Composition Skills of Children with ADHD: An Intervention Study to Improve Communicative Clarity

by

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Abstract

The aim of the current study was to assess whether providing visual feedback on the written compositions of children with ADHD was an effective method to improve communicative clarity. Participants were twenty children, aged 7 to 9 years with ADHD. Children composed instructions on how to build a figure so that a confederate could reproduce the image based only on the child’s instructions. Participants in the experimental group received feedback on their compositions in the form of the reconstructed figure and were able to then compare the figures side by side on-screen and edit their instructions. Participants who received visual feedback outperformed participants in the no feedback group on the clarity of compositions at post-test, and at a six-week delayed post-test, and were able to apply their learning to transfer tasks. This research makes valuable contributions to understanding the factors that contribute to successful early writing for children with ADHD.
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Chapter 1
Introduction

1 Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is one of the most commonly diagnosed disorders of childhood affecting 3-7% of school-aged children (American Psychiatric Association, 2000). ADHD is characterized by developmentally inappropriate degrees of inattention, hyperactivity and impulsivity leading to functional impairment in a variety of areas (Ota & DuPaul, 2002). One of the most common difficulties exhibited by children with ADHD is chronic academic underachievement (Barkeley, 1998). Students with ADHD have lower academic grades and higher dropout rates compared to students without ADHD (DuPaul & Stoner, 2003). Writing is one academic domain in which children with ADHD are at high risk for underachievement. According to a study by Mayes, Calhoun & Crowell (2000), approximately 65% of children with ADHD have considerable difficulty writing. Although pharmacological interventions and behaviour modification programs are most often used to improve outcomes for students with ADHD, those interventions are not sufficient to ameliorate academic underachievement (Purdie, Hattie & Carroll, 2002). Further academic interventions are needed to enhance educational outcomes for these students (DuPaul & Stoner, 2003) since any deficits in early childhood rapidly become cumulative. The focus of the current study is to evaluate the effectiveness of an intervention designed to improve early writing skills in young children with ADHD. The particular aim is to foster reader awareness in these children, as consideration of the perspective of one’s audience is important in both oral as well as written communication and has been shown to differentiate strong from poor writers (e.g., Flower, 1979; Bereiter & Scardamalia, 1987).
1.1 Oral Communication Skills, Theory of Mind, and ADHD

Communication skills are necessary for academic success and serve as a building block for the development of other academic skills. In order to communicate successfully, a speaker must attend to the mental states of their conversational partner (Nilsen & Fecica, 2011). Attributing mental states, such as beliefs, intentions, desires and emotions, to oneself or others is described as having a theory of mind (Watson, Cross & Wellman, 2001). An adequate theory of mind is necessary, but not sufficient for successful real world communication (Astington, 2003). In addition to having adequate mentalizing ability, one must also have the cognitive ability to modify one’s communication patterns based on the listener’s perspective (Nilsen & Fecica, 2011).

Children with ADHD show considerable difficulty in various areas of communication (Bruce, Thernlund, & Nettelbladt, 2006; Geurts, Broeders, & Nieuwland, 2010). They provide less effective messages as a speaker, fail to adapt their communication to different conversational roles (Landau & Milich, 1989) and show difficulty with pragmatic language (Kim & Kaiser, 2000; Stroes, Alberts, & van der Meere, 2003). Deficits in communication are also apparent when examining the oral narrative abilities of children with ADHD. In a study by Tannock, Purvis and Sachar (1993), children with and without ADHD were requested to re-tell a story. Results indicated that although the two groups did not differ in their ability to comprehend the story, they did differ in their ability to re-tell the story. Compared to typically developing peers, children with ADHD produced narratives that were less organized and cohesive, and contained numerous ambiguous references, such as referring to him, when there was a father and a son in the story.

To communicate successfully, a number of skills are needed, one of them being executive function. Executive function abilities are impaired in people with ADHD (Willcutt, Doyle, Nigg, Faraone & Pennington, 2005) and refer to behaviours that are self-regulatory and responsible for
selecting and sustaining goal-directed actions (Westby & Watson, 2004). The communication breakdown seen in children with ADHD likely occur in part because children with ADHD lack the necessary executive function skills to easily support the recruitment of mentalizing skills when communicating (Nilsen & Fecica, 2011). Children with ADHD recognize that people have different perspectives from their own (Charman, Carroll & Sturge, 2001; Perner, Kain & Barchfeld, 2002), but they struggle to adapt their communication patterns to meet the needs of their audience (Sodian & Hulsken, 2005). Research on the relationship between EF and language has found that EF ability is correlated with egocentric language (Nilsen & Graham, 2009) and accounts for a significant variance in predicting communicative behavior in children with ADHD (Clark, Prior & Kinsella, 2002).

1.2 ADHD and Written Communication

Children with ADHD have difficulty not only with oral discourse but also with written communication (Lienemann & Reid, 2006). Children with ADHD score below their typically developing peers on measures of overall adequacy of text, accuracy, structure, grammar, lexicon and spelling on a range of written tasks including descriptive writing, letter writing, and narrative (Mayes, Calhoon & Crowell, 2000; Re & Cornoldi, 2010; Re, Pedron & Cornoldi, 2007). Just as in spoken discourse, perspective taking is also critical in written discourse. To communicate successfully, writing theorists Traxler and Gernsbacher (1992, 1993), propose that a writer must be able to build and compare three representations of text: the first is a representation of what the writer wants to say, the second is a representation of what the writer has actually written, and the third is a representation of how the reader will interpret the text. To determine how a reader will interpret a text, a writer must take the perspective of their reader and consider the available and unavailable information of their reader. Representing the mental states of one’s reader is
considered to be even more difficult in writing than in oral communication (Olson, 1994; Halliday, 1987). In conversation, a mutual understanding is created by cues such as facial features, gestures, intonation, and feedback from one's listener (Holliway, 2010). These cues are not present in written communication, which is one reason it is a challenge for a writer to consider their reader’s perspective.

Given the importance of perspective taking while writing, it is likely that the communication breakdown in the writing of children with ADHD is similar to the reason for communication breakdown in these children’s oral discourse. Children with ADHD may recognize the importance of considering the perspective of their reader but struggle to incorporate the reader’s perspective while writing. To consider multiple perspectives, a writer must continually monitor their writing to ensure they are considering not just their own perspective (what they want to say) but also their reader’s perspective (how the reader will interpret the text). As children with ADHD show deficits with self-monitoring (Barkeley, 1998) it is not simply enough to tell a child with ADHD to think about their reader while writing. ADHD is not a disorder of knowing what to do, but doing what one knows, therefore, strategies that address both self-monitoring and writing skills are necessary.

1.3 Visual feedback and ADHD

One method for improving the ability of children with ADHD to self-monitor their behavior is to provide them with constant feedback (Barkeley, 1998). Feedback enables the child to make a mental comparison between what they are doing and what they should be doing so that they can improve their behavior to the appropriate levels (Reid, Schartz & Trout, 2005). Additionally, various meta-analyses on how typically developing students learn have highlighted the critical importance of feedback in improving educational outcomes. For instance, an analysis
of over 8,000 studies (Hattie, Biggs & Purdie, 1996) suggests that the most important principle in improving educational outcomes is providing feedback.

The type and quality of feedback one receives, however, is also important in improving outcomes (Nicol & Macfarlane-Dick, 2006). Recent research in developmental psychology suggests that beginning with concrete representations is important in all new learning (e.g., Schwartz & Sadler, 2007). There is also impressive empirical evidence from a meta-analysis of studies of effective instruction to support the importance of visual representations, which are by definition, concrete (Marzano, Pickering & Pollock, 2005). It seems, therefore, that providing students with concrete, visual feedback would be a most effective instructional strategy to improve children’s compositions.

The efficacy of receiving feedback from a reader to improve the clarity of written compositions has been tested in typically developing populations through the use of a referential communication paradigm. Referential communication refers to an individual’s ability to establish a shared perspective with another by using cues to guide communication, and the referential communication paradigm is a useful design to examine communicative perspective-taking skills (e.g Krauss & Glucksberg, 1969). In a referential communication task, a speaker or writer attempts to effectively communicate the distinguishing properties of a stimulus to a listener or reader who does not have visual access to the stimulus being described. According to Grice’s (1975) maxim of quantity, a speaker should only provide information that is relevant to the listener by monitoring the listener’s knowledge state. In written referential communication interventions with typically developing older children and adults, participants were instructed to write descriptions of figures so that their reader could choose the correct figure among a set of distracters based only on the written descriptions (Traxler & Gernsbacher, 1993,1994; Holliway, 2004). The participants then received feedback as to which object their reader chose, which
provided feedback as to the clarity of the written descriptions. As the feedback significantly improved the quality of the written descriptions, it seems that gaining insight into the perspective of one’s reader is an effective method to improve writing quality.

1.4 ADHD and Motivation

When considering the important factors necessary to improve writing achievement for children with ADHD, it is important to consider student motivation in addition to the instructional strategies directly related to improving writing clarity. Children with ADHD often present with maladaptive motivation patterns relating to academic achievement. For example, children with ADHD invest less effort, and quit working on a task sooner than children without ADHD when given a demanding academic assignment (Milich & Okazaki, 1991). Previous research has shown that novel and stimulating interventions improve performance in children with ADHD (Zentall, 1993) and in particular, computer-based interventions show promise as a means to improve the academic ability of these children (Ota & DuPaul, 2002). Given that writing is demanding, and a domain in which children with ADHD struggle, designing interventions these children will find engaging will likely contribute to greater gains.

1.5 Current Study

The intervention is a computer-based interactive intervention in which children will build novel animate figures called Gruffees. Children will compose instructions for a reader to reconstruct their Gruffee based solely on the instructions without having actually seen the Gruffee figure. Participants will be assigned to two groups, feedback and no-feedback. The feedback group will receive visual feedback from their reader in the form of the reader’s reconstructed Gruffee. It is anticipated that this visual feedback will highlight any instructions that were unclear and that did not take into account their reader’s perspective. Even if some of the children can
type, in this study they will all dictate their compositions to a scribe. Dictation will be used to control for individual differences in fine motor and spelling abilities.

The aim of the current study is to assess whether providing children with visual feedback on their compositions is an effective method to improve reader consideration in young children with ADHD, and thereby improve the clarity of their writing. Participants will be young, that is 7 to 9 years old as the aim is to prevent children who might be starting behind, from falling further behind. To assess the efficacy of visual feedback for improving writing clarity, the following questions will be addressed.

Research questions

1. Will children with ADHD who receive training in the form of visual feedback improve the clarity of their instructions on a referential communication task as compared to children with ADHD who do not receive feedback?

2a. Will any gains for participants who received feedback transfer to a novel, but qualitatively similar task (proximal transfer task)?

2b. If so, will these gains be maintained over a period of approximately 6 weeks?

3a. Will any gains made for participants who received feedback transfer to a dissimilar, non-computer based task (distal transfer measure)?

3b. If so, will these gains be maintained over a period of approximately 6 weeks?
Chapter 2
Method

2 Method

2.1 Participants

Participants were 20 children (13 males, 7 females) between the ages of 7 to 9 years ($M=8.1$, $SD=.98$). All children received a formal diagnosis of ADHD from a clinical psychologist ($n=17$) or psychiatrist ($n=3$) within two years from the time of testing; 16 children received a diagnosis of ADHD combined subtype (ADHD-C), two participants received a diagnosis of ADHD predominantly hyperactive/impulsive subtype (ADHD-H) and two participants received a diagnosis of ADHD predominantly inattentive subtype (ADHD-I). Participants were recruited from clinics specializing in ADHD, postings on websites for ADHD, and private schools catering to individuals with special learning needs.

2.2 Measures and Materials

2.2.1 General Testing Materials.

The pre test, intervention, post-test, and proximal transfer task measures were created using Microsoft Power Point™ and displayed on a laptop. Participants used an external mouse to build Gruffees and other figures from a set of printed reference images. The experimenter used an external keyboard to type the participant’s dictated instructions and the instructions were transferred onto the confederate’s computer using a flash drive. A digital audio recorder was used to record all testing sessions.

2.2.2 Gruffees Task.

For the Gruffees task, children built Gruffees, which are novel figures made of eight
different shapes. On the display screen (see figure 1), the body of the Gruffee was located on the right half of the screen and the body parts on the left. The body parts were divided into six different compartments, with each compartment containing four variations of the same body part. The body parts varied on two dimensions, for example, an arm differing on colour (green or purple), and shape (straight or bent). There was a space at the bottom of each display screen for the participant’s instructions.

2.2.3 Proximal Transfer Task.

This task was similar to the Gruffee’s task but instead of Gruffees, participants built an outer-space vehicle called a Gruffeemobile. A Gruffeemobile is comprised of 8 spaceship parts (see figure 2) and each part, as with the Gruffee task, varied on two dimensions. Space at the bottom of the display screen was available for the participant’s instructions.

2.2.4 Distal Transfer Task.

The distal transfer task consisted of a set of materials necessary to complete a magic trick in which an object appeared to magically go through a cup (see Appendix A). The materials changed slightly from post-test to delayed post-test although the steps required to complete the trick stayed the same. At post-test, the participants completed a trick in which a pom-pom went through a cup and in the delayed post-test, the participants completed a trick in which a seed went through a flower pot and turned into a flower.

2.2.5 Control Measures.

To assess for possible differences in visual perception, the Beery™ Visual-Motor Integration Developmental Test of Visual Perception, fifth edition (Beery VMI-5; Beery & Beery, 2004) was administered. The Peabody Picture Vocabulary Test, fourth edition (PPVT-4; Dunn & Dunn, 2007) was administered to control for language ability. Parents of the
participants in the study filled out a demographics questionnaire that requested demographic details about the parents. The following section of the questionnaire requested information relating to the child’s ADHD diagnosis, any treatments accessed and/or received over the years prior to and following their child’s diagnosis, and any other formal diagnoses the child has or previously had aside from ADHD.

2.2.6 Procedure and Intervention

Each child was tested by the same experimenter in a quiet room. The confederate was seated in a separate room but introduced to the child before the second and again before the third testing session. Before beginning each session, the experimenter gave the participant a general overview of the session and if it appeared necessary from the child’s behaviour (for example the child was not attending, or getting out of their seat) the experimenter set clear expectations for appropriate behavior. Each participant was seen three times. During session one, participants were administered the PPV-T, Beery, and pre-test measure. Session one took approximately 45 minutes. Session two took place within the same week and participants were given the intervention and immediate post-test measures; this session took approximately 1 hour. Session three took place six weeks after session two and participants were administered the delayed post-tests to assess for retention; this session was approximately 45 minutes long. See Table 1 for an overview of each session.

Pre-test. Participants in both groups constructed the same Gruffee from a reference image located beside the computer. Children were then told “I need you to come up with some instructions so that [confederate’s name] can build a Gruffee that looks just like yours. The thing you have to remember, though, is that [confederate’s name] won’t be able to see a picture of what your Gruffee looks like.” The participants were shown the confederate’s screen to highlight
to the participants that the confederate would not see a picture of the Gruffee. Participants then dictated their instructions and the experimenter wrote them down one line at a time at the bottom of the screen.

*Intervention*

Similar to the pre-test, all participants built Gruffees and dictated instructions on how to build them so the confederate could build the Gruffee based on the participant’s instructions. During the intervention, children were allowed to choose which Gruffee they wanted to build to increase their engagement with the task. Participants in the feedback condition sent their instructions to the confederate for the Gruffee to be rebuilt and participants in the no feedback condition were told their Gruffees would be built later. In the *feedback* condition, the confederate built the Gruffee highlighting any ambiguities in the child’s instructions, for example, if a child did not specify exactly where to put a body part, the confederate purposefully put the body part in the incorrect location. The experimenter then displayed the child’s Gruffee and the confederate’s rebuilt Gruffee side by side with the child’s instructions at the bottom of the screen. The participants were asked “Are they the same” to prime them to start looking at the differences between their own Gruffee and the confederates Gruffee. The experimenter then read through each instruction one by one to allow the child to edit their instructions. In the *feedback group* the experimenter read back each instruction, and highlighted the body part the child was describing on their screen and compared it to the confederates screen and asked “was that right”? If the child said no, the experimenter then asked “what could you have said instead?” If children had a difficult time coming up with revised instructions the experimenter would prompt the child with further questions such as “what could you have said so that [confederate’s name] could choose the correct body part, or put it in the correct location?” In the no feedback group, to
control for time on task, the participants instructions were read back to them in the absence of visual feedback and after each instruction the experimenter asked “was that right?” and if the child responded no, the experimenter followed with “what could you have said instead?”

Immediate Post-Tests. The Gruffee post-test was the same as the pre-test except that participants built a different standardized Gruffee. Participants were then administered the proximal transfer task which involved the child building a Gruffee-mobile and dictating instructions for the confederate to build it based only on these instructions. For the distal transfer task participants were shown how to complete the magic trick and then dictated instructions so that the confederate could perform the same magic trick based only on the participant’s instructions.

Delayed Post-Test. To assess for maintenance 6 weeks after the intervention, participants built a novel Gruffee and dictated instructions on how to build it. Participants also constructed and dictated instructions for a novel Gruffee-Mobile and dictated instructions to complete the slightly-changed magic trick in which a seed went through the flowerpot.

2.3 Scoring

The participant’s scores were based on the clarity of their instructions and were calculated according to how accurately their instructions would allow someone to reconstruct their Gruffee, Gruffee-mobile, and complete a magic trick.

2.3.1 Scoring the Gruffees Task and Proximal Transfer Task

The same coding scheme was used for the Gruffee task and proximal transfer task. Each description of the item and its location received an accuracy score of either 2 (all necessary information provided), 1 (some necessary information provided), or 0 (no necessary information
provided). Necessary information for the items were defined as adjectives that were essential for the confederate to choose the correct body/spaceship part (for example the big, purple leg) and necessary information for the locations were defined as spatial descriptions that were essential for the confederate to put the body/spaceship part in the correct location (for example, the bottom right corner). On both tasks, an overall accuracy score was achieved by summing the accuracy score of necessary items described with the accuracy score of necessary locations described. The greater the number of clear, unambiguous item/location descriptions, the higher the participant’s accuracy score. Accuracy scores were reported as a percentage and calculated by dividing the participants raw accuracy score by the total possible accuracy score. Accuracy percentage scores was the dependent measure used for every task, including the distal transfer task. Participant’s compositions were also coded for any descriptions that provided more information than was needed for successful reconstruction of the Gruffle/Gruffeemobile and these descriptors were coded as uninformative (Grice, 1975). An example of an uninformative descriptor would be providing the colour of a body part when all the body parts were all the same colour.

2.3.2 Distal Transfer Task Coding

The magic trick was comprised of 8 main steps (e.g., hide the pompom); each step was referred to as a general descriptor. Each main step had specific descriptors which were subtle, yet critical elements of the trick that were demonstrated by the experimenter (e.g., selecting a small white pompom from the pile of pompoms). For each of the eight steps in the magic trick, children’s instructions were given an accuracy rating of: 0 (the general descriptor is omitted, even if specific descriptors are provided), 1 (only the general descriptor is provided), 2 (the general descriptor is given and some specific descriptors are provided), or 3 (the general descriptor and all specific descriptors are provided). The accuracy score for each step was aggregated to get a total accuracy score. Any irrelevant information described by the participant
that was not needed for the execution of the magic trick (for example saying “take the fluffy pompom” when all the pompoms were fluffy) was coded as an *uninformative descriptor*.

### 2.4 Reliability

A second rater scored 35% of the data (7 participants randomly selected) to establish reliability. Intraclass correlations (ICCs) were performed on each of the seven outcome measures. Coefficients on the pre-test training measure (.99), post-test training measure (.98), proximal transfer (.99), distal transfer (.99), delayed post-test (.98), delayed proximal transfer (.99), and the delayed distal transfer (.93) yielded high ICCs.
Chapter 3  
Results

3 Results

3.1 Control Variables

Chi-square and t-test analysis were conducted to ensure that the feedback and control conditions were equivalent prior to the intervention on measures that were hypothesized to be related the outcome variables. See Table 2 for a summary of group differences on control variables. No statistically significant between-group differences were found on gender, diagnostic status, age, visual perception, language ability, co-morbidities and medication use ($p > .05$).

3.2 Research Question 1: Group Comparison on Training Measure

The clarity of participants’ instructions, as measured by their overall accuracy scores on the Gruffees task, was compared between the feedback and no feedback condition. The distribution of scores at three different times of assessment (i.e., pre-, post-, and delayed post-test) was calculated and all normality assumptions were satisfied. There were no significant between group differences on the pre-test between the feedback ($M = 48.75, SD = 32.98$) and control condition ($M = 43.81.5, SD = 27.56$) on pre-test accuracy, $F(1,18) = .19, p = .67$.

A repeated measures analysis of variance (ANOVA) was conducted to determine whether participants who received visual feedback significantly improved the clarity of their compositions over time relative to the control group. The between-subjects factor was condition type (feedback vs. no feedback), and the within-subjects factor was time of assessment (pre-test, post-test, and delayed post-test). Results yielded a significant main effect of condition, $F(1, 18) =$
8.58, \( p = .009, \eta^2 = .32 \), a significant main effect of time, Wilks’s \( \Lambda = .67, F(2, 17) = 4.17, p = .034, \eta^2 = .33 \), and a significant interaction between condition and time, Wilks’s \( \Lambda = .58, F(2, 17) = 6071, p = .01, \eta^2 = .42 \), all of which indicated large effect sizes. Differences in accuracy scores for both conditions, across all three periods of assessment, are illustrated in Figure 3.

Post—hoc One-way ANOVAs were conducted at each time of assessment to determine when groups significantly differed on accuracy. Participants in the feedback group (\( M = 81.23, SD = 13.66 \)) outperformed participants in the no feedback condition (\( M = 40.63, SD = 26.35 \)) at post-test, \( F(1,18) = 18.73, p < .001, \eta^2 = .54 \). These differences were then found at delayed post-test, \( F(1,17) = 13.87, p < .001, p < .001, \eta^2 = .48 \), where participants in the feedback condition showed higher accuracy scores (\( M = 76.88, SD = 11.24 \)) than participants in the no feedback condition (\( M = 42.19, SD = 24.88 \)).

To examine within group differences between different time periods of assessment, paired sample \( t \) tests were conducted. Results indicated that, for the feedback condition, accuracy scores showed significant improvement between pre-test and post-test, \( t(9) = -4.18, p = .002 \), and pre-test to delayed post-test, \( t(9) = -3.26, p = .01 \). No significant changes were noted from post-test to delayed post-test, \( t(9) = 1.45, p = .18 \). In contrast, within-group comparisons for the no feedback condition revealed no significant improvements in accuracy scores from pre-test to post-test, \( t(9) = .31, p = .77 \), pre-test to delayed post-test \( t(9) = .08, p = .94 \) or post-test to delayed post-test, \( t(9) = -.43, p = .68 \).

3.3 Research Question 2: Group Comparison on Proximal Transfer Task

To evaluate whether gains in writing clarity for participants in the feedback group would transfer to a similar task (describing how to build a Gruffeemobile), a repeated measures
ANOVA was performed. The independent variables were the two training conditions and the two
timepoints at which participants were tested (i.e., post- and delayed post-test). The dependent
variable was the overall accuracy scores achieved on this proximal transfer task at each
timepoint. All of the data met normality assumptions. Group means and standard deviations for
the accuracy scores across the two timepoints are displayed in Table 3. The results showed a
significant main effect of condition, $F(1, 17) = 15.44, p = .001$, with a large effect size, $\eta^2 = .48$.
No significant main effect of time, Wilks’s $\Lambda = .97, F(1, 17) = .45, p = .51$, $\eta^2 = .03$, or
significant interaction between condition and time, Wilks’s $\Lambda = .93, F(1, 17) = 1.93, p = .29$, $\eta^2$
= .07, were found. Post-hoc analyses were conducted to examine group differences at each time
point. These analyses indicated that participants in the feedback condition significantly
outperformed participants in the no feedback group on both their
proximal transfer post-test, $F(1,17) = 11.14, p = .004$, $\eta^2 = .40$, and delayed proximal transfer post-test, $F(1,18) = 19.92, p < .001$, $\eta^2 = .53$, accuracy scores. To examine within group change between the post-test and
delayed post-test, paired sample $t$-tests were conducted within each training condition. No
significant differences existed between proximal transfer post-test and delayed proximal transfer
post-test $t(9)= -1.21, p = .26$ for the participants in the feedback group meaning that they were able
to maintain the gains made at delayed post-test. No significant differences existed for
participants in the no feedback group between proximal transfer post-test and delayed proximal
transfer post-test $t(9)= .31, p = .77$.

3.4 Research Question 3: Group Comparison on the Distal Transfer Task

To evaluate whether any gains in writing accuracy for participants who received visual
feedback would transfer to a distal, non-computer based task (i.e., describing a magic trick), a
repeated measures ANOVA was performed. The independent variables were the two conditions
and the two timepoints at which participants were tested (i.e., post- and delayed post-test). The dependent variable was the overall accuracy scores achieved on this task at each timepoint. All of the data met normality assumptions. Group means and standard deviations for the accuracy scores on this task are also displayed in Table 3. The results showed a significant main effect of condition, $F(1, 18) = 7.89, p = .01, \eta^2 = .31$, a large effect size, but no significant main effect of time, Wilks’s $\Lambda = .97, F(1, 18) = .48, p = .50, \eta^2 = .03$, or significant interaction between condition and time, Wilks’s $\Lambda = .86, F(1, 18) = .12, p = .11, \eta^2 = .14$. Follow-up analyses were made to examine group differences at each time point. These analyses indicated that participants in the feedback condition outperformed participants in the no feedback condition on their distal transfer post-test nearing significance, $F(1,18) = 4.23, p = .054, \eta^2 = .19$, and significantly outperformed participants in the no feedback condition at the delayed distal transfer post-test, $F(1,18) = 10.67, p = .004, \eta^2 = .37$. To examine change between the post-test and delayed post-test, paired sample $t$-tests were additionally conducted within each training condition. No significant differences existed between distal transfer post-test and delayed distal transfer post-test $t(9) = -1.29, p = .23$ for the participants in the feedback group, or for participants in the no feedback group $t(9) = 1.25, p = .24$.

3.5 Uninformative Descriptors

In addition to looking at the necessary descriptors participants gave to distinguish the correct body part and correct body part placement, uninformative descriptors that were not needed to distinguish the stimulus were examined. Means and standard deviations for both groups at each time point and post-test can be seen in Table 4. At pre-test, there were no significant difference on the number of miscellaneous descriptors between the feedback and no feedback condition $t(18) = .70, p = .50$. Paired sample $t$-tests were performed to determine
whether there were any changes in the number of uninformative descriptors described after receiving the intervention. No within group differences were found in the feedback group from pre-test to post-test \( t(9) = -0.88, p = .61 \), pre-test to delayed post test \( t(9) = -0.59, p = .57 \), pre-test to proximal transfer task \( t(9) = 0.20, p = .85 \) and pre-test to delayed proximal transfer-task \( t(9) = -1.83, p = .11 \). Similarly for the control group, there were no within group differences group from pre-test to post-test \( t(9) = -0.53, p = .61 \), pre-test to delayed post test \( t(9) = 0.93, p = .38 \), pre-test to proximal transfer task \( t(9) = 0.20, p = .08 \) and pre-test to delayed proximal transfer-task \( t(9) = 0.48, p = .64 \). No analyses were conducted for the distal transfer task (magic trick) due to the fact that the task elicited close to zero uninformative descriptors for participants in the feedback group (\( M = 1.0, SD = .91 \)) and no feedback group (\( M = .47, SD = .80 \))
Chapter 4
Discussion

4  Discussion

There is a strong link between ADHD and academic underachievement. DuPaul, McGoey, Eckert and VanBrakle (2001) found that a sample of 58 preschool-aged children with ADHD scored significantly below typically developing participants on a test of cognitive development and pre-academic skills. In addition to showing greater rates of academic underachievement, children with ADHD also show less enjoyment of learning and have a preference for easy versus challenging work (Carlson, Booth, Shin & Canu, 2002). The maladaptive motivation patterns in conjunction with academic underachievement highlights the importance of designing and assessing motivating interventions that lead to academic gains for children with ADHD. The goal of the current study was to assess whether visual feedback from a reader would be an effective method to improve the communicative clarity of young children with ADHD.

4.1  Summary of Results

On the Gruffees post-test and delayed post test, participants who received visual feedback in the form of a reconstructed Gruffee from a reader, significantly outperformed participants in the no feedback group on the clarity of their dictated compositions. Furthermore, participants in the feedback group significantly improved from pre-test to post test, and were able to maintain their gains at delayed post-test. In contrast there were no gains made for participants in the no feedback group between pre-test, post-test, and delayed post-test.

Participants who received visual feedback were also able to transfer gains made from the intervention to a proximal transfer task in which participants built and dictated instructions to
build a Gruffée-mobile. Participants in the feedback group outperformed participants in the no feedback group at both the post-test and delayed post-test six weeks later. Participants in the feedback group improved significantly from pretest to post-test and maintained these gains from post-test to delayed post-test. Finally, for the distal transfer task in which participants were asked to dictate instructions for someone to perform a magic trick, again participants in the feedback group significantly outperformed participants in the no feedback group in the clarity of their magic trick instructions both at post-test and delayed post-test. Additionally, participants who received visual feedback were able to maintain their gains from post-test to delayed post-test.

4.2 Theoretical and Education Implications

This research makes theoretical and practical contributions to understanding the factors that contribute to successful composition skills for children with ADHD. It suggests that the visual feedback was responsible for the rapid gains children with ADHD displayed after receiving the short intervention. The efficacy of feedback in this study is consistent with other studies that found that one of the characteristics necessary for improving academic ability for children with ADHD is to provide them with frequent immediate feedback about the quality of their performance (Greenwood, Hart, Walker & Risley, 1994; Pfiffner & Barkley, 1998). Participants in the current study were unable to give the clarity of instructions needed for the confederate to accurately reconstruct the Gruffée until they received feedback on two rounds of Gruffees. The type of feedback children received in this study also likely contributed to the gains made. In a review paper on the efficacy of feedback for improving educational outcomes, Hattie and Timperley (2007) reported that feedback was most successful when students received information feedback about a specific task, when feedback included information on how to complete the task more successfully, and when feedback was tied to specific goals. In the current
intervention, the participants had a concrete goal, which was for the confederate to accurately reconstruct their Gruffee. Participants also received information feedback as to which instructions were clear and which instructions were not clear. The feedback was visual and therefore concrete, thereby allowing the participants to easily judge the clarity of their compositions.

The feedback received by participants was delivered on a computer. It is likely that this mode of feedback contributed to the success of the intervention. Computer-assisted instruction has been shown to improve learning related behaviours, motivation, and academic achievement for children with ADHD. In a study by Shaw & Lewis (2005), students with ADHD who used computer-assisted instruction on an academic task, were more focused on the critical elements of the task and were able to sustain their attention longer, compared to students who received paper and pencil instruction. Computer-assisted instruction has also been shown to improve overall math achievement in young children with ADHD (Ota & DuPaul, 2002). However, not all types of computer-based interventions will lead to gains for children with ADHD. Computer-based interventions that over stimulate a child with ADHD by being too animated and bright can increase errors and decrease time on task (Shaw & Lewis, 2005). The intervention in the current study was interactive and colorful, but was not animated and therefore likely not distracting as the figures children constructed were 2 dimensional, and no movement or audio accompanied the figures. Additionally, the fact that participants in the current study built novel characters likely increased their interest in the task and therefore served as a motivator. It should be noted that in the current study both the feedback and no feedback groups used a computer and built novel figures. Therefore we cannot disentangle the role of the computer from the role of feedback in the current results. It is likely that both contributed to the gains made.
4.3 Evidence of actual perspective taking

While participants who received visual feedback improved the clarity of their compositions, it is not necessarily the case that the participants were considering the perspective of their reader. Composition clarity may have improved because participants who had received feedback had learned to be more descriptive. One way of examining whether participants were perspective taking or merely being more descriptive would be to examine their compositions according to Grice’s Maxim of quantity (1975). According to this maxim, communication should not be more informative than required, meaning that one takes into account the knowledge of one’s audiences in order to say as much as is needed without saying too much. In the current study, the participant’s uninformative descriptors were those that were overly descriptive and not needed for the confederate to successfully reconstruct the Gruffee, Gruffee-Mobile, and complete the magic trick. If participants in the current study were following Grice’s Maxim of quantity, this would support the notion that the participants were taking the reader’s perspective into account. In an attempt to determine whether participants were perspective-taking or merely being more descriptive we examined the participants’ necessary descriptors and uninformative descriptors. In both groups, there were no differences between pre-test and post-tests on the frequency of participant’s uninformative descriptors when describing how to build the Gruffee and Gruffee-mobile. However, there was a significant increase in necessary descriptors for the feedback group, and no change in the number of necessary descriptors for the no feedback group. These results imply that participant who received visual feedback did not become overly descriptive, and were likely considering the perspective of their reader. The distal transfer task did not elicit enough uninformative descriptors to compare the two groups. One possible reason for this is that participants were able to carry out the steps of the magic trick while describing the steps which may have allowed the participants to focus on only the necessary aspects of the task.
These findings that participants were likely perspective taking are in accordance with research indicating that ADHD is a production disorder as opposed to a knowledge disorder. Children with ADHD have adequate knowledge of what is required of them in certain situations, but their knowledge does not always translate into practice because of the deficits in EF that these children exhibit. Evidence of a production disorder is apparent when comparing the writing of children with ADHD to their typically developing peers. Both groups score the same on their knowledge of the important aspects of the writing process, but their actual compositions significantly differ because children with ADHD have difficulty applying their knowledge to the writing task (Re & Cornoldi, 2010). The same pattern has also been observed when examining knowledge of social situations. Children with ADHD have the required knowledge of how to act in social situations, but their behaviour does not show evidence of them using that knowledge (Hoza & McQuade, 2008). Given that ADHD is a production disorder, it is reasonable that under the proper conditions children in the current study were able to take the perspective of their reader while composing.

4.4 Future Directions and Conclusions

Although results indicate that the intervention was effective, there are several limitations that need to be addressed in future research. The main limitation was the sample size. The sample was small and therefore the results need to be interpreted with some caution. Additionally, more stringent criteria need to be applied in future research regarding ADHD diagnoses. Although all children had received a formal diagnosis of ADHD, we did not collect current information about symptom severity. The sample was also heterogeneous as some participants had co-morbid diagnoses and all ADHD subtypes were included in the sample. Future research could address which subtypes would benefit the most from this intervention.
In conclusion, this study contributes important and relevant information about how to improve communication skills for young children with ADHD. Writing skills are becoming increasingly important for workplace success so it is therefore essential to determine factors that will contribute to the development of early writing. The results of the current intervention support the efficacy of visual feedback as a method to improve communicative clarity. This technology-based intervention can be modified for use in the classroom as part of a curriculum plan to close the achievement gap between children with ADHD and their typically developing peers.
References


S. J. (Eds.), Comprehending oral and written language (pp. 55–82). New York: Academic.


doi:10.1080/01690969208409378


doi:10.1080/01690969308406958


Appendix A

Magic Trick Instructions for Immediate Post Test Session

1. First, before you bring your audience in, take a small white pompom and hide it inside the blue cup.

2. Next, stack the cups so that the blue cup is in the middle. Make sure the cups are facing up like this. Now you can bring your audience in to see the magic trick.

3. Begin by flipping the cups down on to the table. Make sure to flip the cups quickly so that the secret pompom does not fall out of the blue cup. See, if you flip the cup too slowly, your audience will see the pompom that is hidden inside.

4. Next, take a pompom from the pile. Make sure to take a pompom that is exactly the same as the one that is hidden under the blue cup. Place the pompom on top of the blue cup and say “I’m going to make this pompom magically go through the blue cup. Watch!”

5. Now, take the two cups on the side and stack them on top of the blue cup. Make sure the blue cup is on the bottom.

6. Wave your hands around, so it looks like you’re doing magic.

7. Give the stack of cups a good tap so that it looks like the pompom is falling through the cup.

8. Now lift all the cups together and reveal the pompom that appears to have magically fallen through.
<table>
<thead>
<tr>
<th>Session 1</th>
<th>Session 2</th>
<th>Session 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training (2 Gruffee rounds)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control measures:</td>
<td>Immediate Post-test:</td>
<td>Delayed Post-test:</td>
</tr>
<tr>
<td>Visual-perceptual (Beery VMI-5)</td>
<td>Training measure (Gruffee)</td>
<td>Training measure (Gruffee)</td>
</tr>
<tr>
<td>Receptive language (PPVT-4)</td>
<td>Proximal Transfer (Gruffeemobile)</td>
<td>Proximal Transfer (Gruffeemobile)</td>
</tr>
<tr>
<td>Pre-test:</td>
<td>Distal Transfer (Magic trick)</td>
<td>Distal Transfer (Magic trick)</td>
</tr>
<tr>
<td>Training measure (Gruffee)</td>
<td></td>
<td></td>
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</table>
Table 2. *Comparison of Feedback and No Feedback Groups on Control Variables*

<table>
<thead>
<tr>
<th></th>
<th>Feedback</th>
<th>No Feedback</th>
<th>Statistic</th>
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<tbody>
<tr>
<td></td>
<td>(n = 10)</td>
<td>(n = 10)</td>
<td>$\chi^2$</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>6</td>
<td>7</td>
<td>.22</td>
</tr>
<tr>
<td>Female</td>
<td>4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>ADHD Subtype</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>ADHD-H</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>ADHD-I</td>
<td>2</td>
<td>0</td>
<td>2.25</td>
</tr>
<tr>
<td>ADHD-C</td>
<td>7</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td><strong>Co-morbidities</strong></td>
<td></td>
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</tr>
<tr>
<td>CAPD</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>LD</td>
<td>2</td>
<td>1</td>
<td>1.74</td>
</tr>
<tr>
<td>ODD</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>6</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td><strong>Chronological age</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>$M$</td>
<td>8.2</td>
<td>7.9</td>
<td>-</td>
</tr>
<tr>
<td>$SD$</td>
<td>0.9</td>
<td>1.1</td>
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</table>
Beery VMI-5<sup>a</sup>

<table>
<thead>
<tr>
<th></th>
<th>M</th>
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<tbody>
<tr>
<td>M</td>
<td>98.50</td>
<td>102.78</td>
<td>-</td>
<td>-.52</td>
<td>.61</td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>19.28</td>
<td>16.22</td>
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PPVT-4<sup>a</sup>

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
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<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>109.20</td>
<td>103.00</td>
<td>-</td>
<td>1.04</td>
<td>.31</td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>14.94</td>
<td>11.50</td>
<td></td>
<td></td>
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</tbody>
</table>

Time between S2 and S3<sup>b</sup>

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>45.7</td>
<td>46.00</td>
<td>-</td>
<td>-.16</td>
<td>.88</td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>3.74</td>
<td>4.69</td>
<td></td>
<td></td>
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<td></td>
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</tbody>
</table>

<sup>Note</sup>. <sup>a</sup>Represents standard scores; <sup>b</sup>Time between Session 2 and Session 3, reported in days.
Table 3. Mean Communication Accuracy Scores on Transfer Measures at Post- and Delayed Post-test

<table>
<thead>
<tr>
<th></th>
<th>Post-test</th>
<th>Delayed Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Proximal Transfer</strong> (Gruffeemobile)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feedback</td>
<td>75.35 (20.16)</td>
<td>80.31 (13.9)</td>
</tr>
<tr>
<td>No Feedback</td>
<td>38.75 (26.73)</td>
<td>37.5 (26.96)</td>
</tr>
<tr>
<td><strong>Distal Transfer</strong> (Magic Trick)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feedback</td>
<td>46.25 (12.34)</td>
<td>51.25 (14.57)</td>
</tr>
<tr>
<td>No Feedback</td>
<td>32.92 (16.37)</td>
<td>30.83 (13.35)</td>
</tr>
</tbody>
</table>

*Note.* Standard deviations are shown in brackets.
Table 4. *Mean Number of Uninformative Descriptors by Condition, Task, and Period of Assessment*

<table>
<thead>
<tr>
<th></th>
<th>Feedback</th>
<th>No Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gruffees Task</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-test</td>
<td>7.67 (5.37)</td>
<td>6.88 (4.57)</td>
</tr>
<tr>
<td>Post-test</td>
<td>11.11 (5.71)</td>
<td>8.12 (6.83)</td>
</tr>
<tr>
<td>Delayed Post-test</td>
<td>11.50 (5.53)</td>
<td>5.76 (5.03)</td>
</tr>
<tr>
<td><strong>Proximal Transfer (Gruffemobile)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-test</td>
<td>8.00 (4.88)</td>
<td>6.12 (5.66)</td>
</tr>
<tr>
<td>Delayed Post-test</td>
<td>12.72 (5.70)</td>
<td>6.06 (5.21)</td>
</tr>
<tr>
<td><strong>Distal Transfer (Magic Trick)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-test</td>
<td>1.00 (.91)</td>
<td>.47 (.80)</td>
</tr>
<tr>
<td>Delayed Post-test</td>
<td>.83 (.86)</td>
<td>.82 (1.07)</td>
</tr>
</tbody>
</table>

*Note.* Standard deviations are shown in brackets.
Figures

*Figure 1.* Gruffee blank display screen before the Gruffee is built, and a built Gruffee awaiting participants’ instructions.
Figure 2. Proximal transfer task: Gruffeemobile blank display screen before the Gruffeemobile is built, and a built Gruffeemobile awaiting participants’ instructions.
Figure 3. Referential communication accuracy scores on the training measure (Gruffees) at all three periods of assessment (i.e., pre-test, post-test, and delayed post-test).