to be added to my child's educational file and made available to myself, and to the school speech pathologist and teaching staff, to assist in the planning of my child's educational program.

................................................................. .........................................................
Signature of parent or guardian Date

OR

I wish all records of my child's performance to remain confidential.

................................................................. .........................................................
Signature of parent or guardian Date
Subject Number ...........

Response Sheet

Vowel Name and Sound Tasks

Subject Identification Number Examiner

Date

Time Beginning Completion Duration

Test order number

1.1 Vowel Naming Task:
O A U i E

Score /5

1.2 Vowel Name Recognition Task
E O U i A

Score /5

Beginning Reading Study
April - May, 1993
1.3 Consonant Naming Task

\[
\begin{array}{l}
v \\
F \\
V \\
B \\
P \\
L \\
S \\
D \\
N \\
M \\
T \\
K \\
R \\
\end{array}
\]

Total Score (column)  Total Score (column)

Total Score /12

1.4 Consonant Name Recognition Task

\[
\begin{array}{l}
v \\
M \\
P \\
F \\
V \\
L \\
N \\
B \\
S \\
K \\
R \\
D \\
T \\
\end{array}
\]

Total Score (column)  Total Score (column)

Total Score /12

1.5 Consonant-Phoneme Sound Recognition Task

\[
\begin{array}{l}
v \\
D \\
M \\
S \\
K \\
R \\
B \\
T \\
F \\
P \\
L \\
N \\
\end{array}
\]

Total Score (column)  Total Score (column)

Total Score /12
Response Sheet
2. CVC-NC Manual Task

<table>
<thead>
<tr>
<th>Subject Identification Number</th>
<th>Examiner</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Time Beginning</th>
<th>Completion</th>
<th>Duration</th>
</tr>
</thead>
</table>

Response (indicate yes and no's and circle matching symbol) 
- e.g. - - +/ - - - +/ + + +/

Orientation Items
*DAAV
*JOON
*JUUN
*PEET
*MiiK

<table>
<thead>
<tr>
<th>Test Items</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TAAK</td>
<td>Blik</td>
<td></td>
</tr>
<tr>
<td>RAAK</td>
<td>BUUT</td>
<td></td>
</tr>
<tr>
<td>LAAK</td>
<td>BOOL</td>
<td></td>
</tr>
<tr>
<td>KAAK</td>
<td>BAAT</td>
<td></td>
</tr>
<tr>
<td>BAAK</td>
<td>BEEK</td>
<td></td>
</tr>
</tbody>
</table>

Total Set Score /5

Total for CVC-NC (Manual) Task /10

---

Response Sheet
2B. CVC-NC Manual Task - Advanced

<table>
<thead>
<tr>
<th>Subject Identification Number</th>
<th>Examiner</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Time Beginning</th>
<th>Completion</th>
<th>Duration</th>
</tr>
</thead>
</table>

Response (indicate yes and no's and circle matching symbol) 
- e.g. - - +/ - - - +/ + + +/

Orientation Items
First two items of each set of Test 2, without saying the words:
*TAAK
*Blik
(Continue with other items of Test 2, as required, if task is not understood.)

<table>
<thead>
<tr>
<th>Test Items</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LAAN</td>
<td>LUUP</td>
<td></td>
</tr>
<tr>
<td>TIIM</td>
<td>KIIT</td>
<td></td>
</tr>
<tr>
<td>SUUN</td>
<td>LOOP</td>
<td></td>
</tr>
<tr>
<td>TOOD</td>
<td>FEEL</td>
<td></td>
</tr>
<tr>
<td>NEET</td>
<td>RAAT</td>
<td></td>
</tr>
</tbody>
</table>

Total Set Score /5

Total for CVC-NC (Manual) Task - Advanced /10
### Response Sheet

3. Rosner Phoneme Deletion Test

<table>
<thead>
<tr>
<th>Subject Identification Number</th>
<th>Examiner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>Beginning</td>
</tr>
<tr>
<td>Test order number</td>
<td></td>
</tr>
</tbody>
</table>

**Orientation Items:**

* A **cowboy**  
  *B **steamboat**

**Test Items** *(Stop testing after two successive errors in * items)*

| *1 sunshine** | sun     |
| *2 picnic**   | nic     |
| *3 cucumber** | cucumber|
| *4 up-side-down** | up-side |
| *5 unhappy**  | happy   |
| *6 dynamite** | namite  |
| *7 telephone** | tele    |
| *8 (4) coat** | oat     |
| *9 (5) meat** | eat     |
| *10 (6) sake** | ache    |
| *11 nose**    | ose     |
| *12 seal**    | seal    |
| *13 lark**    | ark     |
| *14 tan**     | tan     |
| *15 mill**    | ill     |

| *16 fin** | in     |
| *17 sink** | ink    |
| *18 (7) game** | gay   |
| *19 (8) write** | row  |
| *20 (9) please** | plea |
| *21 (10) step** | lap   |
| *22 (11) play** | lay   |
| *23 (12) sale** | sale  |
| *24 (13) smack** | sack |

**Score 3.1 Rosner: 19**

(Record the number of the last correct item before two successive errors in * items.)

**Score 3.2 Revised version: 24**

(Record the total number of correct responses before two successive errors in * items.)
Response Sheet
4. Yopp-Singer Phoneme Segmentation Test

Subject Identification Number Examiner

Date

Time Beginning Completion Duration

Test order number

Orientation Items
old
ride
go
man

Test items:

\[ \text{dog} \quad \text{in} \]
\[ \text{lay} \quad \text{grew} \]
\[ \text{keep} \quad \text{ice} \]
\[ \text{race} \quad \text{that} \]
\[ \text{fine} \quad \text{at} \]
\[ \text{zoo} \quad \text{red} \]
\[ \text{no} \quad \text{top} \]
\[ \text{three} \quad \text{me} \]
\[ \text{she} \quad \text{by} \]
\[ \text{job} \quad \text{sat} \]
\[ \text{wave} \quad \text{do} \]

Total Score (column) Total Score (column)

Total Score /22

Response Sheet
7. Spelling Phonological Recoding

Subject Identification Number Examiner

Date

Time Beginning Completion Duration

Test order number

<table>
<thead>
<tr>
<th>response</th>
<th>initial</th>
<th>final</th>
<th>vowel</th>
</tr>
</thead>
<tbody>
<tr>
<td>bat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>puck</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sock</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>desk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>top</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>feet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dime</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mif</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fak</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7.1 Total initial consonants /10
7.2 Total final consonants /10
7.3 Total vowels /5

Total:
Response Sheet
5. Decoding - Partial and Complete

Subject Identification Number Examiner

Date

Time Beginning Completion Duration

Test order number

5.1 Complete Decoding (Vandervelden items)
Score from scoring sheet /15

5.2 Partial Decoding (Vandervelden items)
Score from scoring sheet /44

5.3 Subscore (Vandervelden items)*
Decoding Initial Score /10

5.4 Subscore (Vandervelden items)*
Decoding Final Score /10

5.5 Subscore (Vandervelden items)**
Decoding Vowels /5

5.6 Subscore (Ehri & Robbins) *
Score from scoring sheet /5

5.7 Subscore Long Vowel items **
Score from scoring sheet /8

↓ kin
↓ *PIF

• fop
* DEP**

• mal
HUB

• rut
GAM

• bev
•• BAME

DI
•• FEAM

MO
•• PUNE

TA
•• NIRE

* SUP**
•• SOAM

* MIF**
•• VITE

* FAK**
•• DAKE

* TOK**
•• KILE

* BES
* BISK

* KUS
* SPAK
Response Sheet
6.1 Word Reading - Primary Test

<table>
<thead>
<tr>
<th>Subject Identification Number</th>
<th>Examiner</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Time Beginning</th>
<th>Completion</th>
<th>Duration</th>
</tr>
</thead>
</table>

Record response word ↓

<table>
<thead>
<tr>
<th>no</th>
<th>was</th>
<th>up</th>
<th>m</th>
</tr>
</thead>
<tbody>
<tr>
<td>yes</td>
<td>milk</td>
<td>you</td>
<td>and</td>
</tr>
<tr>
<td>the</td>
<td>bed</td>
<td>go</td>
<td>are</td>
</tr>
<tr>
<td>we</td>
<td>ball</td>
<td>jump</td>
<td>boy</td>
</tr>
<tr>
<td>is</td>
<td>car</td>
<td>book</td>
<td>girl</td>
</tr>
<tr>
<td>see</td>
<td>like</td>
<td>stop</td>
<td>little</td>
</tr>
<tr>
<td>yellow</td>
<td>pig</td>
<td>red</td>
<td>sleep</td>
</tr>
<tr>
<td>play</td>
<td>good</td>
<td>dog</td>
<td>help</td>
</tr>
<tr>
<td>in</td>
<td>all</td>
<td>come</td>
<td>fast</td>
</tr>
<tr>
<td>green</td>
<td>fish</td>
<td>look</td>
<td>rug</td>
</tr>
<tr>
<td>eat</td>
<td>said</td>
<td>it</td>
<td>swim</td>
</tr>
<tr>
<td>mom</td>
<td>this</td>
<td>dad</td>
<td>with</td>
</tr>
<tr>
<td>run</td>
<td>away</td>
<td>big</td>
<td>him</td>
</tr>
<tr>
<td>man</td>
<td>name</td>
<td>cat</td>
<td>day</td>
</tr>
<tr>
<td>cat</td>
<td>two</td>
<td>work</td>
<td>she</td>
</tr>
</tbody>
</table>

Total column correct /30

Response Sheet
6.2 Pictures in Word Reading - Primary Test

<table>
<thead>
<tr>
<th>Subject Identification Number</th>
<th>Examiner</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Time Beginning</th>
<th>Completion</th>
<th>Duration</th>
</tr>
</thead>
</table>

PCS

<table>
<thead>
<tr>
<th>house</th>
<th>cake</th>
</tr>
</thead>
<tbody>
<tr>
<td>woman</td>
<td>brush</td>
</tr>
<tr>
<td>pencil</td>
<td>butterfly</td>
</tr>
<tr>
<td>bowl</td>
<td>truck</td>
</tr>
<tr>
<td>bicycle</td>
<td>computer</td>
</tr>
<tr>
<td>rake</td>
<td>mouse</td>
</tr>
</tbody>
</table>

Total column correct /30

Total correct /12

Total /60
Response Sheet
Visual Analysis Task

Subject Identification Number   Examiner

Date
Time Beginning  Completion  Duration
Test order number

Response (Indicate yes and no's and circle matching symbol
- e.g. - - +/     - - - +/-     + + +/-

Orientation Items

A  λ
B  △
C  λ\-→△
D  △↑

Test Items

<table>
<thead>
<tr>
<th>Stimulus visible</th>
<th>Stimulus withdrawn</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  ∅∅∅∅</td>
<td>6  ∅∅∅∅</td>
</tr>
<tr>
<td>2  ~∅∩∩</td>
<td>7  ~∅∩∩</td>
</tr>
<tr>
<td>3  ♠♦-♡</td>
<td>8  ♠♦-♡</td>
</tr>
<tr>
<td>4  -♡→I♡</td>
<td>9  -♡→I♡</td>
</tr>
<tr>
<td>5  ↓I♡</td>
<td>10  ↓I♡</td>
</tr>
</tbody>
</table>

Total Set Score  /5  Total Set Score  /5

Total for Visual Analysis Task  /10
Appendix 3-2-A

Sample Explanatory Fax and Consent Form, Study 2

To:
From: Shirley McNaughton
Return FAX number:

Date: April 18, 1995
Dear

As part of my work for my Ph.D. at the Ontario Institute for Studies in Education (OISE), I would like to ask AAC users whom you work with in Ottawa to participate in my research. It involves working individually with me and with a colleague, Elizabeth Baird, doing a set of reading related tasks — some of which have been developed by other researchers and some that I have designed myself. The total time to be spent by each person would involve approximately six hours, spread over several work sessions. Each participant would have breaks as needed and Elizabeth and I would come over several days, to ensure that the tasks would not become too tiring. The tasks have been designed so that they can be done without speaking and with minimal hand use. Eye responses can be used throughout if that is the individual's most reliable and preferred response method.

The results of those who use AAC will be compared to the test results of beginning readers who do not have a disability. The objective of the study is to see how those who use AAC differ from speaking individuals with regard to some of the component skills of early reading.

In any reporting of the research findings, the identity of individual participants will be protected through the use of coded identification numbers and pseudonyms. The results will given to each participant upon completion of the study, with supplementary information pertaining to the interpretation of the findings being given to a person designated by the participant. If this option is not desired, all information pertaining to an individual's performance will remain with the researcher and kept confidential. A report on the overall results of the research program will be sent at the end of the study to all participants.

Many of the persons who I hope will agree to participate in this study know me, but for those who don't, the following is a brief description of my background: I have worked
as a teacher and administrator in the educational field in Toronto, for over twenty-five years and was executive director of Blisymbolics Communication International up to my retirement in 1989. Much of this time has been spent with children and adults who are nonspeaking and who require augmentative and alternative communication in order to communicate. My work was honoured in 1989 through my being named a Member of the Order of Canada (C.M.) I currently serve on the Board of Directors of Blisymbolics Communication International and in this capacity and as a consultant, I am involved in the implementation of a service program throughout Ontario using BlissNet2.

The goal of my research within my doctoral program is to share my findings with other educators. I hope to further our understanding of how persons who are nonspeaking learn to read. I hope those whose names appear at the end of this letter will agree to participate in this study by telling you of their interest in working with me. I will bring a form for each participant to sign if there is interest expressed in participating and if it is agreed that I can come to Ottawa to do this part of my study.

I and Elizabeth Baird would like to come to Ottawa to work with participants on Tuesday May 16 to Saturday May 20. If there is agreement with regard to participating, could you make some space that is free of interruptions available, and/or could you ask if we could work with participants in their own homes? We will do our utmost to accommodate our work to the participant’s and your schedules.

Thank-you for assisting me through asking those listed below if they would be willing to participate. I hope they will decide to do so and I look forward to your response either by phone or fax so that we can make our travel arrangements. Thank-you for helping!

Sincerely,

Shirley McNaughton C.M., M.Ed.
Consent Form for Reading Research

conducted by Shirley McNaughton C.M., M.Ed.
June, 1995 — June, 1996

Name

Birthdate

I agree to participate in the research relating to beginning reading skills being conducted by Shirley McNaughton.

I understand (1) that in all published results of this research, the confidentiality of participants will be protected through the use of pseudonyms; (2) that this research meets the accepted professional standards for the conduct of research within Applied Psychology and Special Education and has been approved by the Ethical Review Committee of the Ontario Institute for Studies in Education, University of Toronto, Canada; (3) that I may withdraw from the study at any time.

I wish to be informed of the results of my performance

I do not wish to be informed of the results of my performance

I wish a summary of my performance to be given to

.........................................................

Signature or mark of participant ......................................................... Date

........................................................

Signature of Witness
Decoding Pseudowords

1. Show card with kin
   Is it niti
   kib
   lin
   kn
   ken

2. Show card with flop
   Is it fox
   flip
   flop
   sop
   pof

3. Show card with mal
   Is it mul
   mal
   maf
   lam
   mal

4. Show card with rut
   Is it rut
   tur
   rot
   rud
   vut

5. Show card with bev
   Is it dev
   bev
   veb
   bav
   bet

Subject's I.D. ....................  Total correct .................... /5
### SSPI Primary Word Reading Task

Date
Time Beginning
Completion
Duration
Test order number

Record response word ↓

<table>
<thead>
<tr>
<th>Word</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>no</td>
<td>was</td>
</tr>
<tr>
<td>yes</td>
<td>milk</td>
</tr>
<tr>
<td>the</td>
<td>bed</td>
</tr>
<tr>
<td>we</td>
<td>ball</td>
</tr>
<tr>
<td>is</td>
<td>car</td>
</tr>
<tr>
<td>see</td>
<td>like</td>
</tr>
<tr>
<td>yellow</td>
<td>plug</td>
</tr>
<tr>
<td>play</td>
<td>good</td>
</tr>
<tr>
<td>in</td>
<td>all</td>
</tr>
<tr>
<td>green</td>
<td>fish</td>
</tr>
<tr>
<td>eat</td>
<td>said</td>
</tr>
<tr>
<td>mom</td>
<td>this</td>
</tr>
<tr>
<td>run</td>
<td>away</td>
</tr>
<tr>
<td>man</td>
<td>name</td>
</tr>
<tr>
<td>to</td>
<td>two</td>
</tr>
</tbody>
</table>

Total column correct /15

Total column correct /30

Total column correct /15

---

### Response Sheet

6.2 Pictures in Word Reading - Primary Test

Subject Identification Number
Examiner

<table>
<thead>
<tr>
<th>PCS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>house</td>
<td>brush</td>
</tr>
<tr>
<td>woman</td>
<td>butterfly</td>
</tr>
<tr>
<td>pencil</td>
<td>truck</td>
</tr>
<tr>
<td>bicycle</td>
<td>computer</td>
</tr>
<tr>
<td>rake</td>
<td>mouse</td>
</tr>
<tr>
<td>cake</td>
<td>bowl</td>
</tr>
</tbody>
</table>

Total column correct

Total column correct

Total correct /12
Homophone Word-Pair Matching Task

<table>
<thead>
<tr>
<th>Page 1</th>
<th>Page 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Show your helper which group of letters sounds (in your head) like a real word.</strong></td>
<td><strong>Show your helper which group of letters sounds (in your head) like a real word.</strong></td>
</tr>
<tr>
<td>(Remember your helper should not say anything!)</td>
<td>(Remember your helper should not say anything!)</td>
</tr>
<tr>
<td>saip</td>
<td>saif</td>
</tr>
<tr>
<td>soef</td>
<td>seet</td>
</tr>
<tr>
<td>deace</td>
<td>peece</td>
</tr>
<tr>
<td>docter</td>
<td>doftor</td>
</tr>
<tr>
<td>blug</td>
<td>bloe</td>
</tr>
<tr>
<td>carn</td>
<td>kard</td>
</tr>
<tr>
<td>rall</td>
<td>roal</td>
</tr>
<tr>
<td>klass</td>
<td>cliss</td>
</tr>
<tr>
<td>ploor</td>
<td>floar</td>
</tr>
<tr>
<td></td>
<td>fite</td>
</tr>
<tr>
<td></td>
<td>shurt</td>
</tr>
<tr>
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<td>neach</td>
</tr>
<tr>
<td></td>
<td>nade</td>
</tr>
<tr>
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</tr>
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<td></td>
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<tr>
<td></td>
<td>beal</td>
</tr>
</tbody>
</table>
Phonological Recoding and STM Task
Test Items and Instructions

Present cards for each letter sequence one at a time (one per second) with only one card visible at a time. Remove cards and give subject appropriate answer form (either similar letters or dissimilar letters). Record the order of the letters given by the subject next to the letters on the form. Circle if correct.

<table>
<thead>
<tr>
<th>3 ITEMS — SIMILAR</th>
<th>3 ITEMS — DISSIMILAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPT</td>
<td>WRF</td>
</tr>
<tr>
<td>VCB</td>
<td>JFY</td>
</tr>
<tr>
<td>PDV</td>
<td>RHW</td>
</tr>
<tr>
<td>TBP</td>
<td>FWH</td>
</tr>
<tr>
<td>CTB</td>
<td>YHW</td>
</tr>
</tbody>
</table>

Total (3) correct

<table>
<thead>
<tr>
<th>4 ITEMS — SIMILAR</th>
<th>4 ITEMS — DISSIMILAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPTB</td>
<td>HJYR</td>
</tr>
<tr>
<td>BTVC</td>
<td>WRFH</td>
</tr>
<tr>
<td>DTCP</td>
<td>YRFJ</td>
</tr>
<tr>
<td>BVDT</td>
<td>JWRH</td>
</tr>
<tr>
<td>VPCD</td>
<td>HWYF</td>
</tr>
<tr>
<td>PVCT</td>
<td>FYRH</td>
</tr>
<tr>
<td>CDTB</td>
<td>WJHF</td>
</tr>
<tr>
<td>TCVB</td>
<td>YHWF</td>
</tr>
<tr>
<td>VCTB</td>
<td>JRYH</td>
</tr>
<tr>
<td>DBVC</td>
<td>HRJY</td>
</tr>
</tbody>
</table>

Total (4) correct

<table>
<thead>
<tr>
<th>5 ITEMS — SIMILAR</th>
<th>5 ITEMS — DISSIMILAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDPCT</td>
<td>JYFHR</td>
</tr>
<tr>
<td>PCVTB</td>
<td>WRHFB</td>
</tr>
<tr>
<td>DVTCP</td>
<td>RYHWF</td>
</tr>
<tr>
<td>TCVBP</td>
<td>FJHRY</td>
</tr>
<tr>
<td>VTCDB</td>
<td>HFYWR</td>
</tr>
<tr>
<td>CPTBD</td>
<td>YFWHJ</td>
</tr>
<tr>
<td>DTBCP</td>
<td>HJWYF</td>
</tr>
<tr>
<td>BTDVC</td>
<td>RFYHJ</td>
</tr>
<tr>
<td>PVBCT</td>
<td>JHWRF</td>
</tr>
<tr>
<td>TBVPC</td>
<td>WJFRH</td>
</tr>
</tbody>
</table>

Total (5) correct

<table>
<thead>
<tr>
<th>6 ITEMS — SIMILAR</th>
<th>6 ITEMS — DISSIMILAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDVCTP</td>
<td>FJYWHR</td>
</tr>
<tr>
<td>PVTBDC</td>
<td>JWRHFB</td>
</tr>
<tr>
<td>DVCTBP</td>
<td>RYJHFW</td>
</tr>
<tr>
<td>CDVBP</td>
<td>RFJYH</td>
</tr>
<tr>
<td>PCVBDC</td>
<td>JHWYFR</td>
</tr>
<tr>
<td>TCVD</td>
<td>JHYFR</td>
</tr>
<tr>
<td>VCTB</td>
<td>JHWRF</td>
</tr>
<tr>
<td>DBVC</td>
<td>WJFRH</td>
</tr>
</tbody>
</table>

Total (6) correct
Response Sheet
Phonological Recoding & STM Revised for matching
STIMULUS SHOWN

<table>
<thead>
<tr>
<th>Subject Identification Number</th>
<th>Examiner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>Time</td>
</tr>
<tr>
<td>Time Beginning</td>
<td>Completion</td>
</tr>
<tr>
<td>Test order number</td>
<td></td>
</tr>
</tbody>
</table>

Response (indicate yes and no's and circle matching symbol
- e.g. - -/+  - - -/+  +/+)
Write letters from selected card if incorrect

Orientation Items
1 KMG 3 MSK
2 SLG 4 LGS

Test Items
SIMILAR DISSIMILAR
1 DPT 6 WRF
2 VCB 7 JFY
3 PDV 8 RHW
4 TBP 9 FHW
5 CTB 10 YHW

Total Set Score /5

Total for STIMULUS SHOWN Task /10

Response Sheet
Phonological Recoding & STM Revised for matching
STIMULUS WITHDRAWN

<table>
<thead>
<tr>
<th>Subject Identification Number</th>
<th>Examiner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>Time</td>
</tr>
<tr>
<td>Time Beginning</td>
<td>Completion</td>
</tr>
<tr>
<td>Test order number</td>
<td></td>
</tr>
</tbody>
</table>

Response (indicate yes and no's and circle matching symbol
- e.g. - -/+  - - -/+  +/+)
Write letters from selected card if incorrect

Orientation Items
1 KMG 3 MSK
2 SLG 4 LGS

Test Items
SIMILAR DISSIMILAR
1 DPT 6 WRF
2 VCB 7 JFY
3 PDV 8 RHW
4 TBP 9 FHW
5 CTB 10 YHW

Total Set Score /5

Total for STIMULUS WITHDRAWN Task /10
Working Memory Task

You are going to hear a voice on the tape. After each sentence you will hear a “beep”. When you hear the “beep”, answer TRUE or FALSE to the statement. When you hear two “beeps”, you have to give the last word of each of the sentences in the group just given. It does not matter if you give the words in the same order as the sentences.

Example: You are a man/woman/boy/girl. (Ask so that answer is TRUE)
I am sitting/standing. (Ask so that answer is FALSE)
OK. Now recall.
(If a young child does not know the concepts of True and False and gets confused during the training trials accept Yes and No as alternatives.)

(You may want to stop the tape after the two beeps to allow the subject more time to respond. The subject should not be penalized for responding slowly. Record the subject’s recalled responses in the order reported, although the subject should not worry about this.)

1. The sun rises in the evening. T F
2. Trees lose their leaves in spring. T F
3. Cars have four wheels. T F
4. Cows and pigs eat meat. T F
5. A red traffic light means “Go”. T F
6. We get milk from cows. T F
7. Plants need water and light to grow. T F
8. In winter, it is warm. T F
9. The CN tower is in Toronto. T F
10. We read from right to left. T F
11. Lettuce and peas are vegetables. T F
12. Centimetres are used for measuring. T F
13. Elephants have grey spots. T F
14. Some birds have fur. T F
15. Canada is close to the United States. T F
16. A motorcycle can move faster than a bicycle. T F
17. An apple is a fruit. T F
18. Fish swim in the sky. T F
19. People can buy groceries in stores. T F
20. Ottawa is the capital of Canada. T F
21. We use a thermometer to tell time. T F
22. Boiling water is hot. T F
23. Toronto is on the shore of the Atlantic Ocean. T F
24. A football is round. T F
25. We sleep at night. T F
26. Insects have eight legs. T F
27. A feather is heavier than a rock. T F
28. Some birds fly north in winter. T F
29. The earth travels around the sun. T F
30. Purple, red and blue are colours. T F
31. Canada is the smallest country in the world. T F
32. Tadpoles become frogs. T F
33. When it is heated, ice melts. T F
34. Canada has ten provinces. T F
35. Carrots and bananas are orange. T F
36. Whales are fish. T F
37. Chickens and robins lay eggs. T F
38. When it rains, the ground gets wet. T F
39. Lions live on farms. T F
40. Dogs and cats bark. T F
41. The Canadian flag is red and white. T F
42. The moon and stars are in the sky. T F

Alexandra Gottardo
<table>
<thead>
<tr>
<th>Subject's Response</th>
<th>Right</th>
<th>Wrong</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Clapped his hands Mark.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>2. The sun shone brightly.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>3. The bear brown growled.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>4. They went at school.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>5. He answered the ringing phone.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>6. I am happy.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>7. The boy run quickly.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>8. We thanked him much vary.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>9. The waiter dropped the tray of plates.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>10. The boy be sad.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>11. The child the letter wrote.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>12. The woman turned on the light.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>13. The lion and the tiger lives in the jungle.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>14. The tourists travelled on car.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>15. Many of the children dressed up for the party.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>16. The children's mother work very hard.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>17. The art the many artists displayed.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>18. They went to visit their relatives on England.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>19. The boy was chased by the dog.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>20. They watched sadly as the cowboy rode the sunset into.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>21. The flock of geese are on the lake.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>22. Was reading the young woman the mystery novel.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>23. When it rains, we wear our boots.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>24. The tall thin man playing was basketball.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>25. The presentation for the award was done by the Queen.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>26. The class was eager to see the movie.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>27. The children with the young teacher enjoys the school trip.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>28. The school of brightly coloured fish swam past the boat.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>29. The new television were watching the people.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>30. The plan was developed to cooperation with famous scientists.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>31. One of the children are sick.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>32. The child, taking the leaves, helps her parents.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>33. The business person, waiting for the flight, travel to Europe often.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>34. The visitor who wears the dark glasses are friendly.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
<tr>
<td>35. The racing car travelled quickly quite.</td>
<td>Right</td>
<td>Wrong</td>
</tr>
</tbody>
</table>

Alexandra Gottardo
17) On the next few pages there is a list of pairs of words. Only one of the two words on each line is spelled correctly. Circle the one that is correctly spelled or indicate the one that is correctly spelled and ask your assistant to circle it.

Remember, NO HELP! We want to know what you think.
If you don't know which word of a pair is correctly spelled, ask your assistant to put a question mark to the right of the second word. Continue until you have finished looking at all the words.

**NOTE TO ASSISTANT:** Use a piece of paper to cover all words below the line being worked on.

<table>
<thead>
<tr>
<th>Word-Pair Spelling Test</th>
<th>skait</th>
<th>skate</th>
</tr>
</thead>
<tbody>
<tr>
<td>evry</td>
<td>every</td>
<td></td>
</tr>
<tr>
<td>cloun</td>
<td>clown</td>
<td></td>
</tr>
<tr>
<td>sheep</td>
<td>sheep</td>
<td></td>
</tr>
<tr>
<td>face</td>
<td>fase</td>
<td></td>
</tr>
<tr>
<td>wrud</td>
<td>word</td>
<td></td>
</tr>
<tr>
<td>no</td>
<td>noe</td>
<td></td>
</tr>
<tr>
<td>thum</td>
<td>thumb</td>
<td></td>
</tr>
<tr>
<td>goat</td>
<td>gate</td>
<td></td>
</tr>
<tr>
<td>street</td>
<td>streat</td>
<td></td>
</tr>
<tr>
<td>wagun</td>
<td>wagon</td>
<td></td>
</tr>
<tr>
<td>tew</td>
<td>two</td>
<td></td>
</tr>
<tr>
<td>fue</td>
<td>few</td>
<td></td>
</tr>
<tr>
<td>answer</td>
<td>ansar</td>
<td></td>
</tr>
</tbody>
</table>
lake
true
cote
work
roar
stoar
snow
laik
trew
coat
wurk
rore
store
snoe
rane
nise
need
boal
milc
sleep
wize
room
rain
nice
nead
bowl
milk
sleap
wise
rume
Appendix 3-2-C

Evaluation of Spontaneous Communication with Focus on Blissymbols

by Margareta Jennische, Dept. of Phoniatrics, Uppsala Academic Hospital, S-751 85 Uppsala, Sweden

<table>
<thead>
<tr>
<th>Name</th>
<th>Date of birth</th>
<th>Date of evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To obtain a profile, put a line at the appropriate level for each variable. The levels are described on the next page.
<table>
<thead>
<tr>
<th>INFORMATION ABILITY TO INFORM WITH USE OF THE PERSONS TOTAL COMMUNICATION</th>
<th>ACCESS TO BLISSymbols</th>
<th>USE OF THE BLISSymbol SYSTEM</th>
<th>SENTENCES AND GRAMMAR</th>
<th>FUNCTIONAL INTERACTION IN TOTAL COMMUNICATION</th>
<th>ATTITUDE, DESIRE AND MOTIVATION FOR COMMUNICATION IN GENERAL</th>
<th>ENVIRONMENTS FOR USE OF BLISSymbols</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Can inform and convey thoughts independently and rather smoothly. Initiates new topics.</td>
<td>Has 500 symbols or more. The symbols represent a large variety of categories.</td>
<td>Uses symbols of all categories spontaneously. Has the ability to combine or use alternatives when needed.</td>
<td>Clear sentence structure. Sentences of different lengths. Uses different indicators to express grammar.</td>
<td>Good functional interaction. The person expresses himself and listens in adequate balance.</td>
<td>Positive attitude and adequate desire for communication.</td>
</tr>
<tr>
<td>4</td>
<td>Can inform and convey thoughts. Cases of misunderstanding occur but they can usually be solved.</td>
<td>Has 200 - 500 symbols of different categories i.e., nouns, verbs, evaluations, a few prepositions, indicators or strategies.</td>
<td>Uses symbols of most categories. Needs encouragement to combine, or find alternatives to be understood.</td>
<td>Distinct sentences. Utterances of several symbols. Tries to use indicators to express grammar.</td>
<td>A. The person is mainly either listener or expressor. OR B. Interaction sometimes disturbed due to misunderstanding.</td>
<td>A. Rather positive attitude but may need to be motivated. OR B. Somewhat too large desire to communicate.</td>
</tr>
<tr>
<td>3</td>
<td>Some ability to give information. The listener has to ask many questions. Many cases of misunderstanding.</td>
<td>Has 50 - 200 symbols, mostly nouns, verbs and evaluations.</td>
<td>Uses nouns, some verbs and evaluations spontaneously. Needs encouragement to expand vocabulary.</td>
<td>Rudimentary sentences. Most utterances contain 2 - 4 symbols. Lack of small words and indicators to express grammar.</td>
<td>A. Clear imbalance between listening and expressing. OR B. Discouraging interruptions because of misunderstanding.</td>
<td>A. Unwilling to communicate. Needs to be motivated. OR B. A profuse desire to communicate.</td>
</tr>
<tr>
<td>2</td>
<td>Very limited ability to give any information. Answers shortly to questions. Mostly the same topic.</td>
<td>Has a very limited number of symbols, not more than 50.</td>
<td>Uses a very limited number of symbols spontaneously.</td>
<td>Expresses one or two symbols. Symbols related to content, not as a sentence.</td>
<td>Only short moments of interaction. Help is needed to interact.</td>
<td>Difficult to motivate for communication. Only short special moments of motivation.</td>
</tr>
<tr>
<td>1</td>
<td>Hardly any ability to give information. Can only inform through &quot;yes&quot; and &quot;no&quot; answers.</td>
<td>Has hardly any blissymbols.</td>
<td>No spontaneous use. Can use a few symbols when encouraged.</td>
<td>Never more than one symbol per expression.</td>
<td>Hardly any ability to interact.</td>
<td>Hardly any occasions of motivation. Hardly any ability to be open for communication.</td>
</tr>
<tr>
<td>0</td>
<td>No ability to give information.</td>
<td>No knowledge of blissymbols.</td>
<td>No use of the blissymbols</td>
<td>No Bliss expressions</td>
<td>No interaction in communication.</td>
<td>No desire or possibility to communicate.</td>
</tr>
</tbody>
</table>
Evaluation of Spontaneous Communication with Focus on Blissymbols.

Name of blissuser: ........................................... Birth date: ................. Age: ....
Name of evaluator/s: ........................................... Date of evaluation: ..........

Evaluator's relation to blissuser: □ teacher □ assistant □ family member □ friend □ team
□ speech and language therapist □ other ............................................................

Evaluation: □ assessment at one occasion □ a general evaluation □ other ............................................................

How well does the evaluator know the blissuser? □ not well □ □ □ □ □ □ very well

Means of communication important in the persons total communication:
□ speech □ bliss □ manual signing
□ icon system ............................................................ □ other graphic system ...........
□ letters □ other ............................................................

Technical device used in the evaluation:
□ Blissymbol chart Pointer: □ hand/finger □ head pointer □ head light □ eyes

□ Communication device with blissymbols:
□ Communication device without blissymbols:

Speed of pointing/communication: very slow □ □ □ □ □ □ fast

Present school system: □ mainstream grade: ...........
□ special education grade: ...........
□ training school grade: ...........
□ other ............................................................

Name of school: ............................................................

Type of center/workshop ............................................................

Daily activity ............................................................

Other ............................................................

□ employed □ unemployed

Type of residence ............................................................

Number of years with blissymbols: .......

Still in blissymbol training: □ Yes □ No

Estimate the amount of training:
□ very seldom □ □ □ □ □ □ very often/every day

Some personal comments on why the communication with blissymbols for this person has become so successful or unsuccessful:

Since the start there have been □ many changes of symbol instructors □ no changes of symbol instructors
□ few changes of symbol instructors

Family / residence involvement □ has always been large □ has been adequate
□ became large after some time □ has been adequate
□ is still poor □ was large but has become poor

School / workplace involvement □ has always been large □ has been adequate
□ became large after some time □ has been adequate
□ is still poor □ was large but has become poor
Educational hits. Describe in a few sentences one or two educational ideas which have been very useful for this person.

### Literacy

<table>
<thead>
<tr>
<th></th>
<th>no</th>
<th>yes</th>
<th>approximate number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reads word icons:</td>
<td></td>
<td></td>
<td>letters</td>
</tr>
<tr>
<td>Reads new words:</td>
<td>X</td>
<td></td>
<td>letters</td>
</tr>
<tr>
<td>Reads sentences:</td>
<td></td>
<td></td>
<td>words</td>
</tr>
<tr>
<td>Reads texts:</td>
<td></td>
<td></td>
<td>sentences</td>
</tr>
<tr>
<td>Tries to spell words, initial letters:</td>
<td></td>
<td></td>
<td>comment:</td>
</tr>
<tr>
<td>Spells word icons:</td>
<td></td>
<td></td>
<td>letters</td>
</tr>
<tr>
<td>Spells new words:</td>
<td></td>
<td></td>
<td>letters</td>
</tr>
<tr>
<td>Writes own sentences:</td>
<td></td>
<td></td>
<td>words</td>
</tr>
<tr>
<td>Writes texts:</td>
<td></td>
<td></td>
<td>sentences</td>
</tr>
<tr>
<td>Uses a writing device:</td>
<td></td>
<td></td>
<td>type:</td>
</tr>
</tbody>
</table>

Number of years in literacy training: 

---

Developed by

Margareta Jennische
Dept. of Phoniatrics
Uppsala Academic Hospital
S-751 85 Uppsala, Sweden
Fax: +46 18 66 53 29

Kerstin Löström
Mora Habilitation Team
Vasagatan 14 C
S-792 32 Mora, Sweden
Fax: +46 250 263 60
Thanks for agreeing to participate in this study! Pencils ready? Let's go!

1) Your name: ____________________________

2) Date of birth: ____________________________

3) Name of person assisting you to fill out this questionnaire: ____________________________

4) Their relationship to you: ____________________________

5) Where are you living?
   a) home with family _______
   b) residential setting for 1-10 persons _______
   c) residential setting for 10 - 40 persons _______
   d) residential setting for more than 40 persons _______
   e) apartment _______
   f) own home _______
   g) other: ____________________________

6) Which of the following methods of communication have you used during your life?
   * Check ALL the methods that apply.
   * Circle ALL the methods that you prefer to use now for your daily face-to-face communication.
   a) yes - no questions ______
   b) vocalizations ______
   c) speech/ words ______
   d) gesture/ body language ______
   e) sign language ______
   f) Blissymbolics ______ approximate number of symbols ______
   g) Picture Communication Symbols (PCS) ______ approximate number of symbols ______
   h) PIC ______ approximate number of symbols ______
   i) other graphic symbol set or system (give name)____________________

   j) pictures/ photographs ______
   k) words on a communication board ______
   l) letters on a communication board ______
   m) voice output device ______

Give the name(s) of the device(s), (e.g. Light Talker, Real Voice)

n) special software, application(s) or program(s), (e.g. Word strategy, BMW, System 2000, Interaction, Education & Play) ______

Please give the name(s) ____________________________

o) computer (e.g. Epson, Mac, Apple IIE, Notebook, etc.) ______

Please give the name(s) ____________________________
7) How do you produce written communication?
Check ALL that apply.
Circle the method that you use the most.

a) computer
   yes ___  no ___ (If no, go to #d)

b) with word prediction or completion?
   yes ___  no ___

c) with a screen and voice feedback program?
   yes ___  no ___

d) typewriter
   yes ___  no ___

e) handwritten by yourself
   yes ___  no ___

f) "facilitated communication"
   yes ___  no ___

please describe the type of facilitation used

---

8) How do you access the computer?

a) I don't use a computer ___ go to #10
b) single switch ___
c) switches ___
d) expanded or alternative keyboard ___
e) regular keyboard ___

f) other ___ please describe

---

9) Do you have a modem?

yes ___  no ___

---

10) What types of writing do you do?

a) writing for face-to-face communication ___
b) writing for school assignments ___
c) writing for personal enjoyment ___
d) writing for the purpose of correspondence (eg. business letters, letters of inquiry etc.) ___

---

11) Do you have any visual difficulties?

yes ___  please describe_________________

no ___ go to #13

---

12) Do you require any of the following special print to read?

a) bold yes ___  no ___
b) large yes ___  no ___
c) small yes ___  no ___
d) other yes ___  no ___

Please describe _________________________
(5)

13) Can you get reading materials independently?
   yes ___ no ___

14) Can you turn pages independently?
   yes ___ (Go to #16) no ___

15) Can you turn pages once you have been set up with a page turning device?
   yes ___ no ___

16) How often do you read for your own interest and enjoyment — i.e., when reading is not a school assignment?
   a) daily ___
   b) about once or twice a week ___
   c) less than three times a month ___
   d) less than once a month ___

(10)

Now, something different again!

This page tells you what to do for Questions #18 to 44

You will see a set of boxes in each question #18 to 44, beginning page 11. You will see a set of boxes in question #18 to 44

Put an X in the box that represents your rating:

1 2 3 4 5

- low ___ moderate ___ high ___
- very little ___ sometimes ___ always ___
- never ___ always ___
- disagree ___ agree ___

For example:

If you rate an activity, person or skill as high or strong or important, your answer would be:

1 2 3 4 5

- low ___ moderate ___ high ___
- very little ___ sometimes ___ always ___
- never ___ always ___
- disagree ___ agree ___

If you rate an activity, person or skill as low or poor or unimportant, your answer would be:

1 2 3 4 5

X ___

- low, poor ___ moderate ___ high, well ___
- very little ___ sometimes ___ always ___
- never ___ always ___
- disagree ___ agree ___

If you don't know what rating to give, put a question mark at the end of the rating scale like this:

1 2 3 4 5

? ___

- low ___ moderate ___ high ___
- very little ___ sometimes ___ always ___
- never ___ always ___
- disagree ___ agree ___
Rate the following materials as to how much you enjoy reading them.

18) T.V. guide
low (very little)  high (a lot)
1 2 3 4 5

19) comics
low (very little)  high (a lot)
1 2 3 4 5

20) newspapers
low (very little)  high (a lot)
1 2 3 4 5

21) advertisements
low (very little)  high (a lot)
1 2 3 4 5

22) letters from family and friends
low (very little)  high (a lot)
1 2 3 4 5

23) magazines
low (very little)  high (a lot)
1 2 3 4 5

24) What is your favorite magazine? __________________________

25) books
low (very little)  high (a lot)
1 2 3 4 5

26) Please describe the types of books you read_____________________

27) novels
low (very little)  high (a lot)
1 2 3 4 5

28) Please describe the types of novels you read_____________________

Rate yourself on the following reading, writing and communication skills:

29) Independent reading
low (skills)  high (skills)
1 2 3 4 5

30) creative writing (e.g. poems, short stories etc.)
low (skills)  high (skills)
1 2 3 4 5

31) writing for daily living (e.g. letters, shopping lists etc.)
low (skills)  high (skills)
1 2 3 4 5
32) spelling for communication purposes

33) word-finding on a word board, to communicate

34) symbol-finding on a symbol board, to communicate

Rate the following sentences as to how they describe your situation:

35) I received excellent reading, writing and spelling instruction as I was growing up.

36) The help I received in my literacy learning was consistent overall as I was growing up.

37) I had enough time in school devoted to learning to read, write and spell.

38) Tell us a bit about the reading instruction that you have had. How do you feel about it? What was good? What was bad?
This is how I would rate the following people with regard to their help with my learning to read, write and spell:

39) friends

40) parents

41) teachers

42) speech pathologists

43) teaching assistants

44) others

46) How many total years have you attended school?  

47) Have you ever been involved in any of the following educational programs? Write how old you were when you began the program and write the total number of years you spent in each program, as best as you can remember.

   | yes | age | # of years |
---|-----|-----|------------|
   |     |     |            |

a) literacy training program  

b) functional reading program  

c) special education program  

d) life skills program  

e) high school program  with credit  

f) college or university  with credit  

g) job training program  

48) Have you ever been given the results of a reading assessment? How old were you? We would appreciate you describing the assessment (as much as you or your parents remember) and sharing the results with us, including a grade level if you were given one.
Appendix 3-2-E

Case Examples for Four SCSPI Subgroups

The following case examples were selected as being "typical" representatives of their subgroup, in that the pattern of their results followed that of the majority of the subgroup members. Subjects were selected as well because information was available regarding their formative years from the Silverman et al (1978) study.

The recommendations that follow regarding an initial instructional program focus primarily on phonological recoding related skills. From this starting point, other areas will be identified for instructional attention. For this purpose, Kemp's Diagnostic Model (Figure 2-6) will be used as reference. In addition, attention will be given to the cognitive abilities of each subject. The unique cognitive development of individuals with SCSPI, as depicted in McNaughton and Lindsay's Model of Symbolic Representational System Learning (Figure 2-3), will be referenced as well. Ways in which Blissymbols can provide innovative cognitive strategies and ways in which newly-gained skills in print can be used to compensate for limited memory and reasoning abilities will be explored.

Pre-Reader Case Example
CE, Year of Birth 1963

CE's Reading Profile shows him to be above the average of the Pre-Reader subgroup in consonant sound recognition, but not competent in this skill. He was unable to perform any of the phonological recoding tasks or recognize any sight words. His performance falls within the average range of his subgroup in tasks of visual analysis retrieval, working memory, syntactic error judgement. His scores on the receptive and expressive language measures and the TONI are slightly below the average of those of his subgroup.

CE indicated that he has visual difficulties but no hearing problems. He needs to wear glasses but they are not put on regularly. Without glasses, he identifies the symbols on his communication board by memory of their location. When using the computer once a week, his glasses are put on for him by his volunteer. CE spends most of his days in a hospital bed. His tolerance for sitting up is not sufficient for him
to stay in his wheelchair for the full day as is required by the nursing schedule. He therefore chooses to remain in bed except for days when there are very special events. Although not rated formally in this investigation, CE's motivation regarding reading related activities was also very high. During every testing session, CE became fully engaged in the tasks within his knowledge level. His limited physical tolerance was respected and the testing period never exceeded 30 minutes.

CE's Ecological Composite Index (35%) is in the same low range as that of his subgroup. To be noted especially from CE's ecological ratings are the following adverse conditions: (a) school and family expectations re literacy were rated negatively; (b) teachers' provision of literacy support during his formative years and current literacy support were rated negatively; (c) time allotted for literacy and quality of literacy instruction were rated negatively; and (d) CE indicated that currently he was not having any "reading" (being read to) opportunities. On the other hand, supportive to CE's potential reading acquisition by means of Writing and Reading with the Internet and Bliss (WRIB) are the positive ratings given to (a) enjoyment in reading; (b) use of over 200 symbols; (c) current access to computer; and (d) high motivation to learn.

Information relating to CE's early educational program from the 1975 Formative Evaluation Study (Silverman et al, 1978) is of interest: Within CE's school program at age 12, 30% of the time was devoted to language arts and within that allotment, 50% was committed to communication, 30% to listening, 10% to reading and 10% to writing (pointing to symbols for message to be transcribed by helper). At age 12, CE was rated by his teacher as functioning at the Pre-Primer level (see Appendix-2B, Rating Guide, 1978). It was also recorded that "sensory motor activities occupy total time."

In presenting his Reading Profile and Ecological Composite Index to CE, attention will be drawn to the strong possibility that ecological factors rather than his anarthria can be considered a primary cause of his reading limitations. This needs to be emphasized to both CE and his family, as they have been led to believe the opposite.

It is known that CE has volunteer support available to him for weekly use of BlissInternet, if he chooses to use it. Seating discomfort is currently a deterrent to working at a computer, however, and arrangements will be needed to improve his seating or to make the computer accessible from his bed if he wishes to make daily use of the computer.

Should CE decide to participate in a WRIB program, the first area of instructional attention will be letter sound recognition and applying his current
knowledge in this area to the initial letters of words appearing with the Blissymbols on his communication board. He will be reminded of his success during one of the testing sessions. CE was attempting to communicate his favourite movie. He indicated "d-d", and after much probing by this author, Dirty Dancing was finally identified!

The regular use of the initial letter strategy in communication with his WRIB team and guessing games involving initial letter sounds will be the first activities. These will be supplemented with memory games relating to topics of interest (computer, sports, hockey) and vocabulary/world knowledge expansion activities with his Peer Tutor. A Peer Tutor who shares these interests will be selected.

Attention will be drawn to the ways in which words on CE's display are constructed and comparisons will be made between the function of the letters in words and the function of the elements in Blissymbols. CE's visual analysis retrieval score (60%) indicates that he no longer attends to the components of compound Blissymbols and thus this area will be re-introduced to him. It should be an interesting domain for him to explore. The Blissymbols on CE's communication display afford the initial medium to which attention can be directed, that is analytic and conscious (the "AAC" of literacy as explained in the Educational Application), to the abstractable and manipulable components of language. First CE can attend to the semantic components of Blissymbols and from there contrasts can be made with the phonemic components of print. Attention that is analytic and conscious can thus be focussed initially on the sounds as distinct from the meanings of words and their components.

Regular opportunities for listening to and discussing stories with CE's Mediator-Partner (and with his Peer Tutor via email in Blissymbols) will be arranged. Composing short messages in Blissymbols, using the initial letter strategy as frequently as possible, and receiving and responding to BlissInternet correspondence will be recommended as the first semi-independent follow-up activities.

Essential first steps:
1. Provision for comfortable seating or for use of a computer from bed.
2. Finding a committed volunteer to serve as Mediator-Partner.
3. Finding a Peer Tutor who shares CE's interests.

---

10 The initial letter strategy in Blissymbol communication involves indicating a symbol that designates the type of person, place or object referred to, followed by its initial letter. e.g., 'man B' for Bob; 'animal H' for horse; 'city T' for Toronto.
Note: Receptive and Expressive Language and TONI are standard scores; remainder are percentage scores.
Ecological Checklist: Subject CE

Indicate "yes" or "no" as to whether there has been environmental support in the following areas:

<table>
<thead>
<tr>
<th>1. Parent support</th>
<th>during formative years</th>
<th>yes</th>
<th>no</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>(rated by subject)</td>
<td>current</td>
<td>X</td>
<td></td>
<td>Most time spent in hospital bed.</td>
</tr>
</tbody>
</table>

| 2. Teacher support | during formative years |     | X  | N/A |
| (rated by subject) | current               |     | N/A|     |

| 3. Literacy instruction | during formative years |     | X  | N/A |
| (rated by subject)      | current               |     | N/A|     |

| 4. Time for literacy   | during formative years |     | X  | N/A |
| (rated by subject)      | current               |     | N/A|     |

| 5. Family expectations re literacy achievements | during formative years |     | X  |     |
| (rated by subject)     | current               |     | X  |     |

| 6. School expectations re literacy achievements | during formative years |     | X  | N/A |
| (rated by subject)     | current               |     | X  | N/A |

| 7. Access to computer  | during formative years |     | X  |     |
|                        | current               |     | X  |     |

| 8. Use of VOCA        | during formative years |     | X  |     |
|                        | current               |     | X  |     |

| 9. Use of over 200 symbols or words | during formative years | X  |    |     |
|                                    | current               | X  |    |     |

| 10. Enjoyment in reading (being read to) | during formative years | X  |    |     |
|                                         | current               | X  |    |     |

| 11. Frequent reading (daily or weekly) | during formative years | X  |    |     |
|                                         | current               | X  |    |     |

| 12. Independence in getting to books and turning pages | during formative years | X  |    |     |
|                                                        | current               | X  |    |     |

<table>
<thead>
<tr>
<th>total &quot;yes&quot;</th>
<th>score</th>
<th>percent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>33%</td>
</tr>
</tbody>
</table>

N/A: These items are not applicable to this subject's situation and have been omitted in the calculation of score.
Pre-Decoder Case Example
KD, Year of Birth 1972

KD's Reading Profile shows her performance to be within the average range of Pre-Decoder reading subgroup for the following tasks: Consonant Sound Recognition, Visual Analysis Retrieval, Syntactic Error Judgement and Receptive Language. Her performance is well above the average performance of the Pre-Decoder Reading subgroup and within the range of the Print Readers for Phonemic Word Spelling, CVC-NC Word Task, Expressive Language and Primary Word Reading. Her performance is below that of the Pre-Decoder Reading subgroup for the following tasks: Recognition Decoding Pseudoword, Working Memory and TONI. KD received a grade level score in the PIAT of 2.5 indicating her skill in using context and sight words to derive meaning from continuous text.

KD reported no visual or auditory problems. Her Ecological Composit Index (65%) is above the range of the Pre-Decoder Reading subgroup and she gave positive ratings to the quality of and attitudes toward literacy instruction of family and school. The time devoted to literacy, however, was rated negatively.

Information relating to KD's early educational program from the 1975 Formative Evaluation Study (Silverman et al, 1978) did not show high expectations for academic achievement by her first school. At age three, after one term in a Preschool Senior Nursery program, she was described as borderline retarded and "sometimes observant; sometimes sees humour in situations". She did, however, demonstrate retention and usage of 70% of the Blissymbols that had newly been introduced to her.

No records were available concerning KD's elementary educational program, however, this author was involved as a consultant during KD's Secondary School program. A reading assessment was undertaken at age 16 and KD performed at a 7.7 reading age level. An intensive primary reading program was initiated by KD's home room teacher. She was given literacy support through individualized instruction one period per day within an otherwise integrated program. This continued with several different teaching assistants until age twenty-one.

KD has a very supportive home situation and literacy experiences are provided whenever possible. In the three years since leaving secondary school, several different arrangements have been made for literacy experiences. Assistants with varying degrees of knowledge regarding reading instruction have been engaged for one-two hours on
week days. Since KD already has access to BlissInternet, it is hoped that she will decide to participate in WRIB.

The first area of instructional attention will be to the decoding of words and pseudowords. The difference in KD's performance on the CVC-NC Word Task (in which words were known but spelled in a nonconventional way) and the Decoding Pseudoword Task is of interest. It would appear that she is having greater difficulty when the stimulus represents a word that is unknown to her. This is consistent with her success in reading words in context as in the PIAT. Much practice with new words which must be decoded will be planned. Nonsense words within messages and games of interest to KD will be encouraged within the interactions between KD and her Peer Tutor. KD will also be encouraged to write messages independently using a combination of Bliss and Print and spelling words phonemically whenever possible. At present, "writing" is done by KD pointing to symbols and her partner transcribing them for others to read. KD will be encouraged to independently contribute sections to these stories. They will then be used for KD to read later and to respond to questions based on the story.

KD's limited working memory skills will be given attention and activities will be encouraged that support her in developing strategies for storing and retrieving information. The criteria used in selecting her Peer Tutor will include both proficiency in developing cognitive strategies and experience in phonological decoding.
Reading Profile
Pre-Decoder PAR
Subject KD

Error Bars: ± 1 Standard Error(s)

Cell Mean

Consonant Sound Recognition
Phonemic Spelling
CVC-NC Word Task
Recognition Decoding
Pseudoword Task
Primary Word Reading
Visual Analysis Retrieval
Working Memory
Syntactic Error Judgement
Receptive Language (CELF-R)
Expressive Language (CELF-R)
TONI
Ecological Rating

100  84  75  00  100  60  31  66  50  67  63  65

Note: Receptive and Expressive Language and TONI are standard scores; remainder are percentage scores.

Additional Information
visual difficulties — none reported
hearing difficulties — none reported
articulation abilities — anartheic
phonological similarity effect in serial order memory — no
Ecological Checklist: Subject KD

Indicate "yes" or "no" as to whether there has been environmental support in the following areas:

<table>
<thead>
<tr>
<th>1. Parent support (rated by subject)</th>
<th>during formative years</th>
<th>current</th>
<th>yes</th>
<th>no</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>KD lives in the family home with as much support as community services provide.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Teacher support (rated by subject)</th>
<th>during formative years</th>
<th>current</th>
<th>yes</th>
<th>no</th>
<th></th>
</tr>
</thead>
<tbody>
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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Literacy instruction (rated by subject)</th>
<th>during formative years</th>
<th>current</th>
<th>yes</th>
<th>no</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Time for literacy (rated by subject)</th>
<th>during formative years</th>
<th>current</th>
<th>yes</th>
<th>no</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. Family expectations re literacy achievements</th>
<th>during formative years</th>
<th>current</th>
<th>yes</th>
<th>no</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6. School expectations re literacy achievements</th>
<th>during formative years</th>
<th>current</th>
<th>yes</th>
<th>no</th>
<th></th>
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<tbody>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>7. Access to computer</th>
<th>during formative years</th>
<th>current</th>
<th>yes</th>
<th>no</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8. Use of VOCA</th>
<th>during formative years</th>
<th>current</th>
<th>yes</th>
<th>no</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>9. Use of over 200 symbols or words</th>
<th>during formative years</th>
<th>current</th>
<th>yes</th>
<th>no</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10. Enjoyment in reading</th>
<th>during formative years</th>
<th>current</th>
<th>yes</th>
<th>no</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>11. Frequent reading (daily or weekly)</th>
<th>during formative years</th>
<th>current</th>
<th>yes</th>
<th>no</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>12. Independence in getting to books and turning pages</th>
<th>during formative years</th>
<th>current</th>
<th>yes</th>
<th>no</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
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</tbody>
</table>

ECI (using 17-item rating scale = 65)

<table>
<thead>
<tr>
<th>Score</th>
<th>Percent</th>
<th>Year</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/12</td>
<td>66%</td>
<td>formative years</td>
<td>parent support</td>
</tr>
<tr>
<td>8/12</td>
<td>66%</td>
<td>current</td>
<td>accessibility to computer</td>
</tr>
</tbody>
</table>
Primary Reader Case Example
SB, Year of Birth 1965

SB’s Reading Profile shows her to be within the average range of the Primary Reading subgroup in the following tasks: Primary Word Reading, Visual analysis Retrieval, Syntactic Error Judgement, Receptive Language and TONI. Her performance is above the average range of the Primary Reading subgroup in the following tasks: Phonemic Word Spelling, CVC-NC Word Task, Expressive Language, Spelling Word-Pair. Her performance is below the average range of the Primary Reading subgroup in the following tasks: Recognition Decoding Pseudoword Task, Working Memory, Homophone Word-Pair.

SB’s Ecological Composite Index (59%) is within the range of the Primary Reading subgroup. Overall, however, support to literacy during her formative years was not strong. SB gave negative ratings to Parental Support to Literacy and Amount of Time Devoted to Literacy during her formative years. She said, "I was out of class alot because persons thought I could not learn. I did not know this until a teacher told me. She was the one I trusted to help me find out, but I always thought I could read! I made up things and the teachers never figured it out. I wanted to cry when I was finally told I wasn't reading!" SB indicated during the testing that her knowledge of the letter-sound relationships in print were self-taught.

Problems of accessing devices and the computer have always been present and continue to be. SB reported visual difficulties and has required a magnified screen. Through the years it has been difficult to obtain glasses that meet her visual needs and also to have them put on regularly. SB's reported no auditory difficulties.

Information relating to SB's early educational program from the 1975 Formative Evaluation Study (Silverman et al, 1978) is of interest: At age nine, her school program was described as devoting 50% of the time to language arts and within that, 10% of the time to reading. Her reading performance was rated at the Late Kindergarten/Early Grade 1 level (see Appendix-2B, Rating Guide, 1978).

SB is highly motivated to improve her reading skills and to help others learn Blissymbols. She attends an adult literacy program and works daily on a computer, using a word prediction program.

In presenting the Reading Profile and Ecological Composite Index to SB, attention will be drawn to the limited literacy instruction that was given to her during her formative years and the problems she has always experienced related to computer
access. It will be emphasized that these ecological factors rather than her anarthria can be considered primary factors limiting her reading ability. Of interest is the difference in her performance on the CVC-NC Word Task in which instruction is given and in which the stimuli are known words and her performance on the Decoding Pseudoword Task. SB demonstrated that she could perform a phonological decoding task when support was provided, however, she had difficulty when the stimuli were pseudowords. This is not surprising for someone whose decoding skills are self taught.

Since SB has access to BlissInternet, she will be eligible to become involved in WRIB. If she decides to participate, her role will be twofold. She will be a Learner with her own instructional support team. She will, as well be invited to serve as a Peer Tutor for a Learner at the Pre-Reading level. SB has much knowledge to share and a keen willingness to help others. She will make a strong contribution to another participant's reading program. SB has extensive learning needs of her own, however, and will benefit from a word recognition instructional program based on phonological decoding skills.

The first activities for SB in her learning program will be practice in reading materials which require decoding new words within the context of continuous text as well as drill activities to gain speed in decoding. Practice in decoding pseudowords will be introduced within a game activity. The focus within WRIB will be upon decoding skills, since SB is getting practice in writing and spelling within her adult education program. Initially, in her role as Peer Tutor, she will be asked to provide practice to her Learner in letter sound associations. As SB gains skill in decoding herself, however, she will be asked to develop simple decoding tasks for the Pre-Decoder participant for whom she serves as Peer Tutor. Since Working Memory is another area in which SB is performing below the Primary Reader subgroup, she will be introduced to activities which encourage her in developing strategies for storing and retrieving information.
Ecological Checklist: Subject SB

Indicate "yes" or "no" as to whether there has been environmental support in the following areas:

<table>
<thead>
<tr>
<th>Support Type</th>
<th>Yes</th>
<th>No</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Parent support</td>
<td></td>
<td></td>
<td>Attending an adult literacy program</td>
</tr>
<tr>
<td>(rated by subject)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(current)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>during formative years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Teacher support</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(rated by subject)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(current)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>during formative years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Literacy instruction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(rated by subject)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(current)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>during formative years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Time for literacy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(rated by subject)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(current)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>during formative years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Family expectations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>re literacy achievements</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(current)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>during formative years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. School expectations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>re literacy achievements</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(current)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>during formative years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Access to computer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(current)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>during formative years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Use of VOCA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(current)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>during formative years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Use of over 200 symbols or words</td>
<td></td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>(current)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>during formative years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Enjoyment in reading</td>
<td></td>
<td></td>
<td>ECI (using 17-item rating scale = 59)</td>
</tr>
<tr>
<td>(daily or weekly)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(current)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>during formative years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Frequent reading (daily or weekly)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(current)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>during formative years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Independence in getting to books and turning pages</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(current)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>during formative years</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>[Score and Percent Table]</td>
<td>6</td>
<td>50%</td>
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</tr>
<tr>
<td>[during formative years]</td>
<td>10</td>
<td>83%</td>
<td></td>
</tr>
<tr>
<td>[current]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Independent Reader Case Example
NQ, Year of Birth 1963

NQ is considered an Independent Reader because of (a) his average percentage score on the CVC-NC Word Reading and Decoding Pseudowords Tasks being over 50 and (b) his sentence comprehension (PIAT) grade level being over 2.9. He performs at or above the average of Independent Readers in tasks related to phonemic word spelling, decoding CVC-NC words, decoding pseudowords, primary word reading, working memory, syntactic error judgement, receptive language, expressive language and TONI.

NQ's performance within the present study is below the average of the Independent Readers on the Homophony Nonword Pair Task and the TORC subtests of General Vocabulary, Syntactic Similarities and Paragraph Comprehension. His Reading Comprehension Quotient (48) is well below that of the Independent Reader subgroup (70), which in turn is two standard deviations below the mean of the nondisabled population of 16-year-olds. NQ's receptive language (87) is higher than average for the Independent Reader subgroup, however, it is still below the mean for the normal population of 16-year-olds (M=100).

The disparity between the visual analysis retrieval skills that were lower than the average of his peers and the TONI score that was higher than the average of his peers is interpreted as due to attentional factors. The TONI task was interesting and challenging to NQ. The visual analysis of Blissymbols represented an early skill no longer required and of little interest.

To be considered in reviewing NQ's test results is the late introduction of reading instruction that focussed on decoding skills. It was not until he was 22 years of age that his conscious attention was directed to the analytic nature of written language. He credits this single year with a breakthrough for him in understanding print code. His Ecological Composite Index of 100% indicates the positive ratings throughout given by NQ. Any limitations he might have felt relating to his literacy as he was growing up were perceived as a result of his condition of cerebral palsy, not from the instructional program.

Of interest in this regard is the report of his school history from the 1975 Formative Evaluation Study (Silverman et al, 1978). At that time, at age 12, his intellectual functioning was judged by his teacher and those working with him to be mildly retarded (Educable level), while at the same time, he was judged to be "very
alert, observant, sees humour in situations". Regarding his language, "All his sentences are excellent and grammatically correct and meaning is clear". He was using 100% of his 600 Blissymbol display. Half of his school time was spent in language arts and within this half, 10% was devoted to listening, 40% to communicating, 30% to reading and 20% to writing. NQ was reported as functioning at the Grade 2 level but relying on sight words. The report indicated that he was working on word-attack skills, but this did not seem to be perceived by NQ as providing the insight he needed with regard to decoding.

In the reading of words, sentences and paragraphs with a general vocabulary (as in test materials), NQ's laboured phonological decoding skills along with average receptive language resulting in scores below average for the Independent Reading subgroup. In reading materials on topics of strong personal interest, however, NQ displays a strong sight vocabulary and an exceptional ability to compensate for his weakness in phonological decoding.

The following is an excerpt from the writing sample submitted by NQ:

As a person with a communication problem, I personally know how important an Electronic Highway system is. I couldn't be as involved with disabilities issues as I am. The nonspeaking community is a small piece of the society that will greatly benefit from an Electronic Highway. So you know this will have a great impact in how we live in Canada. As I was reading the Statement that deals with the Electronic Highway, I was thinking of the great gain this will make to our population who are blind, deaf, nonspeaking, elderly, etc. The only problem that some of our nonspeaking population might have is their literary skills are too low to use a form of Electronic Mail system. This is why BlissNet is so important to maintain and develop to its' fullest.

The high performance in the Phonemic Word Spelling Task, the performance within the range of his reading peers in the recognition decoding tasks (CVC-NC Word Task and Decoding Pseudoword Task), the high nonverbal intellectual (PIAT) indicator, high ecological rating and average language skills, along with the observed exceptional language skills in topics of interest and experience (reading sample above), provide very encouraging predictors for increased reading skill for NQ in the future. A recommended self-instructional program would include extensive practice in reading
materials which require decoding new words within the context of continuous text as well as drill activities to gain speed in decoding.

Serving as a Peer Tutor would provide NQ with the latter experience (review and practice) as he provides support to a Learner who is identifying letter sounds and applying them to decoding for the first time. Of particular assistance to both NQ and any Learners he may work with as a Peer Tutor, would be activities using his VOCA. The use of synthetic speech is a relatively new capability for NQ. He received his first voice output communication device in 1994. He should be encouraged to explore and teach techniques for analysing words into their component parts, to give himself practice and to draw conscious attention to the phonemes of words to the individual he is helping. Providing instruction by means of BlissInternet for analytic exercises would be beneficial to both NQ, in designing the task, and the Learner, in following through on the assignment.
Note: Each task has different measurement units; the task names and units are listed in the legend.

- **Reading:**
  - High Level: 3+ (PLAT) — indicates above average performance
  - Standard Level: 3 — indicates average performance

- **Additional Information:**
  - Pronunciation quality
  - Reading errors
  - Writing problems
  - Reading at grade level
  - Visual difficulties
  - Auditory difficulties
  - Reported reading difficulties

- **Subject:**
  - Independent Reader
  - Primary Reader
Ecological Checklist: Subject NQ
Indicate "yes" or "no" as to whether there has been environmental support in the following areas:

<table>
<thead>
<tr>
<th>Area</th>
<th>Support During</th>
<th>Support Current</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Parent support (rated by subject)</td>
<td>yes</td>
<td>no</td>
<td>&quot;My most gain in reading was when I got a reading tutor. It seemed that everything came in that one school year. The system that I learned from was the 'Laubach Way to Reading' (which was back to sounding words out.) A great deal of my reading skills came with this system with one to one tutoring.&quot;</td>
</tr>
<tr>
<td>2. Teacher support (rated by subject)</td>
<td>yes</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>3. Literacy instruction (rated by subject)</td>
<td>yes</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>4. Time for literacy (rated by subject)</td>
<td>yes</td>
<td>no</td>
<td>&quot;Time for literacy&quot; was rated &quot;moderate&quot;.</td>
</tr>
<tr>
<td>5. Family expectations re literacy achievements</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>6. School expectations re literacy achievements</td>
<td>yes</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>7. Access to computer</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>8. Use of VOCA</td>
<td>current</td>
<td>yes</td>
<td>ECI (using 17-item rating scale) = 100</td>
</tr>
<tr>
<td>9. Use of over 200 symbols or words</td>
<td>current</td>
<td>yes</td>
<td>N/A</td>
</tr>
<tr>
<td>10. Enjoyment in reading</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>11. Frequent reading (daily or weekly)</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>12. Independence in getting to books and turning pages</td>
<td>yes</td>
<td>no</td>
<td>total &quot;yes&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Score</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>92%</td>
</tr>
<tr>
<td>8/8</td>
<td>100%</td>
</tr>
</tbody>
</table>

N/A: These items are not applicable to this subject's situation and have been omitted in the calculation of score.
Appendix 3-2-F

Sample Assessment Report
Subject KE, Pre-Reader

Date: 
To: speech-language pathologist
    parent
    teacher
    educational assistant
    AV/Computer Services
    consultant

From: educational consultant,

Regarding: KE
1. Literacy Assessment
2. Program Recommendations
3. Computer Options and Support

1. Literacy Assessment

The following is a summary of KE's performance in March and April, 1996 on a battery of tests relating to reading acquisition and reading related skills. The underlying premise of the test battery is that an understanding of the skills contributing to reading acquisition requires a number of developmental indices. The tests offer a means of probing beginning reading skills. The results are presented as KE's Reading Profile, through which his performance can be compared to the performance level of other adults with severe congenital speech and physical impairments who are at the Pre-Reader level.

This assessment was undertaken at the request of XXX, speech-language pathologist, XXX Board of Education, with written permission by XXX, KE's mother, for the results to be considered in the planning of KE's educational program. The support of XXX, KE's home room teacher and XXX, KE's educational assistant for his Basic Level Grade 9 English class was appreciated in conducting the assessment.
The tasks used within the test battery were: letter name and sound, upper and lower case matching, a nonconventional consonant-vowel-consonant task, decoding pseudowords, spelling phonological recoding, primary word recognition, picture recognition, visual matching and analysis, working memory, syntactic error judgement, phonological recoding and short term memory, and reading comprehension. As well, receptive and expressive language skills and degree of dysarthria were assessed by XXX, speech language pathologist, and reported by her.

KE's performance on the battery of tasks demonstrated gaps in his basic beginning reading skills, particularly with regard to letter-sound associations. He demonstrated an inability to decode new words at the primary level. KE seems to rely solely on sight word recognition, having learned most of these words from his Blissbook. This is enabling him to function at an early Grade One level. Without an understanding of and fluency in applying letter-sound relationships, KE will be unable to develop independent reading skills. In addition to explicit instruction, KE needs extensive experience independently reading primary books. His weakness in letter-sound knowledge, resulting in an inability to apply phonic skills, not only restricts KE's progress in learning to read, but, just as importantly, prevents him from using spelling to communicate new words and ideas in order to supplement his oral speech and his Blissymbols.

KE's visual skills are good, as demonstrated in his recognition of pictures, sight words from his Blissbook and in Bliss and letter matching tasks. In short term memory tasks, KE is easily distracted and does better when the memory demands are reduced and visual reminders are maintained. KE needs instructional support in tasks requiring planning, dividing his attention between two levels of information, analyzing visual material, systematically examining all options, and in remaining focussed on the overall goal of a task. He is co-operative and motivated when help is given and shows the ability to persist with a task and to concentrate for periods of up to an hour when changes to the pace and type of task are introduced, when he is encouraged to manipulate materials and to write, and when the tasks are designed to meet his interest and ability level.
2. Program Recommendations

The overall goals in recommending a literacy instructional program for KE are twofold: First, KE needs further instruction in order to read independently — for hobbies, for possible vocational opportunities, and for life in the community. His skill acquisition to date indicates that he can benefit from further instruction. Second, KE needs to improve his spelling skills in order to further his communication competency. KE could benefit from expanding both his Blissymbol and spelling strategies and using them together to express his ideas. As well, increased literacy abilities will open up additional technology opportunities for KE.

In planning KE's literacy instructional program, the skills typically developed in grades one and two can provide the overall context. KE's interests and Blissbook vocabulary should be kept in mind, remembering that his word knowledge is built on his Blissymbol vocabulary. Some preferences that were discovered: He likes to use the computer, to manipulate materials, to write, to make choices about the ordering of tasks, to do a task independently, to engage in motor activity.

KE could benefit from a regular daily program planned to support his continuing development of reading and communication skills. In apportioning KE's time, I would suggest 1/5 be devoted to reviewing his Blissymbols and developing functional Blissymbol strategies to generate new concepts; 1/5 to improving his listening and receptive and expressive language skills (XXX speech language pathologist will be giving suggestions for this area); and 1/5 to increasing his sight word vocabulary — derived from the words in his Blissbook initially, but adding to this a personal dictionary (in notebook and index card form, of words not directly in his Blissbook, but which he could describe using his Blissymbols and for which he could create a "combined" Blissymbol.) With all of these words and with others he encounters, attention should be given at first to the initial letter of the word, as the beginning step in recognizing it. The remaining 2/5 of his instructional time should be devoted to the development of phonological skills leading to phonological decoding (applying a knowledge of phonics to decode new words.)

Many of the learning activities can rely on a movement back and forth between Blissymbols and words. KE can be given questions orally to which he responds by using his Blissbook and he can be given tasks involving lists of typed words to which he responds in Blissymbols, independently using the computer. Questions can be asked in Blissymbols (by the instructor printing them using the Talking Blissapple software) and KE can be asked to respond with a word (referring to his Blissbook as
needed) which he types independently. In addition, questions can be typed in words known to KE and he can be asked to independently respond in Blissymbols using his Blissymbol software. To be avoided are tasks that merely require KE to copy printed words or Blissymbols.

Developmental levels in phonological decoding and its relationship to progress in reading:

The following levels of development, derived from the work of Margaretha Vandervelden, Ph. D., a researcher at OISE, can be helpful in planning learning activities for KE. The easiest tasks are those in which a word is spoken and the student is asked to match the written form of the word with the spoken form. At this level, the student does not have to retrieve the sound of the word from his/her knowledge base, as it has been given to him/her. This is called recognition phonological recoding.

The next most difficult task is that in which the student is asked to write/type (spell) a word, in response to the spoken form having been given to him/her. Again the student does not have to retrieve the sound of the word from his/her knowledge base, because again it has been given to him/her; however, for this task, the student must produce the letters that are associated with the sounds he/she hears. This is often called inventive spelling (spelling phonological recoding).

The most difficult level is that of phonological recoding, when the student is shown a printed word and must read (decode) it by retrieving the sounds that are related to the letters in the presented word from his/her own knowledge base. This stage is frequently referred to as decoding, (phonological recoding). At this stage, to decode words successfully, the student must be secure in his/her knowledge of letter sounds as they relate to the visual form of the letters. To do this within the context of continuous print (running text), places even greater demands on the student. He/she must know the sounds so well that they can be retrieved instantly or automatically, for at this stage, the student must decode and as well, must interpret what is being read as he/she progresses through the sentence and then the paragraph. Short term and working memory are critical factors in decoding words and comprehending printed text. The student must hold in memory the sounds that have preceded the one he/she is currently working on (short term memory). He/she must also segment the word into parts, retrieve the sound associated with the letter(s) being decoded, and synthesize these sounds with the previous sounds (working memory.) The more practice a student has with letter sounds (gaining the ability to process them instantly and automatically), the
smaller the demands on working memory and the greater will be his/her reading progress in reading words and sentences.

The above sequence of phonological recoding skills can provide a structure for KE's program. First he needs to be more secure in all his letter sounds. From my testing, he was unsure of the sounds associated with the letters u, b, p, f, l and v. In working with KE, other letter sounds which cause him trouble may be discovered and he should be given opportunities to work with any of these letters along with the ones already identified, through participating in a variety of fun matching and identification games. In applying KE's phonological knowledge to words, it is best to begin with three-letter words (consonant-vowel-consonant) and it should be remembered that as individuals begin to acquire phonological processing skills, they first become aware of the beginning letter in words, and then attention is given to the final and middle components of words.

For the recognition stage, KE could be given three printed words and the instructor could say one of the three words. KE would be asked to point to the word that is spoken. Or as a variation, KE could be given one printed word, the instructor would say three words, and ask KE to stop her when she says the one he has in front of him in print. KE could be asked to interpret a series of words (examining them as a sentence) — discovering that they reveal the next topic or a secret message, etc. In each of the aforementioned tasks, the level of difficulty can be increased by first having all the letters of the stimulus words different (e.g., cot, bin, map), then having only the first letter different (e.g., tin, fin, bin), then having only the last letter different or the middle letter different (e.g., man, map, mad; ten, tin, ton). At this stage, the main criteria are (1) that KE is given the spoken word and must match it with the printed word, (2) that he is working with words containing letter-sounds he has demonstrated he knows, (3) he is working with words that he does not know as sight words. (If he already knows the word, he will not need to use decoding skills.)

For the inventive spelling stage, games can be played at which KE can be asked to indicate the beginning letter for each spoken word, presented individually and sequentially. KE could do this by pointing to the appropriate alphabet letters in his Blissbook, by typing, or by finding letters from squares prepared for this purpose (e.g., scrabble letters) that are mixed up on his tray. KE would enjoy the mixing up of the letters before each turn! The end result could be the completion of a crossword-like puzzle, or the discovery of a mystery sentence (e.g., Today we make cookies!). KE would get experience in listening, selecting letters that belong with their sounds,
working toward the completion of a puzzle or a sentence (two-level task), practice in reading the words that result. The next stage for this task could be KE being asked to indicate both the beginning and ending letter, by listening to the word carefully and pointing to the appropriate letter from the alphabet. Later, the middle vowel could be added as the focus for KE's attention. The tape recorder could be used, presenting KE orally with words to be spelled (either totally, or by KE providing the first letter) on his computer. This would provide another independent activity for him. Hopefully many of these letter, sound, word activities can be related to the topic being discussed at morning circle time or in English class. At this stage, the main criteria are (1) that KE hears the word and must decide what letter(s) belong with the sounds he hears, and (2) the letter sounds that appear in the words are ones he has already demonstrated he knows.

For the decoding stage, KE must decide upon the meaning of a word from being presented with the printed form. KE would then give his response by means of a picture or a Blissymbol sentence in addition to his saying of the word. Caution must be exercised here to ensure that KE is not doing a sight word matching from words on his board. Hence, for this activity, an effort must be made to give KE words that are not in his Blissbook. Examples of words that could be used would be cot, bug, rat, nap, tin. Some of the activities in phonic books would be helpful at this stage. This is the most advanced level of 3-letter-word phonological recoding, and should only be introduced after the earlier activities described above have been worked on and KE is demonstrating success with them.

For sight word practice, and as a means of testing the Blissymbols and words in KE's Blissbook, index cards could be used, with one word per card. KE could practice his words each day, sorting them into two piles, those known and those not known (as demonstrated to his instructor.) To indicate he knows what a word is, KE would be asked to point to it in his Blissbook. Only if KE goes right to the symbol should it be judged as known. For those words not known, salient parts of the word could be pointed out to KE, eg. It begins like "mother"; it has two letters the same in the middle; it ends in "ing" but begins like "eat", etc.

For Blissymbol practice, Blissymbols could be presented to KE, applied to index cards as printed from Talking Blissapple. KE could then be asked to find the symbol in his Blissbook, with no verbal cue being given as to the meaning of the symbol. The index cards of Blissymbols could be sorted into those known and not known, as with the sight words. For those that are not known, the instructor could look
the symbol up in Blissymbols for Use and explain the parts to KE, plus talk about any symbol elements of interest as they relate to other symbols. Practice finding symbols and thinking about their locations in his Blissbook (whether or not they "belong" with a group of symbols), would provide an excellent review for KE, of both the words and symbols in his Blissbook. Matching the index cards with symbols to the index cards with words could be another activity for KE.

In all activities, KE should be made aware of his results and keep a record which will allow him and his instructor to look back and see his progress. This record is also critical for the planning of activities. Working for twenty minute periods with frequent changes of task would be preferable to longer work sessions. However, if KE becomes interested in a task, and wishes to continue it, he should be given the opportunity to work at it as long as the class schedule permits. Whenever possible, KE should be given the opportunity to work independently using the computer. His answers could be in either Blissymbols or words, depending on the task. At first, written tasks could be completed with the help of the educational assistant, but the goal should be for KE to complete the task independently.

3. Computer Options and Support
A. Talking BlissApple
KEs current program for the Apple computer, Talking BlissApple was developed in 1982 and lacks several of the features of word processing which we have now come to expect — saving of files to disk, editing, direct entry of letters (without requiring a number code), optional ways of selecting Blissymbols. Nonetheless, KE enjoys using and has become very competent with this program. If KE is to remain with this software, it would be advantageous for someone available to the classroom to be trained in updating and customizing the symbols and gloss (words accompanying the symbols) as KE's sight word and symbol vocabulary grows. Arrangements could be made for this training if a teaching assistant or volunteer can be given the time. One day of training would give a computer knowledgeable person the information they need. They would need to travel to XXX for the day.
B. BlissWrite

A much more current and comprehensive program is BlissWrite now available for a 386 or higher processor. This software is a "Bliss-processing" program and is available from Blissymbolics Communication International. The technical requirements are: 386, 486 or Pentium processor, a VGA monitor, preferably 8 MB of RAM, Windows 3.1 or Windows 95, and a compatible printer. BlissWrite has full editing capabilities, many alternate ways of accessing the symbols, the preferred being the use of WiViK (software providing an on-screen display of symbols) and provides easy movement back and forth between Blissymbols and print. KE's use of this software would be contingent upon having regular access this term to the technical configuration described above or on having regular access to a Macintosh computer in September. For the Macintosh, Ke:Nx would be the software required for the on screen display. The Beta version of BlissWrite for the Macintosh computer is currently being tested. Training of the teacher and/or educational assistant in the use of this software can be arranged.

C. BlissNet and BlissInternet

BlissInternet is a Computer Mediated Communications (CMC) program that accompanies BlissWrite. With the addition of a 14,400 Baud modem (a 2400 Baud modem can be used) and with a connection to an Internet Service Provider, to the above BlissWrite software, KE would be able to send and receive Blissymbol and word messages from others using BlissInternet. Those already using BlissInternet include Blissusers, their parents, friends, interested professionals and students from two public schoolboards who are involved in a program to learn Blissymbols and telecommunications while interacting with persons who use Bliss. An important resource possible through BlissInternet participation is literacy peer tutoring for Bliss users who are beginning readers by Bliss users who have gained competency in literacy. This would be an especially valuable program for KE. BlissInternet users will soon be able to communicate with Blissymbol users worldwide, as other countries begin using BlissInternet. This opportunity would be available, as well, to KE's classmates and other students in his school who are interested in Bliss Pals around the world.
Summary

In looking ahead to KE's graduation from school at age twenty-one, his access to more current technology and an increased competency in both Blissymbols and print are areas that would offer the greatest opportunities for him. Many Bliss users are deriving much satisfaction from communicating by means of CMC and offering assistance to other Bliss users who need tutoring or who enjoy their "electronic" companionship. This is an area worthy of consideration for KE.

Further consultation can be made available through email, telephone, BlissInternet or an occasional visit to XXX. It has been a pleasure to work with KE. He is most fortunate to have such a supportive team.