Understanding Physiotherapists’ Use of Motor Learning Strategies in Gait-Based Physiotherapy Interventions for Children with Cerebral Palsy

by

Jennifer Leigh Ryan

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Rehabilitation Sciences Institute
University of Toronto

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Abstract

Understanding Physiotherapists’ Use of Motor Learning Strategies in Gait-Based Physiotherapy Interventions for Children with Cerebral Palsy

Jennifer Leigh Ryan
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This thesis aims to understand motor learning strategies (MLS) use in physiotherapy interventions for children with cerebral palsy by measuring MLS application and exploring physiotherapists’ perspectives. The Motor Learning Strategies Rating Instrument (MLSRI-20) measures the extent MLS are used within an intervention, but does not necessarily reflect the therapist’s intention to use them. The inter- and intra-rater reliability of the MLSRI-20 were evaluated in traditional and Lokomat-based physiotherapy interventions. Semi-structured interviews explored PTs’ intentions during these interventions. Results indicate the MLSRI-20 reliably measures MLS in physiotherapy interventions and most MLS were used intentionally. These studies provide a preliminary indication that while the independent observation of MLS use captures some of therapists’ intentions and clinical decisions, greater awareness of the range of MLS available is required. The MLSRI-20 can be used as the framework for therapist training, and should be used to measure MLS implementation in clinical and research settings.
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List of Abbreviations

**ABI**: Acquired Brain Injury

**CCM**: Constant Comparative Method

**CI**: Confidence Interval

**CP**: Cerebral Palsy

**CV**: Coefficient of Variation

**GMFCS**: Gross Motor Function Classification System

**Holland Bloorview**: Holland Bloorview Kids Rehabilitation Hospital

**ICC**: Intraclass Correlation Coefficient

**IP**: Information Power

**ML**: Motor Learning

**MLS**: Motor Learning Strategies

**MLSRI**: Motor Learning Strategy Rating Instrument

**MLSRI-20**: Motor Learning Strategies Rating Instrument

**N**: Sample size

**OPTIMAL**: Optimizing Performance Through Intrinsic Motivation and Attention for Learning

**PT**: Physiotherapist

**RA**: Research Assistant

**SD**: Standard Deviation

**UE**: Upper Extremity

**VAS**: Visual Analog Scale

**VR**: Virtual Reality
Chapter 1
Exploring physiotherapists’ use of motor learning strategies in gait-based physiotherapy interventions for children with cerebral palsy

1 Introduction

1.1 Overview

The purpose of this thesis is to understand physiotherapists’ (PTs) use of motor learning strategies (MLS) in gait-based physiotherapy interventions for children with cerebral palsy (CP). The integration of MLS in motor skills-based interventions is gaining prominence in pediatric rehabilitation as it is believed to promote the neuroplasticity underlying motor learning (ML) (1, 2). ML is the acquisition of a motor skill during therapeutic intervention which is retained and then transferred to the child’s everyday routine (3). This transfer of motor skills from therapy to real life creates potential for improvement in daily physical functioning and participation in activities of interest. Children with CP present with a range of motor disorders, often accompanied by sensory, perceptual, cognitive, communication, and behaviour difficulties (4, 5). As a result, optimizing the content of physiotherapy intervention plays an integral role in their motor development throughout childhood and adolescence.

MLS are specific therapeutic actions, based on child- and task-specific factors, with the aim of promoting motor skill acquisition (6). While MLS selection can occur as part of the PT’s clinical decision-making, it is not known how intentional their MLS application is, nor how therapists determine which MLS to use in a given context. An increased understanding of how PTs use MLS during physiotherapy intervention for children with CP would help to guide the design of ML-based interventions, which can then be evaluated for their effect on functional outcomes and optimize how PTs are trained to incorporate MLS into their practice.

The recently developed Motor Learning Strategies Rating Instrument (MLSRI-20) (7, 8) quantifies the use of MLS within a single physiotherapy session. The MLSRI-20 individual item scores generate a profile of the extent to which each of its 20 specified MLS is used, as well as the variety of MLS applied in a single treatment session. This measurement can then support the
systematic comparison of MLS between treatment approaches, treatment sessions, PTs, and/or children. A collection of profiles created by the MLSRI-20 may indicate if there are tendencies towards the use of specific MLS in certain types of physiotherapy intervention, or if any MLS can be applied across a variety of interventions. It might also help to establish the degree to which patterns of MLS application are driven by the child and/or the PT.

Prior to using the MLSRI-20 to create a session profile or draw comparisons between treatment approaches, its reliability must be evaluated. In the first phase of this thesis research, the inter- and intra-rater reliability of MLSRI-20 were evaluated within two types of gait-based physiotherapy interventions for children with CP: traditional physiotherapy, conducted in a gym setting, and in the Lokomat® robotic-assisted gait trainer. Establishing the reliability of the MLSRI-20 was the first step towards determining the ML content of physiotherapy sessions. However, there are known limitations to the interpretation of the MLSRI-20 profile, as it is based on the independent observations of a video-recorded treatment session and does not identify the treating PT’s intentions when using specific MLS. While there is a theoretical link between physiotherapy goals for children with CP and ML theory, previous publications have indicated that PTs may not be intentionally applying MLS in their interventions (9, 10). While PTs are very familiar with certain MLS, such as providing demonstration of a task as a form of instruction or physically guiding a child through the task, they may be less aware of others (9, 10). For example, PTs may use verbal instructions and feedback with a certain focus of attention (e.g., internal or external) without being aware of promoting implicit or explicit ML (11). Similarly, they may be organizing a session using random or variable practice without considering the effects of practice order on ML. Additionally, ML is one of several theoretical approaches used in physiotherapy interventions and there can be overlap among approaches (e.g., verbal instructions, physical guidance, task repetition are strategies used in both ML and exercise science theories) (11). Consequently, one cannot assume that the observation of MLS indicates the intention to use them or the conscious awareness of their use.

Thus, the second phase of this thesis research involved interviewing PTs providing the gait-based physiotherapy interventions in a study exploring traditional physiotherapy and Lokomat-based physiotherapy to better understand how the child’s characteristics, the PT’s clinical decision-making, and the treatment approach influenced MLS use. This information provided a
preliminary indication of whether independent observation of MLS use captures the intentions and clinical decisions of the therapist providing the intervention, and establishes whether the MLSRI-20 is a valid assessment of intentional MLS implementation in clinical and research settings.

1.2 Research objectives

This thesis was conducted in two phases to address five research objectives. The first phase was a measurement study with two objectives: 1) evaluate the inter- and intra-rater reliability of the MLSRI-20 in physiotherapy intervention for children with CP; and 2) understand MLSRI-20 utility through PT rater feedback. The second phase was an interview study that addressed the remaining three research objectives: 1) describe how a child’s individual characteristics affect how a PT uses MLS; 2) explore how a PT’s personal preferences for specific MLS influence physiotherapy intervention; and 3) compare PTs’ clinical decision-making when choosing MLS during traditional physiotherapy with Lokomat-based intervention.

1.3 Thesis organization

The second chapter of this thesis provides background information on ML theory and describes how it relates to MLS. An overview of the MLSRI-20 is provided, and a literature review describes current evidence to support the inclusion of the 20 MLS within the measure. The development of the MLSRI-20 Instruction Manual and the MLS Online Training Program are outlined as background to the evaluation of MLSRI-20 reliability. Two manuscripts focus on MLS use in physiotherapy interventions for children with CP: 1) the reliability study for the MLSRI-20 (Chapter 3); and 2) the exploration of PTs’ MLS use (Chapter 4). The final chapter provides a synthesized discussion of the two phases of research, recommendations, limitations, relevance and concluding remarks.
Chapter 2
The role of motor learning strategies in rehabilitation

2 Background

2.1 Motor learning: From theory to practice

Motor development is dependent upon the interaction of mechanical, neurological, cognitive, and perceptual factors (4). CP is a non-progressive, permanent disorder that affects a child’s movement and postural control, and is often accompanied by sensory, cognitive, communication, and behavioural challenges (4). Neurological conditions, such as CP, not only affect a child’s immediate motor control, but they influence how the child perceives and refines their movement patterns over time, which affects their overall development (12). The motor cortex and corticospinal tract, pathways within the central nervous system involved in developing skilled motor behaviour, are common areas for brain injury in CP (13). The extent of reorganization of these synaptic pathways post-injury plays a critical role in the future development of the injured brain (13). As a result of decreased movement experiences and difficulties problem-solving through movement patterns, therapeutic intervention is often required to facilitate motor skill development in children with CP (12). A typical physiotherapy goal for these children is the acquisition of a motor skill followed by the transfer of that skill from intervention to use in the child’s daily activities (12). This goal is synonymous with the gold standard definition of ML, the acquisition of a motor skill, achieved through practice, which can be retained, transferred, or generalized to new learning situations (3). Neuroimaging studies identify changes in activity in the cortical and subcortical regions of the brain when a motor skill is acquired and refined (2). ML is thought to result in reorganization at both the synaptic and intracortical levels of the brain and is the cause of this experience-dependent neuroplasticity (2).

ML theories are interpretations of how motor skills are acquired through practice (14, 15). Early ML theories emphasized the need for variability in movement and error detection in order to adapt the internal motor schema for a specific skill within the central nervous system (16). More recent theories evolved to address the role of the environment and task-specific practice in the learning process (17). While there was growing awareness of the need to incorporate a child’s
interests into functional therapeutic activities (17), these early theories did not specifically address the motivational and attentional factors that affect ML (18). With growing knowledge of the importance of self-efficacy, motivation, and engagement in ML (17, 19-21) the ‘Optimizing performance through intrinsic motivation and attention for learning’ (OPTIMAL) theory was developed. OPTIMAL considers how an individual’s mindset influences ML by recognizing the impact of social, cognitive, and affective factors on the learning process (18). The need to engage a child in therapeutic intervention is an important concept that affects functional outcomes and plays a role in how a therapist promotes ML within an intervention (17, 22).

ML principles developed from research in exercise and sport sciences evaluate the different practice conditions that lead to acquisition of simple motor skills. These evidence-based statements can be incorporated in physiotherapy intervention through use of MLS, which are the actions a PT takes to promote the acquisition of functional motor skills based on client- and task-specific factors (6). The ultimate goal of applying MLS during intervention is promoting motor skill transfer to environments beyond physiotherapy (6, 23). The following sections explain how therapist use of MLS can promote ML, elaborate on the importance of understanding how PTs use MLS in their interventions, and provide an overview of MLS implementation in the literature.

2.2 Using motor learning strategies to promote implicit and explicit motor learning

Children with CP have varying levels of motor function and information processing capabilities which must be factored into their physiotherapy interventions (24). There are three stages of ML that depend upon the individual’s level of proficiency with a motor skill: cognitive, associative, and autonomous (25). In the cognitive stage of learning, the child uses considerable cognitive resources to complete a task, using explicit movement patterns that are often inefficient and inconsistent (15, 26). In the associative stage, the movements become more fluid and are less consciously controlled (26). By the autonomous stage, the movements are largely automatic, consistent, and efficient, using few cognitive resources (15, 26). As a child progresses through the stages of ML, the role of the PT changes from providing a high degree of verbal and physical guidance to allowing the individual to act more independently (15, 23, 27). For example, a PT may use frequent verbal instructions and feedback coupled with manual facilitation to assist a
child in moving from sitting to standing without the support of their walker. As the child becomes more proficient in the movement, including the timing of muscle activation and the shifting of their centre of mass, the PT may lessen the manual facilitation and decrease the amount of verbal feedback provided. It is essential for the PT to be aware of a child’s stage of ML when working on a particular task and adjust MLS based on their current needs (24, 28).

MLS can be used to promote both implicit and explicit ML (23). Implicit ML occurs independent of cognitive function, whereas explicit ML is dependent upon a child’s age and cognitive abilities (27). Implicit ML is associated with using an external focus of attention, which directs the child’s awareness away from their body and toward the outcome of a movement (15, 29). Feedback using an external focus of attention is known as ‘knowledge of results’ (15). Implicit ML involves the acquisition of a motor skill without the child being able to verbalize knowledge of the skill (30), and has been shown to be of increasing benefit in younger children (31). An external focus of attention can be achieved through approaches such as the use of visual aids, analogy learning, dual task learning, and errorless learning (32, 33).

Explicit ML is associated with using an internal focus of attention which directs the child’s awareness toward their body (15, 29). Feedback using an internal focus of attention is referred to as ‘knowledge of performance’ (15). Explicit learning requires the active involvement of the child in the task itself with awareness of the associated task-relevant knowledge, and is supported by the child’s working memory (23, 28). While knowledge of performance is important for learning more complex tasks, information processing when using an internal focus of attention can overload an individual’s cognitive system and lead to decreased performance and learning (12, 33). Children with CP present with a diverse range of physical and cognitive abilities (4, 34). Decreased motor ability is often associated with lower working memory (32). As such, when aiming to promote implicit or explicit ML, the PT should consider the child’s motor and cognitive abilities prior to selecting the appropriate MLS during intervention.
2.3 Understanding how physiotherapists use motor learning strategies within their interventions: An overview of the Motor Learning Strategies Rating Instrument

The Motor Learning Strategy Rating Instrument (MLSRI) is an assessment that was developed as a means of systematically documenting the type and extent of MLS application in a physiotherapy session where ML is the focus (6). When using the MLSRI, a trained PT watches a video-recorded physiotherapy session, documents the MLS observed and their frequency of use, and then transfers these observations to a score form. The MLSRI was originally a 33-item measure developed and validated in physiotherapy intervention for children with acquired brain injury (ABI) (6), with the intention of applying it across a range of neuromotor disorders. It was developed using a multi-stage, iterative process that involved item generation through extensive literature review and observation of physiotherapy interventions for children with ABI (6). Item generation was followed by face and content validity testing with 12 pediatric ML experts across North America with modifications, as required (6). Initial reliability work for the MLSRI demonstrated excellent intra-rater reliability but only moderate inter-rater reliability when used in physiotherapy interventions for children with ABI (35). The physiotherapy intervention involved traditional gait-based physiotherapy and physiotherapy intervention with active video-gaming using the Nintendo Wii™ (35). Challenges with inter-rater reliability may have been due to the ambiguity of some of the item constructs, and possible varied interpretation of item definitions between raters (35). Prior to using the MLSRI clinically, further revisions and reliability work were recommended (35).

Subsequently, the MLSRI was revised by its lead author with input from several ML experts creating the 20-item measure called the MLSRI-20 (Levac D. MLSRI revisions. Email to Jennifer Ryan (jryan@hollandbloorview.ca) 2016 Jan 28 [cited 2018 Aug 27]) (Table 2.1). The revision involved removing and/or rewording some of the less reliable items and augmenting the scoring descriptions on the five-point scale. Items were also revised to ensure that MLS was the only construct being measured. Several original items were removed because they measured the actions or engagement of the child during the intervention (e.g., “the child appears motivated by, and engaged in, the therapy session”) rather than the PT’s use of MLS. While child engagement is an important factor in ML, the level of engagement is not a MLS, and therefore should not be
included in the measure. Some redundant items were amalgamated (e.g., “the therapist uses open-ended questions” and “the therapist’s instructions/feedback involved ‘asking’ rather than telling” were combined into “the therapist promotes problem-solving by ‘asking’ rather than telling”). The seven categories in the original MLSRI were reduced to three categories in the MLSRI-20: a) What the therapist SAYS (items #1-10), b) What the therapist DOES (items #11-15), and c) how Practice IS organized (#16-20). This supports a more systematic approach to documenting MLS observations and converting observations to item scores. The new categories may better align with PTs’ clinical approach to intervention, which creates potential to facilitate the more seamless integration of MLS into a treatment session. The MLSRI-20 was then used on a preliminary basis in physiotherapy intervention research in children with CP and ABI (36, 37), as well as in adults with stroke (8).

Similar to the original MLSRI, the rater watches a video-recorded physiotherapy session, stopping the video to document observations on the MLSRI-20 Worksheet (Appendix A) as needed. Observations include the types of MLS observed, the frequency each MLS is observed, tasks within the treatment session, and any task variations. Upon completion of the video, the rater reviews the observations documented on the Worksheet and scores each of the 20 items on the MLSRI-20 Score Sheet (Appendix B). The scoring system uses a five-point scale (0-4) where ‘0’ indicates that the MLS was observed “very little” or “0-5% of the time” and ‘4’ indicates that the MLS was observed “most of the time” or “76-100% of the time”. Multiple MLS can be used simultaneously, and in a variety of combinations. For example, a PT might provide verbal encouragement (item #1) while physically guiding (item #12) a child through a task that focuses on a whole skill (item #17).

The individual item scores are not tallied within the MLSRI-20, as a total score does not provide sufficient or necessarily meaningful information on MLS use. Instead, the Score Form is used as a profile of MLS observed in the session, indicating frequency and extent of MLS use throughout the session. MLSRI-20 profiles with higher scores do not necessarily indicate that more ML will occur, nor do they indicate that one session is superior or inferior to another session with a different distribution of item scores. The distribution of item scores is dependent upon the goals and context of a particular session in combination with the PT’s clinical decisions in response to the child’s actions.
Table 2.1 - The individual items and categories in the MLSRI (33 items) and MLSRI-20

<table>
<thead>
<tr>
<th>Category and Item</th>
<th>Original MLSRI Description</th>
<th>Category and Item</th>
<th>MLSRI-20 Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructions</td>
<td>What the therapist SAYS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Provided</td>
<td>1</td>
<td>Encouragement</td>
</tr>
<tr>
<td>2</td>
<td>Informational</td>
<td>2</td>
<td>Instructions direct attention to object/environment</td>
</tr>
<tr>
<td>3</td>
<td>External</td>
<td>3</td>
<td>Instructions direct attention to body movement</td>
</tr>
<tr>
<td>4</td>
<td>Internal</td>
<td>4</td>
<td>Problem solving involves asking (rather than telling)</td>
</tr>
<tr>
<td>5</td>
<td>Asked</td>
<td>5</td>
<td>Feedback relates to movement performance</td>
</tr>
<tr>
<td>6</td>
<td>Performance related</td>
<td>6</td>
<td>Feedback relates to results</td>
</tr>
<tr>
<td>7</td>
<td>Results related</td>
<td>7</td>
<td>Feedback relates to what was done well</td>
</tr>
<tr>
<td>8</td>
<td>Did correctly</td>
<td>8</td>
<td>Feedback relates to what was done poorly</td>
</tr>
<tr>
<td>9</td>
<td>Did wrong</td>
<td>9</td>
<td>Link activity being practiced to other activities</td>
</tr>
<tr>
<td>10</td>
<td>Link tasks</td>
<td>10</td>
<td>Encourages mental practice</td>
</tr>
<tr>
<td>Child Verbalization</td>
<td>What the therapist DOES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Encouraged</td>
<td>11</td>
<td>Uses demonstration/modelling</td>
</tr>
<tr>
<td>12</td>
<td>Problem solves</td>
<td>12</td>
<td>Provides physical guidance</td>
</tr>
<tr>
<td>13</td>
<td>Teaches</td>
<td>13</td>
<td>Provides environment where errors are part of learning</td>
</tr>
<tr>
<td>Practice</td>
<td></td>
<td>14</td>
<td>Recommends practice outside of therapy</td>
</tr>
<tr>
<td>14</td>
<td>Active</td>
<td>15</td>
<td>Provides education to client/caregiver</td>
</tr>
<tr>
<td>15</td>
<td>Repetitive</td>
<td>16</td>
<td>Repetitive</td>
</tr>
<tr>
<td>16</td>
<td>Whole</td>
<td>17</td>
<td>Whole (rather than part)</td>
</tr>
<tr>
<td>17</td>
<td>Variable</td>
<td>18</td>
<td>Variable (rather than constant)</td>
</tr>
<tr>
<td>18</td>
<td>Challenging</td>
<td>19</td>
<td>Random (rather than blocked)</td>
</tr>
<tr>
<td>19</td>
<td>Progressive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Session</td>
<td></td>
<td>20</td>
<td>Progressive</td>
</tr>
<tr>
<td>20</td>
<td>Modelling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Physical guidance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Mental practice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Performance guided</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Returns to tasks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Allows errors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Motivated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Uses resources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Needs redirection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carry-over</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Practice outside therapy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Provides training to caregiver</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wii</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Attentive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Uses feedback</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Therapeutic</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.4 Motor learning strategies in the literature

The aim of this literature review was to describe how the MLS in the MLSRI-20 have been studied and observe what vocabulary was used to describe the MLS. Priority was given to studies involving children with CP. For studies that did not focus on CP, preference was given to other
populations in the following order: other pediatric neurological conditions, adult neurological conditions or typically developing children, and healthy adults, including athletes. The main concept searched was ‘motor learning’ to ensure sensitivity of the search strategy and avoid over-limiting results. Searches were repeated in Medline and CINAHL, with preference for most recent and relevant publications. Publications prior to 1990 were excluded and every attempt to locate publications after 2000 was made. There is no subject heading associated with ‘motor learning’ in Medline or CINAHL. ‘Motor learning’ was searched as a keyword because a preliminary view of the MeSH Subject Heading ‘motor skill’ was found to be too vague for the purposes of this literature review. The combined search of diagnostic group (e.g., [exp Cerebral Palsy]) AND [motor learning.mp] or limiting [motor learning.mp] by age) was used.

To broaden the number of search results and explore the range of vocabulary used to describe each MLS in the MLSRI-20, MLS were also individually explored as a searchable concept, using a number of synonyms, on their own and in combination with [motor learning.mp] (e.g., ‘physical guidance’ was also searched as variations of ‘guidance’, ‘facilitation’, ‘physical support’, ‘support’, ‘assistance’). While searching [physical guidance.mp] AND [motor learning.mp] from 1990 to 2017 in Medline only yielded three relevant results, searching [motor learning.mp] AND the combined synonyms for physical guidance yielded 2938 results. However, this search approach was not as fruitful as anticipated, as many of the MLS within the results were not specific to ‘physical guidance’. Further limiting the 2938 results by combining [physical guidance.mp] AND [motor learning.mp] with [exp Cerebral Palsy] yielded 51 results. In contrast, a separate search of only [exp Cerebral Palsy] AND [motor learning.mp], without MLS synonyms, yielded 70 results and included all 51 results from the previous synonym-based search (Table 2.2).

Table 2.2- Search results for various populations and [motor learning.mp]

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of Medline Results</th>
<th>Number of CINAHL Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>4266</td>
<td>933</td>
</tr>
<tr>
<td>Cerebral Palsy</td>
<td>70</td>
<td>53</td>
</tr>
<tr>
<td>Stroke</td>
<td>179</td>
<td>153</td>
</tr>
<tr>
<td>Brain Injuries</td>
<td>44</td>
<td>19</td>
</tr>
<tr>
<td>Children</td>
<td>583</td>
<td>218</td>
</tr>
<tr>
<td>Adult</td>
<td>1777</td>
<td>355</td>
</tr>
</tbody>
</table>
Consequently, the primary search strategy involved searching [motor learning.mp] and limiting by age or diagnostic group. Entire articles, including reference lists, were then manually reviewed to determine which MLS were explored within the studies. The secondary search strategy involved using MLS synonyms for each MLS to locate potential MLS that were omitted from the initial search. All levels of evidence were included in the review. While original studies were preferred, review papers were used when original studies could not be found within the previously mentioned timelines. A non-exhaustive summary of the current literature organized according to the 20 MLS in the MLSRI-20 is provided below, with the goal of citing MLS use in at least two different contexts when possible (e.g., ‘mental practice’ in children with CP and typically developing children, ‘feedback’ in typically developing children and adults with stroke). The key descriptor for each MLS is highlighted using bolded font.

2.4.1 What the therapist SAYS

This category of MLS refers to therapist verbalizations that promote ML. The role of the language used within an intervention has an effect on ML (18). ‘Encouragement’ is a verbalization that contains no specific information relevant to learning a motor skill but is crucial in motivating a child and engaging their attention in a task. Notably, motivation refers to encouraging active involvement in a goal-directed behaviour, while engagement refers to the overall experience of participating in that behaviour (38). Increased engagement in clinical intervention is associated with improved clinical outcomes in pediatric rehabilitation (22). By increasing engagement in a task, an individual is more likely to be intrinsically motivated to participate and, as a result, increased ML is observed (18, 38-40).

A PT provides ‘instructions’ to a child when teaching them a motor skill. Instructions can have either an internal or external focus of attention (23, 41). Explicit learning can be facilitated by verbal instruction and feedback in children with CP (28). Research in typically developing pediatric populations indicates that using an external focus of attention improves movement effectiveness and efficiency (31, 39, 42).

Use of an external or internal focus of attention is also important when providing ‘feedback’. As noted in section 2.2, explicit verbalizations place demands on a person’s working memory (30), which can be compromised in individuals with neuromotor disorders. In one study, PTs working
in adult stroke rehabilitation reported that, in addition to encouragement, they tended to provide feedback related to their body movement rather than the effects of the movement (43) despite evidence to support externally focused feedback in this population and others (29, 44). More recent literature indicates that PTs working in adult stroke rehab typically provide verbal instructions with an external focus of attention, but give feedback with an internal focus of attention, followed by an adjustment of focus of attention to client preference over time (45).

Feedback can also direct the child’s attention to their successes or failures. Not surprisingly, positive feedback has an impact on a typically developing child’s motivation and plays an important role in ML (39). Most studies investigating feedback in children with CP focused on feedback schedules and referred to visual rather than verbal feedback when comparing an internal versus external focus of attention (29, 46, 47). These studies recognized the difference in cognitive processes between adults and children based on their capabilities to process information, sustain attention, and remember cues. Both typically developing children and children with CP benefit from a 100% feedback schedule, or feedback after each trial (47-49), whereas adults perform better with a reduced feedback schedule (49, 50). However, generalizing the results of visual feedback schedules does not provide enough evidence to inform verbal feedback schedules.

Having a child reflect and problem-solve through a task is a cognitive strategy that promotes ML (19). ‘Asking’ a child with developmental coordination disorder to problem-solve through a task, instead of immediately providing verbal feedback, increased the child’s autonomy and the overall likelihood that ML occurred (51). Involving children with CP in active problem-solving using a top-down approach, such as Cognitive Orientation to Occupational Performance (CO-OP), was found to be feasible and improved their self-efficacy (19).

‘Linking a task’ being practiced in therapy to another task performed either within or beyond intervention is thought to promote the transfer of a motor skill from one task or environment to another in adults with stroke and children with CP (19, 52). This MLS is a form of explicit learning and highlights the importance of meaningful practice (19, 52).

‘Mental practice’ refers to the mental rehearsal of a task without physical movement (53). Motor imagery ability, including vividness of the imagery and the accuracy of the imagined
conditions, improves throughout childhood and plateaus in adolescence (54). The use of motor imagery training improved upper extremity (UE) reaching in youth with unilateral CP compared to a control group while the combination of motor imagery training and physical practice led to improved reaching compared to physical practice alone (55).

### 2.4.2 What the therapist DOES

Verbalizations alone are often insufficient in promoting MLS in individuals with decreased response times (56). Therefore, PTs often ‘demonstrate’ tasks or provide ‘physical guidance’ to augment their verbalizations (56). Demonstration can take the form of observing the therapist perform the task, observing oneself performing the task either via video or using a mirror, or observing a third party performing the task either live or using a video (57). Research in healthy young adults supports the combination of novice and expert demonstrations in ML rather than using one or the other (57, 58). The use of video demonstration, gradually decreased physical guidance, and a gradual increase in opportunity for error was an effective combination of MLS in a case study teaching a child with autism to throw a ball overhand (59).

‘Physical guidance’ is traditionally provided via manual facilitation from the PT, but it can also be provided using external equipment (60) or augmentative technology (61). Robotic-assisted UE movement during intervention led to the acquisition and retention of unassisted UE movement in children with unilateral CP (61). However, PTs’ manual physical guidance was superior to robotic-assisted ambulation in adult stroke rehabilitation, and was attributed to the benefits of variability in human handling (62). While excessive physical guidance is often associated with the learner becoming reliant on the physical assistance to perform the task, research has shown it can be beneficial in the early stages of learning (60).

The benefit of ‘making errors’ during the learning process is thought to be dependent upon the stage of learning and the cognitive abilities of the learner. Healthy adults benefit initially from errorless learning, followed by increasing opportunity to make mistakes (63). Errorless learning can also be beneficial in children, due to their underdeveloped cognitive resources (27). It is easier to acquire a new motor skill when less cognitive resources are devoted to explicit learning (27). However, contrary to these findings, there were no differences in gait outcomes when error augmentation was compared to error minimization in treadmill training for adults post-stroke
Similarly, children with CP were found to learn in environments that either minimized or promoted error for a simple motor task involving aiming a boccia ball at a target (32). These findings indicate that the level of error introduced during intervention should be individualized based on the complexity of the motor skill and the amount of neurological involvement in the learner.

The combination of parent ‘education’ and ‘practice outside of therapy’ is crucial for task transfer and generalization (21). When parent education and practice outside of therapy were combined with standard physiotherapy intervention, infants at high risk for CP had improved ML compared to receiving standard intervention alone (65). Similarly, parent-supported intervention for school age children with chronic ABI resulted in improved ML compared to those who received clinician-directed intervention (21).

2.4.3 How ‘Practice IS’ organized

‘Repetitive’ practice refers to the amount of time an individual spends actively working on a task (40), and formed the basis of initial ML theories (15). There is evidence to support improved motor performance in children with CP with repetitive practice (12). Many robotic-assisted technologies base their ML properties on the repetitive features of the machine (66-68).

‘Part practice’ refers to breaking down a task into its components, whereas ‘whole’ practice involves performing a task in its entirety (40, 69). Part practice is thought to change the biomechanics of the task, and is traditionally encouraged only when learning a complex skill (69). Conversely, whole practice is endorsed when performing discrete or relatively simple tasks (40, 69). A meta-analysis of adult literature concluded that there is no difference in motor skill acquisition when using part or whole practice (69). In contrast, younger school age children had better results when learning to juggle using part practice, while slightly older school age children learned more effectively using whole practice (70).

Contextual interference refers to repetitive practice of a task that is not ‘blocked’ or ‘constant’. This form of practice is thought to promote ML because the learner must use multiple information processing strategies to complete the task (40, 71). ‘Variable’ and ‘random’ practice are forms of contextual interference, with random practice providing the highest degree
of interference (71). Variable practice refers to performing the same task within a treatment session with slight differences in the task, either by adjusting the task demands, the physical guidance provided, or the equipment involved (7). Variable practice in children may lead to improved transfer of a motor skill when presented with new movement variations compared to children who use constant practice (40, 71, 72). Random task order involves the therapist returning to a task within a treatment session after working on at least one other task in between (7). Random task order often results in decreased initial motor performance but improved ML over time in both adults and children (67). The contextual interference provided by random practice is thought to help maintain the child’s attention on a task (67).

‘Progressing’ the level of challenge of a task can be accomplished in numerous ways, whether it is decreasing the amount of physical guidance, increasing the contextual interference, fading the verbal feedback that initially assisted the learner, or increasing the cognitive demands (20). When the level of challenge is progressed, the likelihood for error increases (72). A case series involving the Challenge Point Framework in balance intervention for adults with chronic stroke found that progressing the level of challenge resulted in functional balance improvements (20).

2.4.4 Summary of motor learning strategies evidence in the literature

While the literature review yielded results for all MLS in the MLSRI-20, the evidence was limited, particularly in pediatric clinical populations. Table 2.3 outlines the studies included in the literature review and lists the specific vocabulary used by the authors to describe MLS. Developing an effective search strategy for each MLS was problematic due to the lack of subject headings for ‘motor learning’ or MLS, as well as the variety of synonyms used to describe each MLS in the literature. These challenges led to an additional extensive manual review of the generalized ML search results to ensure that studies were not overlooked or misinterpreted.

At times, ML or MLS terminology was used incorrectly, which confounded the interpretation of study results. For example, one study claiming to compare generic and non-generic feedback was actually comparing generic and non-generic ‘encouragement’ (39), as the verbalizations contained no ML content. The study categorized comments such as “you are a great soccer player” as generic feedback and “those kicks were very good” as non-generic feedback. If the feedback was in fact for ML purposes, it would have indicated why the kicks were effective (e.g.,
“those kicks were good because you followed through with your swing”). Other times, MLS vocabulary differed so drastically from the MLSRI-20 language that it was difficult to generate the set of synonyms that would retrieve the appropriate studies using the aforementioned search strategies. For example, one study comparing parent-led intervention in the home with clinician-led intervention described caregiver education using the term ‘training’, while ‘education’ referred to the parents’ level of schooling (21), while another study referred to ‘parent education’ but used ‘home program’ and ‘environmental enrichment’ to describe ‘practice outside of therapy’ (65). In addition to the differing vocabulary, the ability to generalize results from lab-based studies of simple motor tasks, such as tapping a keyboard with a single finger, in typically developing populations to more complex functional skills in clinical populations is unknown.

Overall, this review highlights the importance of using a common ML language to report research findings, such as the language outlined in the MLSRI-20. If the reliability of the MLSRI-20 is established (the first objective of this thesis), it has the potential to facilitate the documentation of ML content in research and clinical practice using a standardized, systematic approach which, based on this literature review, is currently lacking.
Table 2.3- A summary of the studies in the literature review, including the vocabulary used to describe MLS

<table>
<thead>
<tr>
<th>Study Title</th>
<th>Population</th>
<th>Intervention Focus</th>
<th>Setting</th>
<th>MLS and/or ML Descriptors Used by Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effects of Generic vs Non-generic feedback on motor learning in children</td>
<td>Typically developing children</td>
<td>Kicking ball at target</td>
<td>Lab</td>
<td>Generic and non-generic feedback&lt;br&gt;Negative feedback&lt;br&gt;Motivation</td>
</tr>
<tr>
<td>(39)</td>
<td></td>
<td>Throwing beanbag at target</td>
<td></td>
<td></td>
</tr>
<tr>
<td>External-focus feedback benefits free-throwing in children (42)</td>
<td>Typically developing children</td>
<td>Basketball free-throw</td>
<td>Gym</td>
<td>External/external focus of attention/feedback retention</td>
</tr>
<tr>
<td>Focus of attention in children’s motor learning: examining the role of</td>
<td>Typically developing children</td>
<td>Golf-putting</td>
<td>Lab</td>
<td>External/internal focus of attention instruction&lt;br&gt;Retention</td>
</tr>
<tr>
<td>age and working memory (31)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of informational feedback and attention focus of feedback in treating</td>
<td>Adult stroke</td>
<td>Physiotherapy intervention</td>
<td>Therapy</td>
<td>Instruction&lt;br&gt;Feedback&lt;br&gt;Motivational statements&lt;br&gt;External/internal focus of attention</td>
</tr>
<tr>
<td>the person with a hemiplegic arm (43)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The effects of knowledge of performance and cognitive strategies on motor</td>
<td>CP</td>
<td>Moving therapeutic exercise vehicle backwards</td>
<td>Lab</td>
<td>Physical practice&lt;br&gt;Mental practice&lt;br&gt;Verbal guidance&lt;br&gt;Verbal feedback&lt;br&gt;Physical guidance&lt;br&gt;Augmented feedback&lt;br&gt;Knowledge of performance&lt;br&gt;Knowledge of results&lt;br&gt;Cognitive strategies</td>
</tr>
<tr>
<td>skill learning in children with CP (12)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enabling children with developmental coordination disorder to self-regulate</td>
<td>Developmental Coordination Disorder</td>
<td>Individualized occupational goal</td>
<td>Therapy</td>
<td>Performance breakdown&lt;br&gt;Skill acquisition&lt;br&gt;Problem solving strategies</td>
</tr>
<tr>
<td>through the use of dynamic performance analysis: Evidence from the CO-OP</td>
<td></td>
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<tr>
<td>approach (51)</td>
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</tr>
<tr>
<td>Study Title</td>
<td>Population</td>
<td>Intervention Focus</td>
<td>Setting</td>
<td>MLS and/or ML Descriptors Used by Authors</td>
</tr>
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<tr>
<td>Cognitive orientation to daily occupational performance (CO-OP): A new approach for children with CP (19)</td>
<td>CP</td>
<td>Individualized UE goals</td>
<td>Therapy</td>
<td>Problem-solving, Cognitive strategies, Skill transfer</td>
</tr>
<tr>
<td>Inter-task transfer of meaningful, functional skills following a cognitive-based treatment: results of three multiple baseline design experiments in adults with chronic stroke (52)</td>
<td>Adult stroke</td>
<td>Individualized functional skill</td>
<td>Therapy</td>
<td>Problem-solving strategies, Generalization, Ask, don’t tell, Transfer, Variability, Guidance</td>
</tr>
<tr>
<td>Age-related changes in motor imagery from early childhood to adulthood: probing the internal representation of speed-accuracy trade-offs (54)</td>
<td>Typically developing children</td>
<td>Drawing task (Virtual Radial Fitts Task)</td>
<td>Lab</td>
<td>Motor imagery, Repetitive practice, Motor control, Motor skill learning, Internal models of action</td>
</tr>
<tr>
<td>Motor imagery training promotes motor learning in adolescents with CP: comparison between left and right hemiparesis (55)</td>
<td>CP</td>
<td>UE targeting task</td>
<td>Lab</td>
<td>Motor planning, Motor imagery training, Imagery training, Mental rehearsal, Instruction, Physical practice, Demonstration</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What the Therapist DOES</th>
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<tbody>
<tr>
<td>Enhancement of motor skill learning by a combination of ideal model-observation and self-observation (57)</td>
</tr>
<tr>
<td>Learning through observation: a combination of expert and novice models favors learning (58)</td>
</tr>
<tr>
<td>Study Title</td>
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<tr>
<td>Developing overhand throwing skills for a child with autism with a collaborative approach in school-based therapy (59)</td>
</tr>
<tr>
<td>Motor learning characterizes habilitation in children with hemiplegic CP (61)</td>
</tr>
<tr>
<td>Physical guidance benefits in learning a complex motor skill (60)</td>
</tr>
<tr>
<td>OPTIMAL practice conditions enhance the benefits of gradually increasing error opportunities on retention of a stepping sequence task (63)</td>
</tr>
<tr>
<td>Study Title</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| The influence of errors during practice on motor learning in young individuals with CP | CP                          | Aiming task (Paralympic boccia)                             | Lab     | Motivation
|                                                                             |                             |                                                              |         | Verbal instructions
|                                                                             |                             |                                                              |         | Augmented feedback
|                                                                             |                             |                                                              |         | Error-minimizing
|                                                                             |                             |                                                              |         | Error-strewn
|                                                                             |                             |                                                              |         | Implicit/explicit learning
| The role of movement errors in modifying spatiotemporal gait asymmetry post stroke (64) | Adult stroke               | Gait training (split-belt treadmill)                        | Therapy | Error augmentation
|                                                                             |                             |                                                              |         | Error-based learning
|                                                                             |                             |                                                              |         | Error minimization strategy
|                                                                             |                             |                                                              |         | Encourage carryover of training
|                                                                             |                             |                                                              |         | Verbal feedback focusing on spatiotemporal asymmetry
|                                                                             |                             |                                                              |         | Proprioceptive feedback
| Single blind randomised controlled trial of GAME (Goals-Activity-Motor Enrichment) in infants at risk of CP (65) | CP                          | Early intervention program                                  | Therapy | Parent coaching
|                                                                             |                             |                                                              |         | Home program
|                                                                             |                             |                                                              |         | Environmental enrichment
|                                                                             |                             |                                                              |         | Active motor learning
|                                                                             |                             |                                                              |         | Motor practice
| Direct clinician-delivered versus indirect family-supported rehabilitation of children with traumatic brain injury (21) | Children with traumatic brain injury | Clinician-delivered versus family-supported intervention | Therapy | Problem solving
|                                                                             |                             |                                                              |         | Transfer-of-training
|                                                                             |                             |                                                              |         | Context-sensitive
|                                                                             |                             |                                                              |         | Natural everyday activities
|                                                                             |                             |                                                              |         | Self-modelling
|                                                                             |                             |                                                              |         | Self-coaching
| Practice IS                                                                 |                             |                                                              |         |                                                            |
| The effect of random or sequential presentation of targets during robot-assisted therapy on children (67) | CP or children with traumatic brain injury | Robotic-assisted arm movement with computer screen | Therapy | Repetition
|                                                                             |                             |                                                              |         | Random or sequential presentation
|                                                                             |                             |                                                              |         | Active participation
|                                                                             |                             |                                                              |         | Maintain attention
| Weight-supported training of the UE in children with CP (66)                   | CP                          | Weight-supported arm training                               | Therapy | Enhanced feedback
|                                                                             |                             |                                                              |         | Repetition
|                                                                             |                             |                                                              |         | Motivation
|                                                                             |                             |                                                              |         | Weight-supported
<table>
<thead>
<tr>
<th>Study Title</th>
<th>Population</th>
<th>Intervention Focus</th>
<th>Setting</th>
<th>MLS and/or ML Descriptors Used by Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children’s age modulates the effect of part and whole practice in motor</td>
<td>Typically developing children</td>
<td>Bean-bag juggling</td>
<td>Gym-based</td>
<td>Explicit/implicit learning Whole practice Part practice Complex task</td>
</tr>
<tr>
<td>learning (70)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole and Part Practice (69)</td>
<td>Healthy adults</td>
<td>Meta-analysis</td>
<td>n/a</td>
<td>Part practice Whole practice Task complexity Cognitive demands Task organization</td>
</tr>
<tr>
<td>Feasibility and preliminary effectiveness of a novel mobility training</td>
<td>CP</td>
<td>Mobility training with body</td>
<td>Therapy</td>
<td>Variability Error experience Intervention Challenging Salience Exploration</td>
</tr>
<tr>
<td>intervention in infants and toddlers with CP (72)</td>
<td></td>
<td>weight support</td>
<td></td>
<td>Weight support</td>
</tr>
<tr>
<td>The effect of type of practice on motor learning in children (71)</td>
<td>Typically developing children</td>
<td>Throwing rice bags at targets</td>
<td>Lab</td>
<td>Variable practice Variability Contextual interference Knowledge of results</td>
</tr>
<tr>
<td></td>
<td></td>
<td>on the floor</td>
<td></td>
<td>Practice schedules Random Blocked Constant</td>
</tr>
<tr>
<td>Use of the challenge point framework to guide motor learning of stepping</td>
<td>Adult stroke</td>
<td>Stepping retraining</td>
<td>Therapy</td>
<td>Faded verbal feedback, Challenge point Task difficulty Progression</td>
</tr>
<tr>
<td>reactions for improved balance control in people with stroke (20)</td>
<td></td>
<td></td>
<td></td>
<td>Blocked and random practice Physical assistance Learning from error, learning</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>without error</td>
</tr>
</tbody>
</table>
2.5 Development of MLSRI-20 training materials

The original reliability work for the MLSRI indicated issues with inter-rater interpretation of some of the items (35). Similarly, multiple surveys of PTs revealed they are unfamiliar with how to implement ML theories in their current practice (9, 10). In order to promote greater awareness of MLS and to support standardized use of the MLSRI-20 in the reliability study, a MLSRI-20 Instruction Manual (7) and a MLS Online Training Program (73) was developed by the author team (J Ryan, V Wright, D Levac) at Holland Bloorview Kids Rehabilitation Hospital (Holland Bloorview). The process began with development of the MLSRI-20 Instruction Manual, which defines and provides written clinical examples for 20 MLS, explains how to record observations of MLS on the MLSRI-20 Worksheet, and outlines the rules for converting those observations to scores on the MLSRI-20 Score Form (excerpts provided in 2.5.1). Due to the variety of possible clinical scenarios a rater can encounter, the author team identified the need for video scenarios and interactive examples to further explain each MLS. As a result, the MLS Online Training Program was developed. It provides a detailed explanation of each item with accompanying video examples, tests users’ knowledge with interactive quizzes, allows for clinical reflection with case studies, and links to a PDF of the MLSRI-20 Instruction Manual (excerpts provided in 2.5.2). It currently consists of four modules: 1) Introduction to MLS; 2) How the Practice/Session is Organized; 3) What the Therapist DOES; and 4) What the Therapist SAYS.

Development of the MLS Online Training Program involved content development and creation of the presentation slides by J Ryan, with multiple revisions and iterations based on feedback from D Levac and V Wright. Three children and PTs were video-recorded in physiotherapy interventions in the Lokomat and/or physiotherapy gyms. Videos were reviewed by J Ryan, and clips including examples of MLS were selected for each of the 20 MLS. Once the content and presentation format were finalized, J Ryan reviewed content and specifications with an e-learning developer at Holland Bloorview. Videos were edited and added to the training program, with splicing of video content and the insertion of voiceovers, as required. Review of content and testing of the program occurred in an iterative process, with J Ryan providing author team edits to the e-learning developer. The team identified a future goal creating a fifth module for the MLS Online Training Program for using the MLSRI-20, pending reliability study results.
2.5.1 Excerpts from the MLSRI-20 Instruction Manual

The general rating procedure is outlined prior to the individual item descriptions and details how to record observations on the MLSRI-20 Worksheet.

**RATING PROCEDURE**

1. Familiarize yourself with each item description before you start rating the first video.

2. Write video number, date, and your name on the MLSRI-20 WORKSHEET and MLSRI-20 SCORE FORM.

3. Watch the video
   a) Stop the video whenever necessary to write observations/times/checkmarks on the MLSRI-20 WORKSHEET. Rewind the video, if needed, to review your ratings. Checkmarks represent the number of times you observe a specific MLS. Observations can include the tasks you observe or the quality of a verbalization.
   b) List all tasks and variations of the tasks observed. A “task”, in this context, refers to a therapy-based task that has a beginning, middle and end. It may be comprised of a number of motor skills. The task could be a functional movement (eg., throwing a ball, walking, getting up from the floor, etc) or it could be a therapeutic exercise aimed at improving motor control (eg., balancing on one foot, skipping rope, etc). Take into consideration the context and the focus of the therapist's verbalizations when deciding if a change in the observed exercise is a variation on a task or a completely new task. Variations can include changing equipment or adding new movement components to the task.

   **Task Examples:**
   **Task A** = Sit to Stand
   Variations of Task A could be:
   A1 = sit to stand from arm chair
   A2 = sit to stand from chair without arm rests
   A3 = sit to stand from 10” stool

   **Task B** = Unipedal Balance
   Variations of Task B could be:
   B1 = balancing on one foot on even ground with eyes open
   B2 = balancing on one foot on an unstable surface with eyes open
   B3 = balancing on one foot on even ground with eyes closed

   **Task C** = Obstacle Course
   Variations of Task C could be:
   C1 = weave around pylons → step in/out of hula hoop → perform three sit to stands
   C2 = weave around pylons while dribbling basketball → jump in/out hula hoop → perform 3 squats
   C3 = weave around pylons while dribbling basketball → hop in/out hula hoop on one foot → perform 3 step ups on a block

4. Rate the video
   Once you have finished watching the video, refer to your notes on the MLSRI WORKSHEET, and record your rating for each item on the MLSRI SCORE FORM. General scoring guidelines are provided on the next page, while detailed scoring guidelines for each item are found on pp 10-32.

Plate 2.1- MLSRI-20 Instruction Manual Rating Procedure (7)
General scoring guidelines for the MLSRI-20 are provided prior to individual item descriptions. Scoring is based on the number of observations in total as well as on the number of observations relative to the other MLS observed.

<table>
<thead>
<tr>
<th>Score</th>
<th># Observations</th>
<th>Description</th>
<th>Reference Point for Scoring MLSRI-20 by Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-2</td>
<td>Very little or NOT observed (0-5%* of the time)</td>
<td>I: The extent that each type of verbalization is used within the context of all verbalizations the therapist uses throughout the session.</td>
</tr>
<tr>
<td>1</td>
<td>3-5 or 6</td>
<td>Somewhat observed (6-24%*)</td>
<td>II: The extent to which the type of MLS is observed within the context of the session as a whole.</td>
</tr>
<tr>
<td>2</td>
<td>&gt;5 or 6</td>
<td>Often observed (25-49%*)</td>
<td>III: The organization of the tasks over the entire session; the scores are based on the session as a whole.</td>
</tr>
<tr>
<td>3</td>
<td>&gt;5 or 6</td>
<td>Very often observed but NOT most observed (50-75%*)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>&gt;5 or 6</td>
<td>Most observed (76-100%*)</td>
<td></td>
</tr>
</tbody>
</table>

*The context of the frequency of observation or percentage varies depending on which MLSRI-20 Category you are scoring (Part A, B, or C). Refer to the bolded text in the chart to determine what the “denominator” for the category is. For example, the denominator when calculating a score for Part A would be all verbalizations, whereas in Part B the denominator is the session as a whole. Note that the concept of “percentage” is rarely a strict mathematical calculation. Your scores will be based on the definition and general rules listed for each item, as well as the qualitative and quantitative observations you make.

**Note: There are specific scoring exceptions for items 4, 9, 10, 14, and 15. Refer to the item by item Description for each item for details of these exceptions.

Plate 2.2- MLSRI-20 Instruction Manual Scoring Guidelines (7)
This is an example of an individual item instruction for Part A) What the Therapist SAYS. All individual items start with a definition. General rules and written clinical examples are provided.

**2. INSTRUCT CLIENT TO FOCUS ON OBJECT OR ENVIRONMENT**

Instructions with an external focus of attention direct the learner towards the object or the effects of actions/movements on the environment.

If there is no information about how the person should move to achieve that outcome, this is an external focus.

**GENERAL RULES:**

- Instructions either precede a first or subsequent task attempt.
- Instructions need to contain specific information directed at improving motor learning. Simple cues/commands are not directed at motor learning and are not rated.
- Instructions are not rated as ‘asking’ or ‘telling’ (item #4).

**EXAMPLES:**

“Touch the red ball in the left corner.”

*When working on balancing on a BOSU, the therapist directs attention towards the support surface: “Don’t let the sides of the BOSU touch the floor.”*

“Walk straight refers to how the person should move through her environment. This is possible both in real-life and virtual reality environments.”

“Throw the ball to me.”

“Squat down to pick up the bean bag from the floor.” While “squat” refers to the body, the primary focus of this statement is the external focus of attention—“the bean bag.”

Plate 2.3- MLSRI-20 Instruction Manual individual item description for item #2 Instructs client to focus on object or environment (7)
This is an example of an individual item instruction for Part B) What the Therapist DOES. In addition to the definition, general rules, and clinical examples, there are also comments on scoring and some scoring examples are highlighted to further clarify the process.

**12. PROVIDES PHYSICAL GUIDANCE**

Physical guidance is contact with the client (to facilitate or inhibit movement) for the purpose of performing or learning the task.

**GENERAL RULES:**
- Because it is difficult to distinguish between when a therapist makes physical contact with a client for safety and when a therapist provides physical guidance for learning, rate any physical contact in the treatment session as "physical guidance".
- Use of technology or assistive devices provides physical guidance even though the therapist may not be providing hands-on contact. The amount of physical guidance provided by the device is determined by both qualitative and quantitative observations.
- A therapist can provide physical guidance *constantly* or *intermittently* throughout a task. The therapist can also *fade* the amount of guidance over the task or session.

**EXAMPLES:**
- The client performs a pivot transfer with their hands on the therapist’s shoulders and the therapist provides guidance at their trunk and shins.
- The therapist provides hands-on contact throughout an intervention while the client is using a virtual reality game.
- The client walks holding onto a hula hoop with both hands. Without directly contacting the client, the therapist moves the hula hoop to facilitate weight shift.
- Ambulation on a treadmill using a body weight support harness that supports 50% of the client’s weight.

**SCORING**

Based on extent to which the strategies occur in proportion to each other and in proportion to the session as a whole.

**SCORING EXAMPLES:**
- Constant hand-over-hand assistance while the client practices a badminton serve would score higher than intermittent hand-over-hand assistance.
- Decreasing the body weight support (BWS) throughout a session while walking on the treadmill, would score lower than if the BWS remained high throughout the session. If you cannot determine if changes have been made to the BWS, then you must assume that it is high and constant throughout.
- Frequent hands-on guidance, in addition to using an assistive device (e.g. walker) would score higher than using the device with no hands-on facilitation from the therapist.

Plate 2.4- MLSRI-20 Instruction Manual individual item description for item #12 Provides physical guidance (7)
This is an example of an individual item instruction for Part C) How the Practice IS Organized. Session/practice organization is highly dependent upon defining the tasks in the intervention.

Plate 2.5- MLSRI-20 Instruction Manual individual item description for item #18 Variable (rather than constant) practice (7)
2.5.2 Features of the MLS Online Training Program

The MLS Online Training Program home page. The program is password protected and the user’s progress is tracked, enabling them to start where they left off from one learning session to the next.

Plate 2.6- MLS Online Training Program home page (73)
Each module has a menu (left) of the areas that will be covered.

Plate 2.7- MLS Online Training Program home page for Module 1 (73)
The MLSRI-20 Instruction Manual, Worksheet, and Score Forms can be accessed at any time through the Course Resources tab (right).

Plate 2.8- MLS Online Training Program drop-down menu with MLSRI-20 materials (73)
Modules 2-4 identify each item in the MLSRI-20 that falls within that category.

Plate 2.9- MLS Online Training Program organization of Module 4- MLS: What the Therapist SAYS (73)
This is the format for each MLS description. The blue text at the bottom of the page provides evidence for this MLS in the literature. Users can click on the text for the full citation.

Plate 2.10- MLS Online Training Program definition of repetitive practice (item # 16 MLSRI-20) (73)
Video clips are provided after the item description to demonstrate the MLS in a clinical context, using a variety of PTs and children.

Plate 2.11- MLS Online Training Program video examples of whole and part practice (item #17 MLSRI-20) (73)
Video examples are provided for traditional physiotherapy and Lokomat-based physiotherapy were possible to identify how the MLSRI-20 can be used in multiple treatment settings. Some videos have voice-overs to further clarify the MLS observed.

Plate 2.12- MLS Online Training Program video examples for whole and part practice in traditional and Lokomat-based physiotherapy (73)
This knowledge check example involves matching terms to definitions and the user cannot proceed until they get all items correct.

Plate 2.13- MLS Online Training Program knowledge check for motor learning terminology (73)
This knowledge check example requires the user to complete the entire quiz before getting their results. There is an option to review the individual questions.

Plate 2.14- MLS Online Training Program knowledge check for whole vs part practice (73)
This knowledge check example provides immediate notification if you are correct or incorrect. It also provides an explanation as to why the answer was right or wrong.

**Plate 2.15- MLS Online Training Program knowledge check for internal vs external focus of attention (73)**
There is a summary slide at the end of each module, highlighting the main points covered in the module.

Plate 2.16- MLS Online Training Program Summary of MLS: How the practice/session is organized (73)
Modules 2-4 have reflective case studies at the end of the module with the option of submitting them for feedback.

Plate 2.17 - MLS Online Training Program Case Study for MLS: How the practice/session is Organized (73)
2.5.3 Summary of training material

With the appropriate resources, it may be possible to increase therapists’ awareness of intentional MLS use. The information detailed in the MLS Online Training, in combination with the MLSRI-20 Instruction Manual, created the foundation for the systematic and standardized training of the PT raters participating in the MLSRI-20 reliability study (Chapter 3).
Chapter 3

3 The inter- and intra-rater reliability and utility of the Motor Learning Strategies Rating Instrument in physiotherapy intervention for children with cerebral palsy

3.1 Introduction

CP is a neuromotor condition that affects children’s motor skill development and often influences their involvement in everyday activities (5, 72, 74). Physiotherapy intervention for children with CP can focus on activity-based goals by addressing the acquisition of motor skills that, when transferred from therapy to a child’s daily routine, can result in enhanced participation in meaningful activities (24). ML is the acquisition or change in a motor skill, which is achieved through practice and retained over time (3). PTs aim to promote ML by applying and adjusting ML variables within a treatment session, including their verbal interactions (e.g., instructions, feedback), their physical actions (e.g., demonstration, assistance), and aspects of task practice (e.g., frequency, type, duration, intensity) (6). ML principles are the evidence-based statements that guide how PTs manipulate these variables to promote the acquisition and transfer of motor skills (6). MLS are the observable actions of the PT, involving the selection, manipulation, and application of ML variables, which is based on client- and task-specific factors (6). The implementation of MLS within therapeutic intervention is important to the extent that structuring intervention practice and content in ways that are known to support ML enhances the experience-dependent neuroplasticity that underlies how the injured brain recovers and encodes new information (1, 2, 17, 75).

When considering the efficacy of an intervention, it is important to be aware of the underlying basis, content, and focus of the intervention (76). Even in technology-based interventions, PTs play an integral role in the learning process (77). The rationale for integration of technology-based interventions, such as Nintendo Wii™ (78), WalkAide® (79), and Lokomat® robotic-assisted gait trainer (68), within physiotherapy interventions is that they enhance opportunities for ML. However, studies evaluating the efficacy of the technology rarely detail the ML content within the study protocol (68, 79), which affects a PT’s ability to reproduce these treatments in a
clinical setting. Studies evaluating the benefits of the Lokomat in children with CP emphasize the repetitive properties of the technology and discuss the benefits of progressing gait-based parameters but fail to elaborate on the use of other important MLS within intervention, including how the PT communicates with the child (68, 80, 81). Without a common language to identify the specific MLS used, it is difficult to dissect the intervention’s ‘active ingredients’ and determine the successful elements within a treatment session. Systematically documenting the ML content of physiotherapy intervention not only allows the comparison of content from one physiotherapy intervention to another, but also creates an opportunity to study the learning styles and/or needs of individuals and/or pediatric clinical populations.

The MLSRI was developed to systematically document the type and extent of MLS used in a physiotherapy intervention where ML is the focus (6). Initial validation work for this 33-item measure demonstrated excellent intra-rater reliability among PT student raters evaluating physiotherapy interventions for children with ABI, but only moderate inter-rater reliability (35). Revision of the less reliable items and further reliability work was recommended prior to using the MLSRI for clinical or research purposes (35). Subsequently, the MLSRI was revised by one of its authors (D Levac) and several ML colleagues into a 20-item measure (the MLSRI-20 (p 7)). The MLSRI-20 is divided into three categories: a) What the therapist SAYS (items #1-10), b) What the therapist DOES (items #11-15), and c) how Practice IS organized (items #16-20) (Appendix B). The MLSRI-20 is scored by a PT who has been trained and certified in its use. The rating system consists of a five-point scale (0-4) where 0 indicates the MLS was observed “very little”, 1 indicates the MLS was observed “somewhat”, 2 indicates the MLS was observed “often”, 3 indicates the MLS was observed “very often”, and 4 indicates that the MLS was observed “most of the time”. The individual items are not tallied to obtain a total MLSRI-20 score because there is no practical value associated with the magnitude of the total score (i.e., a higher score does not indicate a superior ML session). The value of the MLSRI-20 lies at the level of the individual items and the distribution of scores within each category, both of which identify how ML content can vary along a spectrum of MLS use.

Before drawing conclusions from assessment results, such as the MLSRI-20, it is imperative to determine that it can be used consistently in a specific population from one assessment to the next (82). Therefore, the primary objective of this study was to evaluate the inter- and intra-rater reliability of the MLSRI-20 when used to describe MLS use in physiotherapy interventions for
children with CP. In addition to consistency, the assessment should be able to be applied practically within the intended research or clinical setting. Therefore, the utility of the MLSRI-20 was evaluated using PT rater feedback about ease and confidence in rating.

3.2 Methods

3.2.1 Overview of Study Design

A measurement study design was used. Four pediatric PTs were trained by J Ryan to administer the MLSRI-20, which involved a combination of classroom-based training sessions and web-based learning using a MLS Online Training Program (73) designed by Ryan, Levac, and Wright. The PT raters were required to pass a criterion test that consisted of scoring MLS use within two video-recorded interventions and obtaining 70% agreement in scores with J Ryan and D Levac. The PT raters were then paired by a research assistant (RA) via a random draw. These pairs were used for the inter-rater comparison and were maintained for the duration of the study. Thirty videos (83) of physiotherapy interventions were used to evaluate inter- and intra-rater reliability. Given the wide variety of treatment approaches used in physiotherapy intervention for children with CP, the MLSRI-20 needs to be able to be used with different types of intervention. Thus, to enhance the generalizability of the reliability results, videos of traditional gait-based physiotherapy and physiotherapy using the Lokomat robotic-assisted gait trainer were used. Inter-rater reliability was evaluated by having both PTs within a rater pair independently rate one of two sets of 15 videos. Intra-rater reliability was evaluated by randomly reassigning each of the 15 videos to one of the PTs within each pair for a second independent rating (total n= 30).

3.2.2 Participants

The reliability study participants were children with CP (Gross Motor Function Classification Scale (GMFCS) (34) levels I to IV), ages 6 to 17 years, who had participated in one of three Lokomat randomized trials at Holland Bloorview. Two of these studies had a crossover design where each child participated in an 8-week block of biweekly traditional gait-based physiotherapy and an 8-week block of biweekly physiotherapy using the Lokomat, with block order being the randomization component (84). The third study was a randomized control trial where each participant was randomized to one 8-week block of biweekly physiotherapy that consisted of traditional gait-based physiotherapy, Lokomat-based physiotherapy, a combination
of the two intervention types, or a control where no intervention took place (85). Videos of at least two treatment sessions were recorded for each child to permit documentation of the various intervention components within the Lokomat studies. These videos were eligible for rating in the MLSRI-20 reliability study. It was hypothesized that the videos would contain varying degrees of MLS use as the treating PTs were encouraged to use a ML approach and received a one-hour overview of MLS presented by the Lokomat study PI at the outset of the initial study. More in-depth MLS training was provided by J Ryan prior to the third randomized control trial.

The Research Ethics Boards at Bloorview Research Institute and University of Toronto approved the MLSRI-20 reliability study protocol (Appendix C). All participants and a parent/guardian were informed of the objectives and procedures of this study. Written consent was obtained from the parent and child (or child assent where appropriate) before the child’s Lokomat study videos were used in the reliability study (Appendix D). The treating PTs in the Lokomat studies were contacted and written consent was obtained to include their videos in the current study (Appendix E).

3.2.3 Procedures

3.2.3.1 PT Rater Recruitment

An email was sent to the Holland Bloorview internal PT email group, which consisted of approximately 25 PTs. The email invited those who were interested in becoming PT raters for the MLSRI-20 to apply to join the study. The email stated that study involvement was contingent upon completion of MLSRI-20 training and passing a criterion test. Exclusion criteria included any PT who had worked as a treating PT in the Lokomat studies at Holland Bloorview to avoid having a PT rater assess videos of themselves, which would confound reliability results. Eight PTs responded to the email and four were randomly selected by the RA, using randomization software. These PTs provided informed consent and then were trained to use the MLSRI-20.

3.2.3.2 Video Selection

Videos were screened by the RA using a Screening Checklist for Video Use Form (Appendix F). The main inclusion criteria were: 1) audio quality (i.e., to ensure both the PT and the child could be heard); and 2) video clarity, lighting, and camera angles (i.e., to ensure both the PT and child could be seen). After screening the videos, the RA provided a list of de-identified participants
with the completed Screening Checklist to J Ryan, who selected which videos were eligible for the reliability study, based solely on the information provided on the checklist. This process ensured there was no selection bias towards the children or treating PTs in the videos.

3.2.3.3 Video assignment and rating

Prior to video assignment (Appendix G), the RA de-identified and paired the PT raters. Raters were not aware of their PT rater pairing and were asked not to speak with the other PT raters in the study about the videos to avoid influencing the MLSRI-20 scores. Videos were randomly assigned to one of the PT pairs, with each pair rating 15 videos in total. To address intra-rater reliability, the RA assigned one of the two PT raters within a pair to rate the same video using the MLSRI-20 a second time, using a block randomized design balanced every three videos so that each PT rated 7-8 videos a second time. The PT rater did not have access to the previous MLSRI-20 Worksheet or Score Forms when completing the second rating. The minimum amount of time permitted between the first and the repeat video ratings was one week, and at least two other videos must have been rated in between.

Rating involved each PT rater individually watching the video-recorded physiotherapy intervention, stopping the video, as needed, to record observations on the MLSRI-20 Worksheet. Observations included documenting each of the 20 MLS observed and the frequency of use, the tasks observed, task order, and any task variations. Upon completion of viewing the video and recording observations, the rater reviewed and summarized the observation data on the Worksheet (e.g., frequency counts of each MLS use) before translating it into item scores on the MLSRI-20 Score Form. The PT rater also completed the MLSRI-20 Feedback Form (Appendix H) indicating: the amount of time spent rating the video, and the degree of difficulty scoring each MLSRI-20 category, as well as her overall confidence in the rating, on a 10 cm visual analog scale (VAS), where 0 cm was “very difficult” and 10 cm was “no trouble at all”. After each category, there was a comment section where the PT rater could elaborate on areas of concern.

3.2.3.4 Statistical analysis

All analyses were conducted using MedCalc statistical software (version 12.3.0.0). Descriptive statistics were calculated, and the distribution analyses evaluated. The comparison of MLSRI-20 total scores, category scores, and individual item scores within rater pairs was reviewed to
evaluate the inter-rater reliability of the MLSRI-20. While individual item scores are not tallied for a total score when using the MLSRI-20, the score for one item often influences the score of another. As such, analysing the individual items alone would not capture the overall reliability of the MLSRI-20. Therefore, inter- and intra-rater reliability were determined for the total, category, and individual item scores. A combination of intraclass correlation coefficients (ICCs) (86), Bland-Altman plots (87), and coefficient of variation (CV) (88) were used to estimate the association and agreement between ratings, evaluate the influence of the magnitude of the scores on the agreement, and assess the relative and absolute variation between ratings (89). The ICC (2,1) was used based on the goal of generalizing results beyond this study (89). The associated 95% confidence intervals were also calculated. A minimum ICC of 0.90 was set as the a priori target to indicate excellent reliability, while 0.75-0.90 would indicate good reliability, with a 95% CI lower bound of 0.60 for the total MLSRI-20 scores (86). For the MLSRI-20 to be reliable in clinical and research-based settings, a minimum ICC of 0.75 was targeted (86).

Bland–Altman plots (87) evaluated measurement bias for the inter-rater and intra-rater scenarios to identify whether the measure had varying reliability at different scoring levels. Finally, the CV was calculated, with a target goal of < 10% (90).

Descriptive statistics were used to evaluate the utility of the MLSRI-20. Inter- and intra-rater differences in PT rater confidence and difficulty in rating the MLSRI-20 were analyzed using paired t-tests. Pearson correlation coefficients evaluated associations between MLSRI-20 category scores and rating difficulty and confidence, and were also used to assess associations between MLSRI-20 total scores and time to rate each video. The comments provided by the PT raters for each MLSRI-20 category on the feedback form were grouped according to content and summarized alongside the reliability results for individual items to determine the overall utility of the measure.

### 3.3 Results

#### 3.3.1 Participants

Thirty videos were rated, with a total of 18 children participating in the physiotherapy interventions represented in the videos. Twelve of the 18 children had two videos included in the study. Sixteen videos were traditional-gait based physiotherapy interventions, while 14 were
Lokomat-based interventions. There were 11 treating PTs (all female) in the 30 videos. PT raters had a range of clinical experience, from 3 to 18 (mean=13) years, in inpatient and outpatient pediatric settings.

3.3.2 Reliability

The MLSRI-20 total mean scores (SD) for inter-rater data were 27.00 (6.47) for the first rater pair and 27.17 (3.98) for the second rater pair, out of a total of 80 possible points (overall range of 17 to 40). The MLSRI-20 total mean (SD) scores for intra-rater data were 29.71(4.94) for rater A, 27.25(2.82) for rater B, 25.50(5.81) for rater C, and 26.86(4.50) for rater D (overall range of 16 to 38). While the histogram of the total scores was normally distributed, histograms of the individual items were not. There were no differences in MLSRI-20 mean total scores when comparing traditional physiotherapy and Lokomat interventions.

The ICC for inter-rater reliability of the MLSRI-20 total score was 0.78 with a 95% CI of 0.53-0.89, while the ICC for intra-rater reliability for the total score was 0.89 with a 95% CI of 0.76-0.95. Tables 3.1 and 3.2 outline inter- and intra-rater reliability at the category and individual item levels. Eight individual items (#2-4, 6, 8, 12, 17, 19) for the inter-rater scenario and two individual items (#10, 14) for the intra-rater scenario had ICCs less than 0.30.
Table 3.1- MLSRI-20 inter-rater reliability by category and individual item

<table>
<thead>
<tr>
<th>Category and Item</th>
<th>Description</th>
<th>First Rating Mean (SD)</th>
<th>Second Rating Mean (SD)</th>
<th>ICC (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>What the therapist SAYS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Encouragement</td>
<td>2.03 (0.89)</td>
<td>2.00 (1.04)</td>
<td>0.75 (0.47-0.88)</td>
</tr>
<tr>
<td>2</td>
<td>Instructions-Object/Environment</td>
<td>0.87 (0.86)</td>
<td>1.07 (0.94)</td>
<td>0.51 (0.00-0.77)</td>
</tr>
<tr>
<td>3</td>
<td>Instructions- Body movement</td>
<td>1.53 (0.68)</td>
<td>1.37 (0.71)</td>
<td>0.25 (0.00-0.64)</td>
</tr>
<tr>
<td>4</td>
<td>Asking rather than telling</td>
<td>0.60 (0.81)</td>
<td>0.40 (0.67)</td>
<td>0.29 (0.00-0.66)</td>
</tr>
<tr>
<td>5</td>
<td>Feedback- Movement performance</td>
<td>1.80 (0.85)</td>
<td>1.90 (0.85)</td>
<td>0.48 (0.00-0.75)</td>
</tr>
<tr>
<td>6</td>
<td>Feedback- Results</td>
<td>0.90 (0.88)</td>
<td>0.77 (0.97)</td>
<td>0.00 (0.00-0.52)</td>
</tr>
<tr>
<td>7</td>
<td>Feedback- What was done well</td>
<td>0.47 (0.57)</td>
<td>0.47(0.73)</td>
<td>0.53 (0.00-0.78)</td>
</tr>
<tr>
<td>8</td>
<td>Feedback- What was done poorly</td>
<td>0.27(0.45)</td>
<td>0.37(0.67)</td>
<td>0.04 (0.00-0.54)</td>
</tr>
<tr>
<td>9</td>
<td>Link activities</td>
<td>0.47(1.01)</td>
<td>0.60(1.07)</td>
<td>0.86 (0.70-0.93)</td>
</tr>
<tr>
<td>10</td>
<td>Mental practice</td>
<td>0.07 (0.37)</td>
<td>0.13 (0.73)</td>
<td>0.89 (0.77-0.95)</td>
</tr>
<tr>
<td></td>
<td><strong>What the therapist DOES</strong></td>
<td></td>
<td></td>
<td>0.00 (0.00-0.52)</td>
</tr>
<tr>
<td>11</td>
<td>Demonstration</td>
<td>0.60 (1.10)</td>
<td>0.37(0.76)</td>
<td>0.88 (0.74-0.94)</td>
</tr>
<tr>
<td>12</td>
<td>Physical guidance</td>
<td>2.97 (1.03)</td>
<td>3.03 (1.19)</td>
<td>0.14 (0.00-0.60)</td>
</tr>
<tr>
<td>13</td>
<td>Errors as part of learning</td>
<td>1.43 (1.01)</td>
<td>1.07 (0.87)</td>
<td>0.51 (0.00-0.77)</td>
</tr>
<tr>
<td>14</td>
<td>Recommends practice</td>
<td>0.07 (0.37)</td>
<td>0.27 (0.69)</td>
<td>0.56 (0.08-0.79)</td>
</tr>
<tr>
<td>15</td>
<td>Provides education</td>
<td>0.27 (0.69)</td>
<td>0.20 (0.61)</td>
<td>0.68 (0.33-0.85)</td>
</tr>
<tr>
<td></td>
<td><strong>How the Practice IS Organized</strong></td>
<td></td>
<td></td>
<td>0.52 (0.00-0.77)</td>
</tr>
<tr>
<td>16</td>
<td>Repetitive</td>
<td>3.90 (0.31)</td>
<td>3.90 (0.31)</td>
<td>0.41 (0.00-0.72)</td>
</tr>
<tr>
<td>17</td>
<td>Whole</td>
<td>3.47 (0.78)</td>
<td>3.43 (0.86)</td>
<td>0.00 (0.00-0.31)</td>
</tr>
<tr>
<td>18</td>
<td>Variable</td>
<td>2.27 (1.14)</td>
<td>2.37 (1.33)</td>
<td>0.67 (0.29-0.84)</td>
</tr>
<tr>
<td>19</td>
<td>Random</td>
<td>0.97 (1.03)</td>
<td>1.10 (1.37)</td>
<td>0.00 (0.00-0.43)</td>
</tr>
<tr>
<td>20</td>
<td>Progressive</td>
<td>2.07 (1.28)</td>
<td>2.10 (1.13)</td>
<td>0.52 (0.00-0.77)</td>
</tr>
</tbody>
</table>
Table 3.2- MLSRI-20 intra-rater reliability by category and individual item

<table>
<thead>
<tr>
<th>Category and Item</th>
<th>Description</th>
<th>First Rating Mean (SD)</th>
<th>Second Rating Mean (SD)</th>
<th>ICC (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>What the therapist SAYS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Encouragement</td>
<td>2.03 (0.89)</td>
<td>2.20 (0.92)</td>
<td>0.58 (0.12-0.80)</td>
</tr>
<tr>
<td>2</td>
<td>Instructions- Object/Environment</td>
<td>0.87 (0.86)</td>
<td>0.93 (0.98)</td>
<td>0.68 (0.32-0.85)</td>
</tr>
<tr>
<td>3</td>
<td>Instructions- Body movement</td>
<td>1.53 (0.68)</td>
<td>1.47 (0.73)</td>
<td>0.55 (0.06-0.79)</td>
</tr>
<tr>
<td>4</td>
<td>Asking rather than telling</td>
<td>0.60 (0.81)</td>
<td>0.40 (0.67)</td>
<td>0.88 (0.57-0.94)</td>
</tr>
<tr>
<td>5</td>
<td>Feedback- Movement performance</td>
<td>1.80 (0.85)</td>
<td>1.80 (0.76)</td>
<td>0.40 (0.00-0.72)</td>
</tr>
<tr>
<td>6</td>
<td>Feedback- Results</td>
<td>0.90 (0.88)</td>
<td>0.77 (0.94)</td>
<td>0.78 (0.53-0.89)</td>
</tr>
<tr>
<td>7</td>
<td>Feedback- What was done well</td>
<td>0.47 (0.57)</td>
<td>0.53 (0.57)</td>
<td>0.54 (0.04-0.78)</td>
</tr>
<tr>
<td>8</td>
<td>Feedback- What was done poorly</td>
<td>0.27 (0.45)</td>
<td>0.17 (0.38)</td>
<td>0.49 (0.00-0.76)</td>
</tr>
<tr>
<td>9</td>
<td>Link activities</td>
<td>0.47 (1.01)</td>
<td>0.67 (1.09)</td>
<td>0.82 (0.64-0.92)</td>
</tr>
<tr>
<td>10</td>
<td>Mental practice</td>
<td>0.07 (0.37)</td>
<td>0.07 (0.37)</td>
<td>0.00 (0.00-0.49)</td>
</tr>
<tr>
<td></td>
<td><strong>What the therapist DOES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Demonstration</td>
<td>0.60 (1.10)</td>
<td>0.83 (1.26)</td>
<td>0.94 (0.87-0.97)</td>
</tr>
<tr>
<td>12</td>
<td>Physical guidance</td>
<td>2.97 (1.03)</td>
<td>3.10 (1.03)</td>
<td>0.86 (0.70-0.93)</td>
</tr>
<tr>
<td>13</td>
<td>Errors as part of learning</td>
<td>1.43 (1.01)</td>
<td>1.60 (0.67)</td>
<td>0.73 (0.43-0.87)</td>
</tr>
<tr>
<td>14</td>
<td>Recommends practice</td>
<td>0.07 (0.36)</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00-0.52)</td>
</tr>
<tr>
<td>15</td>
<td>Provides education</td>
<td>0.27(0.69)</td>
<td>0.13(0.51)</td>
<td>0.43 (0.00-0.73)</td>
</tr>
<tr>
<td></td>
<td><strong>How the Practice IS Organized</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Repetitive</td>
<td>3.90 (0.31)</td>
<td>3.87(0.43)</td>
<td>0.78 (0.53-0.89)</td>
</tr>
<tr>
<td>17</td>
<td>Whole</td>
<td>3.47 (0.78)</td>
<td>3.57 (0.86)</td>
<td>0.84 (0.66-0.92)</td>
</tr>
<tr>
<td>18</td>
<td>Variable</td>
<td>2.27 (1.14)</td>
<td>2.23 (1.19)</td>
<td>0.72 (0.41-0.87)</td>
</tr>
<tr>
<td>19</td>
<td>Random</td>
<td>0.97 (1.03)</td>
<td>1.00 (1.08)</td>
<td>0.83 (0.64-0.92)</td>
</tr>
<tr>
<td>20</td>
<td>Progressive</td>
<td>2.07 (1.28)</td>
<td>2.17 (1.12)</td>
<td>0.81 (0.60-0.91)</td>
</tr>
</tbody>
</table>
The CVs were 11.8% and 7.8% for the inter- and intra-rater scenarios, respectively. The Bland-Altman plot for inter-rater reliability did not demonstrate a scoring bias for MLSRI-20 total scores. The plot for intra-rater reliability indicated a slight tendency for videos with lower total scores being rated slightly lower on the second rating while videos with higher total scores were rated slightly higher on the second rating (Figure 3.1).

![Bland-Altman plot of intra-rater MLSRI-20 total scores](image)

Figure 3.1- Bland-Altman plot of intra-rater MLSRI-20 total scores
3.3.3 MLSRI-20 scoring

As illustrated in Figure 3.2, the individual items that generally scored highest and/or were also used most frequently were: #1- Encouragement, #5- Feedback related to movement performance, #12- Provides physical guidance, #16- Repetitive, #17- Whole, #18- Variable, and #20- Progressive. The items that scored lowest and/or were also used least frequently were: #8- Feedback related to what was done poorly, #9- Linked Activities, #10- Mental practice, #14- Recommend practice outside of therapy, and #15- Client/caregiver education.

![Figure 3.2- Frequency of MLSRI-20 individual items rating greater than zero within the sample](image)

* median score >/= 2

Figure 3.2- Frequency of MLSRI-20 individual items rating greater than zero within the sample

There were several items that did not use the full range of the rating scale (Figure 3.3, p. 52). The narrowest scoring range observed used three out of the possible five scores in the following items: #4- Asking (scores 0-2), #8- Feedback related to what was done poorly (scores 0-2), and #16- Repetition (scores 2-4). There are four special items (#9, 10, 14, 15) in the MLSRI-20 that are scored on a three-point scale (0, 2, 4) instead of the five-point scale used in the rest of the measure. Of these special items, #9- Links activities and #10 Mental practice used the entire breadth of the scale while #14- Recommends practice outside of therapy and #15- Client/caregiver education only used two out of three points (0 and 2).
Please rate the extent to which these strategies occur in the session as a whole:

<table>
<thead>
<tr>
<th></th>
<th>Very little 0-5%</th>
<th>Somewhat 6-24%</th>
<th>Often 25-49%</th>
<th>Very often 50-75%</th>
<th>Mostly 76-100%</th>
</tr>
</thead>
</table>

A) What the therapist SAYS:
1. Provides encouragement                          0 1 2 3 4
2. Directs client’s attention to object or environment 0 1 2 3 4
3. Directs client’s attention to body movement       0 1 2 3 4
4. Involve ‘asking’ (rather than ‘telling’)          0 1 2 3 4
5. Relates feedback to movement performance         0 1 2 3 4
6. Relates feedback to results                      0 1 2 3 4
7. Relates feedback to what was done well            0 1 2 3 4
8. Relates feedback to what was done poorly         0 1 2 3 4
9. Links activity being practiced to other activities 0 1 2 3 4
10. Encourages the client to undertake mental practice 0 - 2 - 4

B) What the therapist DOES:
11. Uses demonstration/modeling                     0 1 2 3 4
12. Provides physical guidance                       0 1 2 3 4
13. Provides an environment where errors are a part of learning 0 1 2 3 4
14. Recommends practice outside of therapy          0 - 2 - 4
15. Provides training or education to client/caregiver 0 - 2 - 4

C) Practice is:
16. Repetitive                                         0 1 2 3 4
17. Whole (rather than part)                         0 1 2 3 4
18. Variable (rather than constant)                  0 1 2 3 4
19. Random (rather than blocked)                     0 1 2 3 4
20. Progressive                                       0 1 2 3 4

* shaded scores represent the range of the scale used in the study

Figure 3.3- Range of the MLSRI-20 response scale used by individual items

3.3.4 MLSRI-20 utility

The MLSRI-20 Feedback Form used a VAS to indicate the “degree of difficulty” or “confidence rating” for scoring each MLSRI-20 category where 0 cm is “very difficult” and 10 cm is “no trouble at all”. The VAS results are summarized in Table 3.3 and were calculated based on the initial rating of each video, completed by one PT rater within the pair (e.g., n=30). There were no between rater differences in difficulty rating (p=0.91) or confidence in rating (p=0.53) for the
same video. There were no differences within a rater for difficulty rating (p=0.83) or confidence in rating (p=0.13) for the same video.

Table 3.3- MLSRI-20 Feedback Form VAS Results

<table>
<thead>
<tr>
<th>Category</th>
<th>Difficulty Mean (SD)</th>
<th>Difficulty Range</th>
<th>Confidence Mean (SD)</th>
<th>Confidence Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) What the therapist SAYS</td>
<td>6.5 (2.1)</td>
<td>1.3-10.0</td>
<td>6.3 (2.3)</td>
<td>0.9-10.0</td>
</tr>
<tr>
<td>B) What the therapist DOES</td>
<td>7.5 (1.7)</td>
<td>1.9-10.0</td>
<td>7.8 (1.6)</td>
<td>3.0-10.0</td>
</tr>
<tr>
<td>C) How Practice IS Organized</td>
<td>7.4 (2.4)</td>
<td>0.7-10.0</td>
<td>7.0 (2.6)</td>
<td>0.7-10.0</td>
</tr>
</tbody>
</table>

The mean (SD) session video length was 34.0 (6.8) minutes (range 21.0 to 53.0 min). The total mean time to rate a video was 77.1 (27.3) minutes (range 40 to 160 minutes). There was no difference within each rater when comparing time taken to rate the same video the first and second time (mean difference = -4.3 minutes, p=0.28), or when comparing time taken to rate the same video between its two raters (mean difference= -2.5, p=0.77). There was a significant relationship (maximum r=0.97, p<0.01) between the ease of scoring and the confidence in rating. While there was no association between the time required to rate a video and the MLSRI-20 total score (maximum r=0.16, p=0.12), there was a weak inverse relationship between the time to rate a video and the ease of rating or confidence in rating (maximum r = -0.35, p<0.01).

There was no association between MLSRI-20 category A scores and rating difficulty or confidence of rating. There was a weak inverse relationship between MLSRI-20 category B or C scores and rating difficulty or confidence (maximum r = -0.36, minimum p<0.05).

Comments on the MLSRI-20 Feedback Form highlighted the challenges encountered when rating the videos, which were separated into two categories: video-related and measure-related challenges. Video-related challenges included difficulties distinguishing between the verbalizations of the PT, the PT assistant, and the caregiver, as well as the interference of background noise. Measure-related challenges included difficulty categorizing verbalizations and distinguishing between tasks within the intervention (Table 3.4).
Table 3.4- Summary of PT rater comments on the MLSRI-20 Feedback Form

<table>
<thead>
<tr>
<th>MLSRI-20 Category</th>
<th>Number of comments</th>
<th>Most Frequent Comment(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) What the Therapist SAYS</td>
<td>20 (out of 30 videos)</td>
<td>Difficulty hearing what the PT was saying = 9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Difficulty distinguishing between instructions and feedback = 6</td>
</tr>
<tr>
<td>B) What the Therapist DOES</td>
<td>11</td>
<td>Difficulty scoring item 13 (Provides environment where errors are a part of learning) = 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Difficulty determining how much physical guidance (item 12) the Lokomat was providing = 3</td>
</tr>
<tr>
<td>C) How Practice IS Organized</td>
<td>9</td>
<td>Challenging to determine what the tasks were within the session = 4</td>
</tr>
</tbody>
</table>

3.4 Discussion

3.4.1 Reliability

The estimated inter- and intra-rater reliability of the MLSRI-20 total score was within acceptable limits (ICC= 0.78 and 0.89, respectively), as per a priori targets outlined in 3.2.3.4. MLSRI-20 profiles should continue to be interpreted with caution when scoring is completed by different raters, as the measure demonstrated good, rather than excellent, reliability. Additionally, the targeted lower bound of 0.60 for the 95% CI was not achieved for inter-rater reliability, i.e., estimated value was 0.53, and the CV for the inter-rater calculations was slightly higher than the targeted 10% (11.8%). Because the MLSRI-20 is an assessment tool and not an outcome measure (i.e., it is not designed to measure changes in use of MLS), this extent of inter-rater scoring variation was deemed acceptable by the investigative team.

As expected, inter- and intra-rater reliability of category scores and individual items was lower than for the total scores. Individual items with ICCs less than 0.30 were examined to determine if item descriptions should be expanded upon to improve rater consistency (i.e. eight items for inter-rater and two for intra-rater). This was particularly noticeable in the ‘What the therapist SAYS’ category in the inter-rater results. While some of these lower ICCs can be attributed to a low frequency of observation across the sessions (e.g., items #8, 10, 14), others identify the need
for clarification within the MLSRI-20 Instruction Manual (e.g., items #2, 3, 6, 12). These ICCs should be used in combination with the PT rater feedback (discussed below) to improve MLSRI-20 training and decrease measure-related reliability challenges. In the meantime, the MLSRI-20 can be used in its current form to rate MLS use within physiotherapy interventions for children with CP by PTs who have completed MLSRI-20 training.

3.4.2 MLSRI-20 scoring and rationale for use of motor learning strategies

The MLS most frequently observed in the videos were: #1- Encouragement, #5- Feedback related to movement performance, #12- Provides physical guidance, #16- Repetitive, #17- Whole, #18- Variable, and #20- Progressive. While there is limited empirical evidence specific to the use of individual MLS in pediatrics (91), the frequency of these MLS is not a surprise given the clinical presentation and age of the study sample. Encouragement is important to keep a child engaged in the intervention, which is necessary for active participation and promoting ML (18, 38, 40). Addressing quality of movement can be linked to a child’s activity-based goals, as improving movement efficiency and automaticity can lead to increased function. Physical guidance is an alternate form of instruction/feedback to verbalizations (56), which can be beneficial for children with decreased ability to process information due to age or cognition. Because of the presence of sensorimotor challenges in children with CP, physical guidance is often required to clarify errors in movement patterns (46). Practice structure items #16, 17, 18, and 20 are practical ways to enable each child to acquire the amount of practice required to learn a new motor skill while making the intervention both meaningful and engaging. Variable and progressive practice of tasks keeps the child interested in the activities while continuing to work toward their ML goals (67). Finally, whole practice of a motor skill combines the components of a skill and is an effective way of achieving functional goals in children who have not reached neural maturity (70).

Items observed less frequently were: #4- Asking, #8- Feedback related to what was done poorly, #10- Mental practice, #14- Recommend practice outside of therapy, and #15- Education. There are several possibilities for both the decreased frequency of use and narrow scoring ranges of these items. Encouraging a child to problem solve requires a certain level of cognitive ability. Therefore, ‘asking’ (item #4) questions may not be an appropriate MLS for children with decreased information processing capacity. Even in situations where ‘asking’ is seen as a viable
MLS, the treating PT may also decide to use ‘telling’ feedback to explicitly reinforce the child’s problem-solving strategy. As a result, the extent to which ‘asking’ occurred was offset in the overall scoring by the presence of confirmatory ‘telling’ feedback. When working with children, focusing on the negative aspects of their performance can be frustrating and result in decreased engagement in physiotherapy intervention. Therefore, it is reasonable that ‘feedback related to what was done poorly’ (#8) was observed less frequently than focusing on the aspects of the task that had been ‘done well’ (#7), or simply by providing the specific feedback the child needed to correct a task (#5 and 6) without focusing on success or failure.

While evidence supports using ‘mental practice’ in children with CP (55), this MLS (#10) was rarely observed. The dynamic nature of the Lokomat may have limited opportunities for mental practice because it cannot occur while the child is moving (53). Other reasons for not using mental practice could include a lack of PT training with the MLS or the PT’s clinical decision that the MLS is not appropriate for a specific child. The interpretation of decreased use of ‘recommending practice outside of therapy’ (#14) and ‘providing caregiver education’ (#15) is less obvious. Because these videos were from a research study rather than typical clinical intervention, the PTs may have focused less on the aspects of therapy that continue beyond the two interventions each week. However, there may have been additional unknown factors related to the child or parent that led to the PT prioritizing other MLS.

3.4.3 Instrument utility and measure-related challenges

The use of video observation to rate clinical interactions in pediatric rehabilitation is not novel (22, 92). It requires the rater to make inferences regarding the situational context of the observed actions, which introduces observer bias. There were several challenges reported by the PT raters when using the MLSRI-20, based on the limitations of video observation and interpreting PT and child behaviours.

Aligning with the lower individual ICCs, the PT raters indicated they had the most difficulty rating and the least confidence in Part A ‘What the therapist SAYS’. They reported that it was easier to score interventions with fewer verbalizations while rating interventions with increased verbalizations was more challenging. Ratings became increasingly difficult when multiple people were present (e.g., PT, PT assistant, parent) and the rater had to distinguish between what the PT said, and comments made by other people in the room. The PT rater must unpack the
content and context of each verbalization as it can often apply to several items within the MLSRI-20 (e.g., “you are not straightening your knee enough” would be rated as ‘telling’ rather than ‘asking’, feedback related to ‘movement performance’ and ‘what was done poorly’). These complexities might have led to oversights, confusion, or indecision.

Other challenges identified included: not being able to determine how to count repeated verbalizations as they did not always seem to be for ML purposes; determining when a brief verbalization (e.g., “stand tall”) was actually a MLS and not a verbal cue; and how to distinguish between instruction and feedback when a verbalization occurred during a task. While the instruction manual provides direction for these challenges, there is opportunity to expand upon the instructions and make use of video examples to improve understanding of the scoring rules. The addition of video scoring examples to the MLS Online Training Program would guide PT raters through the observation and scoring process in a systematic manner and may clarify some of the scenarios that are difficult to capture in the written MLSRI-20 Instruction Manual.

The PT raters identified Part C (How ‘Practice IS’ organized) as the next most challenging category for rating ease and confidence. Raters’ comments suggested that determining what constitutes a “task” within the intervention may be the reason for their uncertainty. Discrepancies between PT raters when delineating the tasks within an intervention will affect how items #16-20 are scored. The current definition of “task” in the MLSRI-20 Instruction Manual states that a task “refers to a therapy-based activity that has a beginning, middle, and end”. It also indicates that a single task can consist “of a number of motor skills” that can be “functional” or “therapeutic” in nature. The instructions ask the PT rater to consider the context and the focus of the therapist’s verbalizations when deciding if a change in the observed task is a variation on the task or an entirely new task. As a result, the PT’s clinical judgement and experience can affect how she delineates a task. There is opportunity to clarify the tasks by having the treating PT complete an intervention log for the recorded session that outlines task, task variations, and task order.

Finally, because the MLSRI-20 is an assessment that measures observed MLS, an independent PT rater is not aware of the treating PT’s clinical decision-making behind the MLS used. In this study, the PT rater did not know if the MLS was applied with intent, nor were they aware of the child’s physiotherapy goals or responses to MLS in previous interventions. As a result, PT raters had to interpret what they observed based on their own clinical experience. Despite attempts to
clarify the rating process in the MLSRI-20 Instruction Manual and during in-class training sessions, there will always be clinical scenarios that cannot be accounted for in an objective measure. However, based on the comments of the PT raters, there are some explanations within the Instruction Manual that can be clarified. Finally, while it was not the focus of this study, the MLSRI-20 could also be used for self-reflection by the treating PT in the video. It is assumed that challenges related to interpreting clinical decision-making would be eliminated if the MLSRI-20 is used clinically for self-reflection.

3.4.4 Study limitations

As with all psychometric evaluation studies, the estimates of reliability only pertain to the study sample and treatment setting/approach (89). However, the investigative team aimed to create generalizable results by using more than one PT rater pairing and by involving PT raters from a variety of clinical backgrounds. Despite attempting to screen for video quality, the use of a video-recorded physiotherapy intervention continued to create limitations for evaluating MLS, namely with difficulties hearing PT verbalizations. However, video rating is a requirement for the MLSRI-20 as the observation and scoring procedures are too complicated to be completed in real-time (6), and occasional video quality issues will be a part of the scoring, particularly with clinical use where there is less control of the video-recording process than in research. PT raters were encouraged to stop the video to record their observations and rewind as needed to clarify MLS use when multiple MLS are used simultaneously. Since audio challenges will presumably affect all PT raters equally, the impact on the reliability of the measure should be minimal.

While the use of the MLS Online Training Program gave the PT raters a means of reviewing the definitions of the 20 MLS throughout the study, they only had a hard copy of the MLSRI-20 Instruction Manual for the scoring rules. Given the variety of clinical nuances associated with scoring the instrument, access to an online module with video examples specific to using the MLSRI-20 might have been advantageous for the PT raters to review as needed, and has potential to improve rating accuracy and consistency.

Finally, the MLSRI-20 takes a complex construct, and through a combination of observations and clinical judgment by the PT rater, converts observations into objective measurements. Other clinical measures used in physiotherapy intervention for children with CP (e.g., Gross Motor Function Measure (93), the Hypertonia Assessment Tool (94)) also require a combination of
observation and clinical judgment by the assessing PT. However, these clinical measures are conducted as a live assessment and the assessing PT can clarify information in the moment, while the MLSRI-20 is rated by an independent PT based on video observation. With this video-rating, the treating PT’s clinical decision-making or intentions when using an observed MLS are not available for consideration by the rater.

These factors coupled with the individual treatment styles of PTs and the unique characteristics of each child can create ambiguous situations that cannot always be clarified by an instruction manual. Despite these limitations, the MLSRI-20 has strong potential to fill a notable void in documenting and understanding ML-based physiotherapy interventions.

### 3.4.5 Future directions

There are both clinical and research implications of this study. The rater feedback data collected in this study will inform the content of a separate module within the MLS Online Training Program specific to using the MLSRI-20, which will ensure that future users receive comprehensive, standardized training. The use of MLSRI-20 ratings in combination with video-stimulated recall will allow for further analysis of PT clinical decision-making. The MLSRI-20 can be used as a framework for clinicians to reflect upon MLS in their interventions and describe them to clients and families. Comparing the reliability of the MLSRI-20 when used for self-reflection (i.e., the treating PT in the video rates their own intervention) with the results from independent raters may further clarify areas where the assessment can be improved. The MLSRI-20 can also be used to identify and compare ML content in future intervention-based studies for children with CP. Evaluation of the reliability and validity of MLSRI-20 in different allied health professions (e.g., occupational therapy, speech language pathology) who provide motor skills based therapeutic intervention may support the expansion of the assessment into a multidisciplinary tool.

### 3.5 Conclusions

In summary, the inter- and intra-rater reliability of the MLSRI-20 total score falls within acceptable limits for use in clinical and research practice when the PT rater has undergone standardized, comprehensive training. This study contributes to both research and clinical practice by providing a reliable means of documenting ML content within physiotherapy
intervention for children with CP. The MLSRI-20 can provide a framework for clinicians to reflect upon ML in their practice. The consistent use of the MLS language outlined in the MLSRI-20 will support more effective communication between healthcare professionals, children, and their caregivers in relation to the ML content within an intervention.

### 3.6 Acknowledgments

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Chapter 4

4 Exploring physiotherapists’ use of motor learning strategies during gait-based physiotherapy interventions for children with cerebral palsy: comparing traditional physiotherapy with Lokomat® robotic-assisted gait training

4.1 Introduction

Children with CP demonstrate varying motor, sensory, and cognitive deficits, which affect their physical function and participation in activities of daily living (5, 24, 47, 48). While the brain lesions causing CP do not progress with development, physiotherapy interventions can enhance experience-dependent neuroplastic changes to optimize motor function (1). ML is the acquisition of a motor skill, achieved through practice, which can be transferred to new learning situations (3). ML principles are the evidence-based statements that guide how variables within a motor skill can be manipulated to promote the acquisition and transfer of motor skills (6). These principles can be applied in physiotherapy intervention using MLS (40, 95, 96), the observable actions of the therapist involving the selection, manipulation, and application of ML variables during intervention, based on client- and task-specific factors (6). PTs employ MLS with the ultimate goal of helping children with CP transfer newly acquired skills to use in daily activities. As such, understanding the types of PT interventions that most effectively promote the neuroplasticity underlying ML is a key priority in order to optimize time spent in therapy and enhance functional outcomes (24).

The past decade has witnessed the integration of technology-based treatment approaches in pediatric physiotherapy, including the use of virtual reality (VR) and active video gaming (78), functional electrical stimulation (79), and robotic-assisted gait training (68). New technology-based approaches to physiotherapy often claim to be superior to traditional physiotherapy intervention because they purport to strongly align with evidence-based ML principles. For example, VR provides abundant practice dosage and multisensory feedback in an enriched environment, while robotic-assisted gait training combines task-specific, repetitive practice with increasingly active involvement through the adjustment of body weight support and guidance.
factors (68, 78). However, studies evaluating technology-based interventions typically fail to measure whether the purported ML-content is the key ‘active ingredient’ associated with its effectiveness (i.e., measuring ML content alongside other functional outcome measures). They also rarely detail how key ML variables such as practice schedule and feedback/instructions provided by the therapist were delivered in the intervention protocol (68, 78, 79). As such, ML outcomes are attributed to features of the technology, and the potential impact of therapist decision-making in selecting MLS to exploit these ML outcomes is overlooked (68, 78).

While MLS can be used in any physiotherapy intervention where ML is a goal, it is unknown whether certain treatment approaches or characteristics of a child or therapist lend themselves to the use of specific MLS. Although the importance of the interaction among the child, the PT, and the technology is recognised (77), the connection between MLS use and treatment approach could be better understood if the clinical decision-making process during physiotherapy intervention is examined from the PT’s perspective. The desire to understand MLS use within PT interventions led to the creation of the Motor Learning Strategies Rating Instrument (MLSRI-20) which measures the extent to which 20 MLS, within three categories (What the Therapist SAYS, What the Therapist DOES, How Practice IS organized), are used within a video-recorded treatment session (Appendix B). However, the MLSRI-20 does not indicate the PT’s intentions when using specific MLS nor does it explain the clinical decision-making process that accompanies their selections. Further, while there is a theoretical link between physiotherapy goals for children with CP and ML theory, studies suggest that PTs may not be intentionally applying MLS in their interventions (9, 10). Consequently, one cannot assume that the observation of MLS indicates the intention to use MLS.

To complement the objective measurement of MLS use via the MLSRI-20, it is important to examine the clinical decision-making process by speaking with the PTs providing the intervention. This consultation is required to better understand how the clinical decision-making process informs use of MLS and to determine if observation of specific MLS application coincides with the treating PT’s intentions. Thus, the focus of this study was to explore how PTs use MLS in traditional gait-based physiotherapy and physiotherapy intervention using the Lokomat® robotic-assisted gait trainer for children with CP. By exploring MLS selection within these two treatment approaches, it is possible to not only identify differences in MLS use based on a PT’s preference and the child’s characteristics, but also to determine if the treatment
approach influences MLS use. If the treatment approach affects MLS use, there is potential to specify how the Lokomat differs from traditional gait-based physiotherapy intervention from a ML perspective.

4.2 Research question and objectives

The primary purpose of this study was to explore the decisions and experiences related to MLS use in motor skills-based physiotherapy interventions for children with CP. There were three objectives:

1. Describe how a child’s individual characteristics affects how a PT uses MLS.
2. Explore how a PT’s preferences influences the use of certain MLS within their interventions.
3. Compare PTs’ clinical decision-making when choosing MLS during traditional physiotherapy intervention with intervention using the Lokomat.

4.3 Methods

This qualitative study was conducted using a descriptive approach within an interpretivist paradigm (97). ‘Interpretive description’ in healthcare is a qualitative research approach that allows the researcher to gain an enhanced understanding of clinical situations and promotes the development of clinical practice (97). Eight PTs, who provided motor skills-based intervention to children with CP within one of three Lokomat studies at Holland Bloorview, participated in individual, semi-structured interviews with J Ryan.

4.3.1 Participants and sampling

Study participants were recruited from a team of treating PTs who worked in one of three Lokomat clinical trials for children with CP at Holland Bloorview. Children participating in the Lokomat studies varied in age from six to 17 years and had a diagnosis of CP and GMFCS (34) levels of I through IV. There was a range of inclusion criteria and treatment protocols across the three studies. However, all children received twice weekly intervention from two PTs for at least one eight-week block of Lokomat intervention, traditional gym-based intervention, or a combination of the two. Videos were recorded in at least two of the child’s treatment sessions. The Research Ethics Boards at Bloorview Research Institute and University of Toronto approved the study protocol (Appendix I). Written consent was obtained from the parent and child before
video clips from a child’s Lokomat study videos were used in an interview (Appendix J).

Eight of the 20 Lokomat study PTs were recruited using maximum heterogeneity sampling, which aims to capture the diverse range of characteristics within a population (98). In each study, PTs were encouraged to use an individualized ML approach based on their clinical observations within every treatment session. They received a brief one-hour training session prior to the first study (by Lokomat primary investigator) and a more intensive three-hour MLS training session midway through the various studies (by J Ryan). The PT characteristics considered during recruitment included experience working in pediatric physiotherapy and experience treating children in the CP Lokomat studies at Holland Bloorview. Inclusion criteria for participants was being a PT with at least three months of experience working in one of the Lokomat studies. All PTs provided written consent prior to participating in the interview (Appendix K).

There is no established sample size for qualitative studies (98), however in studies that use semi-structured interviews, an appropriate number of participants (N) can be guided by information power (IP) (99). IP is appraised by examining five dimensions: the study aim, sample specificity, use of established theory, quality of dialogue, and analysis strategy (99). The following factors contributed to high IP within the current study and, thus permitted a smaller sample size: the study aim was narrow, the sample specificity was dense, and the investigative team made use of an established MLS model (6)(Figure 4.1). The quality of the dialogue and analysis strategy were conservatively estimated to be moderate. In the literature, sample sizes for qualitative studies exploring the clinical perspectives of PTs have varied from six to 12 PT participants (100-105). The studies with a greater N often had lower sample specificity and broader study aims, thus lowering their IP and requiring a larger N than the current study (101-103).
4.3.2 Data collection

Semi-structured interviews (approximately 60 minutes in duration) were conducted with each PT participant, with the aim of obtaining a range of perspectives on MLS use (106). The interviews began with inductive questioning regarding the PT’s clinical decision-making during the traditional gym-based and Lokomat treatment sessions, and finished with the interviewer guiding the PT to reflect on the effectiveness of her teaching strategies in up to two 3-minute video clips recorded from her treatment sessions within the study. The number of video clips used in each interview depended on whether informed consent was received from the child to include their videos in this study and the availability of video footage for each PT. While two PTs worked with each child in the Lokomat studies, both video-recorded sessions may have involved only one of the two PTs, resulting in some PTs with limited videos to choose from. Each video clip was a tailored compilation, created by J Ryan, of the interviewed PT providing treatment to a single child in the gym and/or in the Lokomat. The clips included several tasks and several MLS. The clips were tailored based on the iterative data collection and analysis process, whereby J Ryan reviewed the videos of the treatment sessions with a specific PT and child and selected MLS that appeared to be representative of the treatment session. A range of MLS use was integrated as much as possible within the clips, including MLS that were frequently and infrequently discussed in previous interviews. Efforts were also made to include what appeared to be effective and ineffective MLS use, as well as differing levels of child engagement and behaviour.

The interviewer avoided biasing the PTs’ responses towards specific MLS by structuring interview questions and subsequent probing questions to be open-ended rather than targeted (107) (e.g., by referring to “the things you do/say to teach children” rather than “the MLS you
use to teach children”). The open-ended questioning prevented over-reporting of MLS use and allowed PTs to express their views using their preferred vocabulary. Reflection on the various MLS the PTs used in the video clips involved inductive questioning and probing. PTs were permitted to comment on anything they observed in the video clip or other scenarios they recalled when working with the child from the video. The Interview Guide is included in Appendix L. Upon completion of each interview, the interviewer completed field notes to summarize the interview process.

4.3.3 Data analysis

The interviews were audio-recorded and transcribed by J Ryan. Primary coding took place after each interview, using NVivo 8.0. The first three transcripts were independently coded by J Ryan and a RA and then compared to ensure consistency of coding. The remaining transcripts were either coded by the RA or J Ryan. Study investigators had access to the de-identified transcripts to gain familiarity with the interview content and enable discussion in the team data analysis meetings. Three data analysis meetings with the study team took place across the analysis period, where the investigators and RA reviewed coding, categorizing, and analysis to date. These meetings occurred after the third, sixth, and eighth interviews. Data analysis consisted of fragmenting (where coded pieces of data were lifted out of the context of the interview) and connecting (the ordering of identified themes in such a way that they aligned with the research questions) (108). Directed content analysis began with data coding using a more deductive approach (107) where all instances of specific MLS were highlighted and coded with predetermined MLS categories from the MLSRI-20 (Table 4.1). Any text that could not be categorized within the predetermined categories was identified and coded using inductive category development (107). Analysis of new codes allowed possible expansion beyond the current theoretical framework for MLS.
Table 4.1- MLSRI-20 item description used as initial framework for directed content analysis (7).

<table>
<thead>
<tr>
<th>MLSRI-20 Category</th>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>What the therapist SAYS</td>
<td>1</td>
<td>Encouragement</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Instructions direct attention to object/environment</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Instructions direct attention to body movement</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Problem solving involves asking (rather than telling)</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Feedback relates to movement performance</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Feedback relates to results</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Feedback relates to what was done well</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Feedback relates to what was done poorly</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>Link activity being practiced to other activities</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Encourages mental practice</td>
</tr>
<tr>
<td>What the therapist DOES</td>
<td>11</td>
<td>Uses demonstration/modelling</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>Provides physical guidance</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>Provides environment where errors are part of learning</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>Recommends practice outside of therapy</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>Provides education to client/caregiver</td>
</tr>
<tr>
<td>How Practice IS organized</td>
<td>16</td>
<td>Repetitive</td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>Whole (rather than part)</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>Variable (rather than constant)</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>Random (rather than blocked)</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>Progressive</td>
</tr>
</tbody>
</table>

As the data set expanded, analysis occurred within and between interviews, using a modified constant comparative method (CCM) (108). While the CCM is typically used when there are two different interview groups (108), and this study had just one PT group, there were two types of intervention that may be linked to different MLS. A modified CCM allowed comparison within and between PTs, within and between the two treatment approaches, and within and between the children participating in the interventions. Analysis via modified CCM occurred using a four-step process, which acted as a coding manual: 1) comparison within a single interview; 2) comparison between interviews, without distinguishing between the types of intervention; 3) comparison between interviews, focusing within each type of intervention; and 4) comparison
between and within children being treated. These comparisons strengthened the internal and external validity of the study findings (108). Analysis was considered complete once the team had considered all alternative explanations, and the resultant themes were consistent and defensible (77).

4.4 Results

4.4.1 Demographics

Eight PTs with varying levels of experience were interviewed over a five-month period. The level of experience in pediatric physiotherapy was set a priori as: high = greater than 8 years, moderate = 3-8 years, and low = less than 3 years. The level of Lokomat study experience was defined as: high= greater than 2 years, moderate = 1-2 years and treated 4 or more children in the study, and low = less than 1 year or treated less than 4 children in the study. Five PTs had high experience in both pediatric physiotherapy and the Lokomat studies. One PT had low pediatric and high Lokomat experience. One PT had a high pediatric and low Lokomat experience. One PT had low experience both in pediatrics and the Lokomat. Seven of the PTs had pediatric physiotherapy experience with children in community-based settings (e.g., home, school), four had experience in outpatient children’s treatment centres, and four had experience in inpatient pediatrics. Six PTs had two videos to reflect upon during the interview, one had one video to reflect on, and one had no videos.

4.4.2 Themes

The three themes that developed in the data analysis illustrated PTs’ decisions and experiences with use of MLS in motor skills-based interventions for children with CP. They were: 1) the factors influencing MLS use; 2) the differing vocabulary to describe ML content; and 3) the Lokomat is “the same but different”. In the illustrating quotes that follow, the names used to identify the PTs are pseudonyms.

4.4.2.1 The factors influencing motor learning strategies use

There were numerous elements described during the interviews that influenced how the PTs selected and used MLS, and these could be attributed to four distinct factors (Figure 4.2).
Figure 4.2 - The factors influencing MLS use in pediatric physiotherapy intervention

‘Static factors’ relate to the child and therapist characteristics that remain the most stable or relatively unchanged in the immediate future (e.g., across an 8-week block of treatment). Child characteristics include the child’s physical presentation, cognitive abilities, age and/or developmental stage, learning style, behavioural attributes, personality, and interests. Therapist characteristics include their preference for a particular MLS, teaching style, professional training, and clinical experience. Alex reflected upon the influence of her clinical experience and professional training and its impact on her comfort using specific MLS.

“… I think some of the [PTs] have taken different courses. Some of them have been practicing in different environments… I’m not as familiar with some of those techniques or in the case of demonstration, sometimes, I just want to see how the child moves first or how they might perceive my instructions so I can figure out if I’ve mislead them with an instruction or I need to change what I’m saying. And, I think there’s value in having them figure out a task or a movement strategy on their own prior to influencing them.” (Alex)

Gabrielle reflected on her exposure to the MLS used by her occupational therapist colleagues and described how this influenced her clinical practice.

“I work alongside some OTs and I think… they’re really good at [the] CO-OP approach of, like, Goal-Plan-Do-Check… before starting, making a plan and then having them try it, waiting for them to... give the feedback on ‘how did that go’. So I think with the older kids that are more cognitively aware, I do try to take a step back sometimes and let them,
kind of, make the decision of ‘how did that go?, ‘how can I improve?’, versus immediately putting my… spin on it.” (Gabrielle)

The PTs indicated that the child’s characteristics ultimately had the strongest influence on how they chose and used MLS during an intervention. However, their awareness of the child’s characteristics was not always immediate and often developed over time, as the PT gained experience working with the child. Brigette discussed how she learned to engage a child in intervention by tapping into their interests. She emphasized that this aspect of decision-making involves a certain degree of conjecture rather than specific clinical knowledge.

“[It’s] trial and error... see what sparks them, see when they start to pay more attention to what I’m saying, see what their language is and what they want to talk about. I really watch and listen and try to go with their lead so that I’m talking about what they want to talk about. And then I say what I want to say but within their topic or [within] their ability to understand.” (Brigette)

The PTs also discussed having to interpret the child’s status in different situations based on verbal and nonverbal communication. Through the course of an intervention block, they drew upon this expanding knowledge of a child’s characteristics to optimize opportunities for ML. Tessa discussed how she became more aware of a child’s learning style and how he communicated as they worked together. In turn, the child also became aware of her teaching style.

“When you start working with the kid for a longer period of time… you might find that you are more in-tune with the child and it’s easier to get your messages across, because you know how to communicate… Developmentally, you need to be appropriate and once you… know the patient, different patients have different styles, different physios have different styles, so I think there is a process that we understand each other and the communication will become more effective and faster.” (Tessa)

The ‘dynamic factors’ affecting MLS choice and use refer to aspects of the intervention that are likely to change over a number of sessions. These factors are based on the overall goals of the child and family coupled with the PT’s clinical decision-making with respect to these goals, the environment(s) in which the intervention takes place, the equipment available, and the
therapeutic rapport that develops between the child and therapist. The PT determines how the child responds to MLS by observing his/her performance, understanding, engagement, and motivation across the sessions. Brigette discussed the need to continually adapt the MLS she uses based on the child’s changing abilities.

“… our starting point changes each time, as they can do more and more. So my verbal cues or my physical cues might change as they do more difficult things or they need less help with the previous things.” (Brigette)

Laurie described how a child’s stage of learning affects the clinical decision-making process, particularly when determining the appropriate practice environment and level of task difficulty.

“…if it’s a very, very difficult skill that’s just only very newly emerging, then [I]… create a very safe and controlled environment, and have lots and lots of repetition, in sort of one environment. And then as they learn and grow in that specific skill, then to add some variety, add some difficulty, and then change the setting so that it’s a bit more real-life, so to speak, or closer to the context that it’s most appropriate or applicable for them.” (Laurie)

The ‘proactive factors’ affecting MLS use refers to how the PT prepares for a single treatment session. During this stage, the PT considers both static and dynamic factors while developing specific goals for the treatment session. Reflection on the child’s past responses to MLS affects which tasks and MLS the PT plans to use in the upcoming session. In addition to reflecting upon their motor performance, the PT must also consider the child’s motivation and engagement intervention, and consider how to facilitate ongoing active participation in the next session. Justine discussed how the child’s engagement and motor performance influences how she varies and progresses tasks in subsequent sessions.

“[I] think about what we did during the last session and hopefully, you know, you’ve seen some changes in what they’re doing. And so I’m thinking about, well, how can I progress along the activities that we were already doing to kind of challenge them further… to continue to make progress?… If they’re bored with certain activities or they’re really not that interested in them, then I’m, you know, coming up with different ideas to get them to do those activities. If they’re really struggling with a specific
activity… I’m going to focus more on that in different contexts, in different activities...”

(Justine)

The ‘reactive factors’ that influence MLS use seem to be the least stable of the four factors and refer to the immediate responses of the PT within the treatment session. These clinical decisions are based on visual and auditory observations, as well as the tactile feedback the PT receives from the child. In addition to assessing physical performance of the motor skill, the PT is also analysing the child’s behaviour, engagement, and motivation in the moment. These factors may be the most used as they are context-specific and highly dependent upon the child’s actions and reactions to the MLS within the session. Kim discussed how proactive planning must be adapted in the moment based on the child’s actions and reactions in the session.

“I like to have that set treatment plan but what happens in a session... is somewhat directed by the kid... I have to react to everything they’re feeding me.” (Kim)

Laurie described her thought process when determining the source of child’s motor performance difficulties during a treatment session. She described how her teaching strategies and the child’s learning needs factor into MLS selection.

“Sometimes it works. Sometimes it doesn’t work. And when it doesn’t work, then I have to find out why it didn’t work. Did they not understand? Were they not watching? Is it too hard? Do they physically need me to have their body do it so they feel it?” (Laurie)

Brigette explained the fluid nature of the ‘reactive factors’ as the ongoing process of how she juggles the child’s interests and engagement with her clinical objectives for a younger child who can be challenging to motivate.

“It’s a little bit of a dance with him. Keep him engaged. Give him a little bit what he wants, get a little bit of what I want, and play with that the entire [session].” (Brigette)

4.4.2.2 The differing vocabulary to describe motor learning content

Directed content analysis allowed an in-depth examination of how the PTs discussed MLS use in relation to the 20 MLS within the MLSRI-20. However, the nature of the inductive questioning during the interviews let the PT describe their clinical decision-making using their own
vocabulary when talking about “the things they did or said to teach children motor skills”. When the PTs described their decision-making, “motor learning” was mentioned nine times in just three of the eight interviews while “motor learning strategies” was mentioned four times in only two of the three interviews that discussed “motor learning”. Instead, the PTs had their own way of describing ML and MLS, and typically used terminology such as “carryover”, “translate”, and “integrate” instead of ML or MLS. While the MLSRI-20 categorizes MLS as: A) What the therapist SAYS, B) What the therapist DOES, and C) how the Practice IS organized, the PTs described their teaching methods using a different framework and terminology.

The PTs focused initially on the task and session organization when asked to describe their teaching approach. Prior to the session, they planned at least a few of the tasks they were going to work on, but they did not consciously plan ‘how’ they were going to teach the child in the session (i.e., what they would ‘do’ or ‘say’). When asked how they would introduce a task, they indicated that they adjusted their instructions and actions based on the child’s responses. For example, they typically started a task with verbal instruction and then augmented the verbalization with a demonstration of the task and/or physical guidance through the task, depending on the child’s characteristics and his/her initial performance of the task. They discussed rewording verbal instructions and feedback based on the child’s performance, understanding, and engagement.

All of the PTs discussed ‘variable’ and ‘progressive’ practice of tasks either within a session or from one session to the next, using the terms such as “vary”, “different”, “change”, “challenge”, “increase”, and “progress”. They also described having the child actively involved in the intervention. They would “adjust” or “modify” their verbalizations, amount of assistance, and task demands to build the child’s confidence before increasing the level of challenge of a task. They discussed the requirement of working on meaningful tasks that had a level of challenge allowing for a certain degree of success in order to maintain child engagement and motivation during each session and from week to week.

The PTs emphasized different aspects of the task when discussing their approach to treatment, including: which tasks lent themselves to being able to work on the components of a motor skill versus practicing the skill in its entirety; how much task order influenced the intervention; and the importance of describing to the child how a task would help them work toward their goals.
While not all PTs emphasized having the child actively problem-solve during task performance, those who did discussed the importance of the child’s cognitive abilities when determining if ‘asking’ the child questions was more appropriate than directly providing feedback.

The PTs often categorized their feedback as “verbal”, “tactile”, or “visual” rather than discussing the content in greater detail (e.g., positive or negative feedback).

Gabrielle: “… typically I’d kind of make that change right away, whether that looks like giving less feedback, giving more feedback, giving more tactile cues, giving more verbal cues…”

Kaillie: “… usually I use verbal instructions and verbal feedback. If I find that it’s not working... I tend to go to tactile stuff... and then I’ll use the visual.”

At times, the PTs used the same words to discuss the same concepts, while other times they used the same words to describe different concepts. “Visual” was used to convey multiple concepts, including:

1) Directing attention to an object (use of an external focus of attention): “Rather than saying ‘take a big step’... we put a toy there so that his knee can come up to the toy... so there’s something visual for him to target.” (Tessa)

2) Demonstrating a task: “… so some children do better with that visual demonstration and I have others who don’t like the visual… processing all that visual information is very challenging for them and often makes them more confused.” (Alex)

3) Use of a mirror for the child to observe their performance: “I try to use visual cues as well... if it’s an activity they can do in front of a mirror... I do try and give that visual feedback for them as well, so it’s not just me describing...” (Justine)

The PTs also discussed “breaking down” a task within two distinct contexts:

1) Part practice instead of whole practice: “When I usually first introduce [a complex skill] … I like to break it down into very small manageable steps and maybe only work on those few beginning steps before looking at the whole picture.” (Gabrielle)
2) When asking a child to problem solve through a motor skill: “So for the really high functioning kids… I can sort of break down the emphasis and be like, ‘okay, why do you think you didn’t do as well this time as you could have?’, and sort of break down the exercise and sort of come up with, like, the problem solving and how to sort of improve it for next time.” (Kim)

They also used different terminology to describe the use of physical guidance including “tactile”, “support”, “assistance”, “hands-on”, or “facilitation”. Physical guidance was used both as a form of instruction and feedback, and it could be varied to increase or decrease the level of challenge.

Tessa: “So you see a lot of hands-on that you need to put him through so as to make him understand what this is all about.”

Laurie: “He was a little bit more cognitively delayed, uh, and so very, very simple and tactile cues… were much more effective than me trying to use words to describe what I was hoping for. So mainly it was visual or tactile cues that really helped him. So there were times we would put the mirror in front of him or have the [computer] screen in front of him and, like, the smiley faces [Lokomat biofeedback] were very readily comprehended…”

Kim: “I often start with hands-on facilitation and sort of move away to less support.”

Brigette: “…take away some of my support… have them do an activity without any guidance… take away assistance if I used to provide assistance or vary my amount of assistance.”

Finally, mapping the approaches the PTs discussed onto the MLSRI-20 framework revealed that each of the following MLS were only spontaneously mentioned once across all eight interviews, by different PTs: recommending practice outside of therapy; mental practice; providing child/caregiver education; and use of random practice order. The MLS in the MLSRI-20 that were not directly discussed during the interviews were: ‘providing an environment that encourages errors’ and ‘linking an activity practiced in therapy to another activity’. There were also several MLS discussed that were not specifically captured by any of the items in the
They were ‘analogy learning’, ‘visual feedback’ (particularly when it was computer-based), and ‘auditory feedback’.

4.4.2.3 The Lokomat is the same but different

The PTs indicated that using the Lokomat required taking a slightly different approach to achieve the same functional goals compared to their approach in gym-based PT. However, these differences were not unlike using various pieces of equipment available to the PT in a traditional physiotherapy session. The Lokomat was simply seen as a different modality in the line of motor skills interventions options.

“I don’t feel it’s very different in terms of the way that I do it. I feel that the Lokomat is just a different thing, right? There are the parallel bars, there is walking with a walker, there is the Lokomat… in terms of how’s the child responding, does the child enjoy this, does this help with our goals, that just goes through both [types of intervention].”

(Kaillie)

While the Lokomat has distinct properties that were factored into their clinical decision-making, the child’s primary characteristics were ‘static’ factors, and therefore many of the MLS used carried over into both types of intervention.

“[With the Lokomat], I think that I would use a lot of the same things where I would, you know, break something into its component parts and focus on those and then add them back. That I still would do. I would say that the repetition piece obviously is important, as well, and that engagement piece. I would say all those were all consistent. It was just how different a context I could make it, or how I could break down those component skills was a little bit different. I just had a little bit more freedom, I guess I would say, outside of the Lokomat.”

(Justine)

The PTs consistently reported less “freedom” regarding task options in the Lokomat compared to traditional physiotherapy.

“In the Lokomat there’s only so much you can do. Like if you want hip flexion, you need to figure out a way to get the knee up in the air, so whether it’s the knee touching my hand, knee touching the ball, or [saying] ‘lift your knee up really high’, or whatever cue it
is, it’s still just the same… continuous, repetitive motion. And then you work within that, but there is, you can only do so many movements because that’s what the Lokomat allows.” (Kim)

In addition to having fewer task options, the PTs placed less emphasis on task order in the Lokomat compared to traditional physiotherapy, which, at times, was contrary to their typical clinical decision-making.

“So, I feel like for the gym, I need to prepare the child, like I need to prepare their body… to have them feel midline and work on sitting activities or lying activities before I progress right away to stepping, standing, stair-climbing, or whatever. So, I feel like I need to go back to some basics and get them aligned and aware and still before I can amp it up and get them to move. [I’m] trying to get stability, I guess, before mobility for the gym exercises. As opposed to the Lokomat, they’re not still; they’re walking, they’re perpetually walking. So I’m trying to work on stability while they’re mobile. So it’s very different to me. It’s backwards.” (Brigette)

Fewer task options resulted in less planning prior to the intervention but, similar to traditional physiotherapy intervention, the PTs continued to focus on progressing the level of challenge.

“The Lokomat, I have to be honest, I do not plan as much…what I want to see in each of my sessions is how much I can decrease the body weight support, how I can decrease the guidance force, and how much I can increase the speed. The speed might be varying; it depends on the activities that I am doing. But my ultimate goal is if I can take off as much support as possible and get the [kids] as active as possible.” (Tessa)

The Lokomat also changed how the PTs used physical guidance to promote ML. For children with greater motor impairment, the Lokomat provided a level of physical guidance which allowed them to focus on other MLS.

“He’s pretty involved [physically] and so the Lokomat gave a lot of support and enabled us to focus [on] a little bit more isolated [movements]... it would have been nice [in traditional physiotherapy] if I had a few, maybe two more hands, just to be able to cue in, like, more effective ways.” (Laurie)
However, the PTs felt the physical guidance they provided through manual facilitation was different from the physical support provided with the Lokomat. These perceived differences led to the PTs reporting differences in how they used physical guidance between the two interventions.

“There’s far less physical hands-on for me, as a therapist, in the Lokomat because the setup itself provides so much tactile support. And there’s much more physical support [by me] in the physio sessions... When you do the hands-on sessions, you might be finessing a particular skill and providing a lot of tactile feedback to a specific limb or a specific area of their body... It’s more physical for me, working in a physio session, and it’s a little bit less physical and a bit more verbal when I’m working in the Lokomat.” (Alex)

The Lokomat provided a unique opportunity for the PTs to use augmentative feedback that was not available in traditional intervention. The child could manipulate computer-generated output in various games or biofeedback scenarios, based on activating specific muscle groups during gait. However, just as some children did not respond to visual demonstration or problem-solving through a task, the augmented feedback was not always effective. Tessa describes how one child (GMFCS IV) with cognitive challenges could not understand how to activate the computer-generated biofeedback graphs.

“…if I have the visual, the biofeedback [and I say] “give me a spike”, he doesn’t understand. He has a lot of difficulty with the biofeedback. But if you give him something concrete, that he can see and touch, and then you can generate a motor response much easier.” (Tessa)

In contrast, Gabrielle worked with a younger child (also GMFCS IV) who was extremely motivated and engaged by the computer-generated feedback. She described how his responses indicated that the computer games were a good fit for him.

“Before kind of prepping for the [computer] game, giving him the information of what it’s going to look like, what is our goal, what are we trying to do during the game… he’s clearly paying attention to what I’m saying and able to say, “oh, well how do I do that?” And so giving him all that information up front kind of preps him for the task... Let’s say if we were working on the biofeedback graphs, I tend to explain first how you’re going to
make the spike and how the spike is going to go away and once we get started, after the first few, if you give slight cueing then he’s, like, got it himself. So I think he responds really well to that kind of verbal cueing and detailed explanations.” (Gabrielle)

4.5 Discussion

The themes generated in this study overlap to address all three research objectives: describe how a child’s characteristics affect MLS use; explore how PT’s preferences influence their MLS use; and compare clinical decision-making when choosing MLS in traditional and Lokomat-based interventions. The unique characteristics of the child are at the forefront of MLS selection and clinical decision-making in physiotherapy intervention, regardless of treatment approach. These individual characteristics are also the foundation for the static, dynamic, proactive, and reactive factors that influence how a PT selects and uses MLS. These factors address the aspects of intervention that remain consistent over a block of treatment, recognize the elements that may change over time, emphasize the need to plan interventions based on the child’s goals and past performances, and acknowledge the importance of instantaneous clinical decision-making during an intervention. Awareness of these factors will permit PTs to systematically prepare for and reflect upon a treatment session, as well as identify and discuss the effects of using certain MLS with the child, their family, and other healthcare providers. The PTs discussed the importance of engagement, motivation, and interests when selecting MLS within a treatment session, reflecting their views about the need to have a child actively involved in physiotherapy in order for ML to occur (38).

In this study, there were similarities in the PTs’ approach to instructing children and providing feedback regardless of treatment approach. These similarities appeared to be linked to the child’s characteristics and a perceived common-sense approach to teaching, rather than individual PT preferences or the fixed properties of a treatment approach. However, there were differences in the terminology used when referring to MLS, which made it difficult at times to distinguish between PT preference and clinical experience when selecting MLS. Every PT integrates their own observational skills, professional training, and clinical experience into their decision-making (11, 109). As a result, there will always be some aspect of MLS selection and use that remains unique to the PT. These differences are a product of the clinical reasoning and reflection that evolve over time rather than a personal preference for a particular MLS. Clinical decision-
making is an iterative process that extends beyond interpreting the physical presentation of the child to analyzing the cognitive and affective factors that influence the child’s understanding and engagement in intervention (11, 109).

The structure of this study allowed PTs to reflect on their clinical decision-making in both traditional physiotherapy and when using the Lokomat. While there are obvious differences in the Lokomat’s properties and the types of tasks that can be performed within it, the PTs appeared to use similar decision-making processes to traditional physiotherapy sessions. They promoted ML based on their clinical knowledge and the child’s unique characteristics and goals. The PTs considered the features of the Lokomat as they would consider the properties of any piece of equipment used within an intervention, and aimed to maximize the opportunities for ML based on its capabilities. They reflected upon the successes and challenges of each session, which is important for continuing to progress toward treatment goals (109). Having fewer task options within the Lokomat was not necessarily a barrier to providing effective intervention, so long as its features met the ML goals and the engagement and motivational needs of the child.

Physical guidance is a MLS frequently used to direct children in physiotherapy (11). The perceived difference of the physical guidance provided by the Lokomat compared to the hands-on physical guidance in traditional physiotherapy emphasizes the degree to which the PT analyzes a child’s performance and modulates their guidance based on tactile feedback. While there are opportunities to modulate the guidance force and body weight support provided by the Lokomat, this reported difference highlights potential challenges for clinical decision-making during intervention involving physical guidance provided by an external device (e.g., using a computer interface). With increased experience using novel technologies, PTs may become more confident in analysing and facilitating motor performance using alternate forms of sensory feedback to inform their clinical decision-making rather than the tactile feedback they traditionally rely upon.

The Lokomat provided additional opportunities for PTs to maximize the use of certain MLS including: repetition within the treatment; the use of verbal feedback or visual demonstration with more physically involved children (because the PT is not having to provide the physical guidance manually); and the use of computer-based biofeedback as an additional form of visual feedback. However, not all PTs identified these additional prospects for use. While the PTs
identified greater difficulty maintaining intensity and maximizing repetition within traditional physiotherapy sessions, they felt that traditional intervention allowed practice of a greater range and variation in functional movement patterns which may enhance opportunities to generalize the skill beyond intervention. There were varying opinions regarding the ease of using part and whole practice within each treatment approach, indicating there were chances to use both forms of task practice to some degree within either. There was less discussion about linking an activity to another activity (in therapy or beyond therapy), providing education to a child or caregiver, encouraging mental practice, and recommending practice outside of therapy. Historically, PTs working in pediatrics frequently recommend practice outside of therapy and provide child/caregiver education (11, 74) and the use of mental practice has been shown to be effective in children with CP (55). However, these MLS inherently will occur less frequently within a session than MLS such as instructions, feedback, physical guidance, and repetitive practice. As such, the PTs may have focused their answers in the interviews on the MLS they used most frequently during treatment.

4.5.1 Limitations

This study was nested within ongoing clinical trials comparing the efficacy of traditional and Lokomat-based physiotherapy. While the clinical trial assigned consistent PTs to children, the intervention mimicked a typical block of treatment sessions, and treatment goals were based on child and family centred goals, it is unknown whether PT perspectives on MLS use would differ in a clinical trial compared to clinically-based treatment outside of research. PTs reported that the main difference between the research protocol and their clinical practice was the duration of each intervention, which was limited to 30 minutes of active intervention within the clinical trial. Time constraints may not have affected the use of more frequent MLS but could have limited opportunities for use of more MLS requiring more in-depth explanation, such as education or mental practice. Other possible challenges to clinical decision-making could include not having access to the child’s medical chart, not initially being aware of psychosocial information, and not being involved in the child’s care long-term.

While the use of video clips in the interview served to stimulate discussion in second part of the interview, it may have influenced which MLS the PTs emphasized during the interviews. However, this aspect of recall bias appears to be limited as some PTs specifically referred to
MLS they remembered using with the child they viewed in the video that were not featured in the video clips provided.

As a treating PT within the Lokomat studies, the author has specific clinical experience that shaped the interpretation of data collected in this study. As the interviewer for this study, her familiarity with some of the participants may have influenced their responses. Inductive questioning was used, in part, to offset the influence of the interviewer. However, the inductive structure may have resulted in the participants omitting some of their own experiences with MLS that could have been more readily captured using deductive questioning. Finally, the author team has extensive experience using the MLSRI-20. While not all themes were not specific to the MLS in the MLSRI-20, it is possible that a different conceptual framework may have yielded different themes.

4.5.2 Contributions to the literature

To the author’s knowledge, this is the first published qualitative study that addresses ML and clinical decision-making in physiotherapy for children CP. The findings of the current study may be generalizable to other diagnostic and pediatric age groups. A similar study has investigated PTs’ perspectives in MLS use in traditional intervention and physiotherapy using commercially-available video games in children with ABI (11). However, the PT participants had considerably less clinical experience providing the novel treatment approach, video clips were not used to stimulate discussion during the interviews, and the technology was less adaptable to the child’s individual needs (11). Comparable studies have been conducted in traditional therapy settings for adult brain injury (104) and stroke (43), using inductive and deductive questioning, respectively. However, the current study interviewed PTs with a slightly broader range of PT clinical experience, and analysed a greater number of MLS by using the MLSRI-20 as a conceptual framework.

The comparison of traditional physiotherapy with a novel form of intervention allowed investigation of possible differences in clinical rationale depending upon treatment approach. While there were aspects of each treatment approach that seemed better suited to some MLS than others, this study provides overall support for PTs’ selection and use of MLS based on the unique characteristics of the child. The use of a robotic interface was no exception. Drawing upon the static, dynamic, proactive, and reactive factors affecting MLS use is an important
aspect of clinical decision-making that can also be applied to different clinical populations. The current study identifies that PTs working within a single treatment centre continue to discuss ML using considerably different terminology, thus highlighting the need for explicit ML education using a standard ML language.

### 4.5.3 Future directions

The results of this study identify several MLS research and clinical practice opportunities. Documenting MLS using a common language in research will support the comparison of ML content among studies and allow more in-depth analysis of how different treatment approaches tap into the ML needs of a particular diagnostic group. Introducing the MLS language to experienced, novice, and student PTs will enhance PTs’ awareness of the variety of MLS available across treatment approaches/settings. To promote the intentional application of MLS in physiotherapy intervention, practice guidelines should be established. Implementation of these practice guidelines, in conjunction with the MLSRI-20 and MLS Online Training Program, as a means of continuing education in physiotherapy should also be evaluated.

Finally, the research and clinical application of MLS should extend beyond PTs. Future research should involve evaluating the practice guidelines and determining their applicability to other allied health professions (e.g., occupational therapy, speech language pathology) who provide motor skills-based intervention. A common MLS language can optimize communication between clients, caregivers, schools, and other healthcare professions when discussing motor skills-based function. Further understanding of how using a common language across healthcare and education influences client care is required, both from the perspectives of care providers and the child and family.

### 4.6 Acknowledgements

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Chapter 5

5 Understanding the importance of measuring and intentionally using motor learning strategies: Discussion and recommendations

5.1 Introduction

This thesis explored PTs’ use of MLS in gait-based physiotherapy intervention for children with CP. The two phases of research provided a preliminary examination of MLS measurement and an exploration of PTs perspectives of MLS use in physiotherapy intervention for children with CP. By conducting both phases of research with a group of children and PTs participating in the same intervention protocol, it was possible to connect the observation of MLS with the PTs’ verbalized intentions to use those MLS. The integration of a measurement study with the clinical perspectives of PTs permitted the preliminary comparison of objective measurements with subjective reflections, which both validated aspects of the MLSRI-20 and identified areas in which further development may be required.

Establishing the reliability of the MLSRI-20 was the first requirement for a larger scale exploration of MLS use in children with CP. The MLSRI-20 creates a profile for each treatment session and has the potential to identify patterns in MLS use for specific children, PTs, or treatment approaches. Because there is potential for discrepancy between an independent observer’s interpretation of a PT’s MLS use and the PT’s internal clinical decision-making process accompanying their actions, a qualitative analysis of PTs’ perspectives in MLS use helped to clarify their intentions. This chapter summarizes the findings of the two phases of research, and discusses how they integrate to support intentional MLS use in physiotherapy intervention for children with CP. The relevance of the findings, limitations, and recommendations are also outlined.
5.2 Summary of findings

5.2.1 Reliability study

The inter- and intra-rater reliability of the MLSRI-20 total scores was good, despite inter-rater results having a 95% CI lower bound and CV slightly outside the \textit{a priori} targeted values. As expected, the inter- and intra-rater reliability for individual items was lower than the reliability of the MLSRI-20 total scores. Varying reliability within the individual items suggest there is room for further clarification of some items within the MLSRI-20 Instruction Manual. PT raters also identified video-related and measure-related challenges when using the MLSRI-20. Video-related challenges included difficulties distinguishing between the verbalizations of the PT, the PT assistant, and the caregiver, as well as the interference of background noise. Measure-related challenges included difficulty categorizing verbalizations and distinguishing between tasks within the intervention.

The individual items that scored highest on the rating scale and were rated most frequently in the 30 videos were: #1- Encouragement, #5- Feedback related to movement performance, #12- Provides physical guidance, #16- Repetitive, #17- Whole, #18- Variable, and #20- Progressive (Figure 3.2). The items that scored lowest on the rating scale and were rated least frequently were: #8- Feedback related to what was done poorly, #10- Mental practice, #14- Recommend practice outside of therapy, and #15- Client/caregiver education.

5.2.2 Qualitative study

The three themes identified when exploring PTs’ use of MLS during intervention for children with CP were: the factors influencing MLS use; the differing vocabulary used to describe ML content; and, the Lokomat is “the same but different”. A novel finding of this research was the identification of static, dynamic, proactive, and reactive factors that influenced how a PT used MLS, which were based on the child’s unique characteristics, how the child responded to MLS, and the PT’s clinical decision-making. Although it was evident that the PTs aimed to promote ML during intervention for children with CP, they used differing terminology to describe MLS. This lack of a common MLS language made it difficult to compare their clinical decision-making processes. Overall, however, it appeared that while there were Lokomat properties that provided opportunities to use certain MLS to a greater degree compared to traditional gym-based
physiotherapy intervention, the PTs used similar clinical decision-making processes to maximize ML opportunities in both treatment approaches.

5.3 Discussion of findings

These two phases of research combine to highlight the following five aspects of MLS use in physiotherapy intervention for children with CP (detailed below): the role of child engagement in ML; the complexities of intentional MLS use; the value of distinguishing between implicit and explicit MLS; the proposed changes to the MLSRI-20; and the need for practice guidelines for MLS use.

5.3.1 The role of child engagement in motor learning

While PTs report gaps in their in-depth knowledge of ML principles (9, 10), they have historically demonstrated ample understanding of the importance of actively involving a child in intervention in order to promote ML, particularly for children with CP (105). Engagement refers to the affective experience of a child during an intervention, which is influenced by choice, reward, and interaction (38). A child’s engagement in this context consists of affective, cognitive, and behavioural involvement, which motivates them to work on tasks both within and beyond a treatment session (110). Optimal child engagement in intervention involves having confidence related to the intervention tasks, belief in the importance of the established therapeutic goals, and hope related to the possible intervention outcomes (110). The therapist plays a crucial role in engaging a child in their interventions (22). Therapists can assess a child’s engagement in a treatment session by the presence or absence of verbal and nonverbal indicators and adjust their interactions accordingly (111). Engagement also refers to an individual’s state of motivation (110), e.g., the child’s drive to undertake action toward sustaining goal directed behavior (38). It was evident within the interview study that the PTs were continually evaluating a child’s level of attention, motivation, and self-confidence within a treatment session, and they demonstrated an appreciation of how these components influence child engagement. The PTs actively recognized that a child’s engagement and motivation strengthened the connection between their therapeutic goals and participation in a treatment session, thus promoting the opportunity for ML.
These findings align with the OPTIMAL theory of ML (18), which states that motor behaviour cannot be separated from the cognitive, psychological, social, and cultural contexts in which it occurs (18). Therefore, it is essential for PTs to create meaningful interactions within session tasks by factoring these contexts into intervention. The PTs in the interview study emphasized the importance of finding the right combination of visual, auditory, and tactile input to engage, motivate, and challenge a child in therapeutic intervention. They considered the child’s affect, or emotional state, when considering how much they could challenge them, as well as the degree to which the child needed to experience success or failure within an intervention. A child’s past experiences with and future expectations for a particular motor skill influence their mindset and willingness to engage in intervention (18). The PTs discussed incorporating the child’s individual characteristics into intervention to optimize their involvement in each task (e.g., motivating through competition, giving the child choices, involving parents in the task, respecting a child’s fears, using humour, adopting a play-based approach).

While ‘encouragement’ (item #1) and ‘feedback related to what was done well’ (item #7) are MLSRI-20 items connected to promoting ML through the child’s self-efficacy and active involvement in the intervention, the current description of ‘encouragement’ within the MLSRI-20 Instruction Manual does not address the range of possible therapist verbalizations that promote child engagement and motivation. Motivating a child with verbal encouragement and positive feedback are important for engagement (i.e., encouragement enhances one’s perceptions of their abilities in a positive manner and promotes resilience when a child faces future mistakes or negative feedback (18, 39)). However, there are other aspects of engagement that could be considered beyond ‘positive verbalizations’ including allowing the child to make choices, creating an opportunity for successful completion of a task, and/or motivating the child through competition. The expansion of engagement or motivation-related options within item #1 ‘encouragement’ would address this omission and ensure that all verbalizations used to promote a child’s active involvement within an intervention are considered. Recommendations for expansion of item #1 are elaborated on in section 5.3.4.

5.3.2 The complexities of intentional motor learning strategies use

The association between intentional MLS use and the ML language outlined in the MLSRI-20 is complex. There are four possible scenarios that describe the occurrence of intention and observed
MLS use within a treatment session: 1) the PT intentionally applies a MLS and the MLSRI-20 rater observes the MLS; 2) the PT unintentionally applies a MLS and the rater observes the MLS; 3) the PT intentionally applies a MLS but the rater does not observe the MLS; or 4) the PT unintentionally applies a MLS but the rater does not observe the MLS. The first scenario is ideal because it easily permits the objective measurement of MLS use. However, as noted in the second scenario, observing a MLS during the session does not necessarily indicate intentional application. For example, a PT can provide instructions directing a child’s attention toward body movement without realizing she is using an internal focus of attention. Indeed, she may not even be aware of the foci of attention and the role they can play in promoting ML. While unintentional MLS use may still affect a child’s ML, the opportunity for the PT to reflect on the strategy’s effectiveness, and its potential value in future applications, is overlooked. Conversely, the intentional use of a particular MLS may not always be detected by an independent observer, because an assessor is not explicitly aware of the PT’s clinical decision-making. For example, the degree to which a PT responds to a child’s motor performance and then grades her physical guidance is not easily measured through observation, unless the change is drastic. There are also several implicit MLS, currently not included in the MLSRI-20, that could present challenges when left to an independent observer to rate. For example, dual-tasking for ML purposes may not always be easily identified, particularly when the PT is verbally discussing an unrelated topic (as an intentional dual-tasking challenge) with a child as he performs a specific motor task. Finally, if neither the PT nor the observer recognizes the presence of a MLS, its use may still have had an impact on ML while opportunities to fully understand the impact on the intervention would be missed.

The intentional use of one MLS does not imply intentional use of other observed MLS, which further complicates the evaluation of MLS application. However, by exploring the perspectives of the PTs providing intervention in the Lokomat studies, we were able to deduce which MLS PTs used intentionally and which were used unintentionally. The relationship between the intention to use MLS and their observation was interpreted by examining the PTs’ clinical decision-making and appraising the language they used. During the interviews, the PTs used general ML terms such as “instructions”, “feedback”, “problem solving”, “repetition”, “challenge”, and “carryover”. While this vocabulary likely indicated specific intention to promote ML during intervention, the general nature of the terms used during the interviews
suggested possible unintentional application of MLS, particularly in the MLSRI-20 category ‘What the Therapist SAYS’. The absence of detail in the PTs’ descriptions of their verbalizations and the discrepancy between their vocabulary and the language within the MLSRI-20 implied the possibility of inadvertent MLS use. For example, while the PTs indicated that they intentionally used instructions and feedback during their interventions, the majority did not differentiate between the types of verbal instructions or feedback. This suggests that they may not have been intentionally using different foci of attention within their verbalizations and were not explicitly aware of the impact that focus of attention can have on the child.

Despite the inconsistencies in labelling MLS among PTs (e.g., “visual” could refer to visual feedback, modelling/demonstration, or use of an external focus of attention), their discussion of these strategies supported the viewpoint that treating PTs are intentionally using some MLS. They regularly discussed the use of more traditional MLS, such as repetitive, variable, and progressive practice, indicating these MLS were intentionally applied. However, the infrequent discussion of the more contemporary MLS, such as mental practice, random practice, or learning through errors, may indicate that PTs are overlooking opportunities to implement these MLS in their practice. Analysis of the measurement and interview studies supports this hypothesis, as several of the MLS that were infrequently observed in the reliability study were also infrequently mentioned during the interviews (e.g., linking an activity being practiced to other activities (#9), encouraging mental practice (#10), recommending practice outside of therapy (#14), providing education to the child/caregiver (#15)).

Physiotherapy intervention extends beyond ML goals and is defined as “the treatment to restore, maintain, and make the most of a patient’s mobility, function, and well-being… through physical rehabilitation, injury prevention, and health and fitness” (112). Non-ML goals in children with CP frequently address the prevention of secondary impairments, encourage a healthy lifestyle, and promote fitness, often through child/caregiver education and homework between treatment sessions. While PTs intentionally use these treatment strategies within a session, they may not be knowingly applying them as MLS. PT raters in the reliability study also commented that some verbalizations during treatment did not appear to be for ML purposes, particularly when the PT did not provide time for the child to process verbal information (e.g., repeated verbal feedback throughout a task). The interviewed PTs spontaneously clarified this by indicating that repeated verbalizations were used to maintain a child’s attention. While the MLSRI-20 does not consider
maintaining a child’s attention’ as a MLS, it was clearly a strategy used to ensure the child remained engaged in the intervention, which would affect ML, and as such should be considered a MLS. Without an awareness that these behavioural and physiotherapy strategies are also MLS which can be used to promote ML, there is potential for PTs to overlook their implementation when addressing ML goals. Therefore, further MLS training is required, not only at an academic level but as part of ongoing physiotherapy practice.

5.3.3 The role of motor learning strategies in promoting implicit or explicit motor learning

A PT’s verbalizations can promote implicit or explicit ML, by directing the child to a particular focus of attention. MLS with an external focus of attention draw the child’s attention away from their body movements and allow them to focus on the outcome of the movements, which often promotes more automatic movement (29, 31, 39). In contrast, applying MLS with an internal focus of attention creates an environment where the child is aware that how they move will influence the successful completion of a task. While several PTs in the interview study alluded to promoting implicit ML during intervention, they did not categorize their actions in terms of MLS. Instead they spoke of facilitating motor skill development implicitly by using “distraction”, “play”, and “function” for children who had difficulty processing information related to “quality”, “details”, or “components” of movement. The PTs categorized their instructions and feedback using more generalized terminology, such as giving “verbal”, “visual”, “physical”, or “tactile” input. These general terms represent possible missed opportunities for more precise MLS use based on the lack of distinction between facilitating implicit and explicit ML. As with engagement in ML, a child’s characteristics factor heavily into the PT’s decisions on how to promote implicit or explicit ML as effectively as possible within an intervention. A child’s stage of ML, cognitive abilities, behavioural attributes, and emotional affect are just a few considerations that should influence the decision to use MLS for implicit or explicit ML purposes. However, the PT must first be aware of the breadth of MLS available before making an informed choice on which MLS to apply.

A clinical example of how intentional MLS implementation can be used to promote explicit or implicit ML involves a 6-year old boy with CP (GMFCS III) who presents with anxiety during balance-related tasks in physiotherapy interventions. His goal is to be able to play catch with a friend at recess. Given our knowledge of some of the child’s characteristics (e.g., we know that
he is young, likely needs a walker to ambulate, and is anxious about moving), using MLS to promote explicit ML could overload his cognitive system and exacerbate his anxiety, resulting in decreased therapeutic rapport, motor performance, and engagement, all of which would have a negative impact on ML (12, 33). In contrast, presenting a task in such a way that implicit ML is promoted might be better suited to him. It could involve playing a game of bean-bag basketball while he stands in his Kaye® walker, which could allow opportunities to use an external focus of attention by providing verbal instructions that focus on the environment and verbal feedback that relates to the outcome of the boy’s movement. Play-based, whole practice might be used to engage and motivate him, while taking his mind off the standing balance aspect of the task.

The PT could naturally progress the level of challenge by giving him a bean bag to hold in one hand while throwing with the other hand, requiring him to remove the hand intermittently from the walker, with or without physical guidance from the PT. Natural variations in the task could be incorporated into the task by having the boy bend down to pick up a bean bag if he drops it rather than overtly arranging a number of bean bags on the floor to pick up. These progressions/variations can be integrated implicitly into the task as a function of the game. As the boy progresses through the stages of ML, his motor performance should become more consistent and requires less cognitive effort (15). The PT may begin to promote explicit ML, in order to further fine-tune his motor skill proficiency, by selecting MLS that increase the boy’s awareness of his body position and the components of the movement (23). He may respond well to the gradual introduction of MLS that promote explicit ML as his self-efficacy with a particular skill increases. At all times, however, it is critical that the PT assesses his responses to her MLS use, and adjusts them accordingly through the intervention process.

5.3.4 Proposed changes to the MLSRI-20

The data gathered in the reliability and interview studies have led to possible changes to the MLSRI-20. However, any revisions beyond wording adjustments would necessitate revalidating the measure. PT raters indicated that scoring the ‘Practice IS’ category within the MLSRI-20 was difficult because determining what constitutes a “task” within the session can be problematic. Because clinician experience informs their clinical decision-making (e.g., determining the beginning, middle, and end of a task), an independent PT rater imparts a certain degree of subjectivity when defining the tasks in a video, which may affect individual item scores. Further,
if the tasks are defined differently between PT raters (e.g., one PT rater could define underhand and overhand throws as a single throwing task, while another PT rater could define them as two distinct tasks), the scores related to task organization will also differ. The subjectivity of defining tasks could be resolved by having the treating PT outline the task organization (e.g., task order, duration of each task, task variations) at the time of the treatment session and provide the information to the PT rater. A proposed MLSRI-20 Intervention Log for Treating Therapists, with an example of an intervention, is outlined in Appendix M.

‘What the Therapist SAYS’ was the MLSRI-20 category where the PT raters indicated they had the most scoring difficulty and the least confidence. One such challenge that related to instructions given was identified both by the PT raters in the reliability study and treating PTs in the interview study. The PT raters did not feel that all verbal instructions given by the treating were for ML purposes, particularly when they were repetitive without allowing time for the child to fully process the information. The treating PTs verified this observation within their interviews by indicating that, at times, their instructions were not for teaching but were instrumental in keeping a child with attention difficulties focused on the task. However, if the importance of engagement in ML is considered, then these repetitive verbalizations for the purpose of maintaining a child’s attention could be considered a MLS. Currently, ‘encouragement’ (item #1) is defined as “verbalizations with positive feedback that are used to engage the child in learning but do not contain content directly related to the learning itself” (7). Examples in the instruction manual include verbalizations, such as “good job”, “keep going”, so close”, and “nice try”. There is no item within the MLSRI-20 that accurately captures verbalization related to a child’s attention or attempting to engage them beyond using positive verbalizations. The ‘encouragement’ item could be reworded to capture the range of options a therapist uses to engage or motivate a child. This item could include elements of the PT attempting to maintain the child’s attention, motivate through competition or play-based intervention, engage using humour, or incorporate the child’s interests within a treatment session. The modifications made to ‘encouragement’ would continue to reflect the MLS construct by evaluating the PT’s efforts to actively involve the child in the intervention rather than measure the child’s level of attention, motivation, or engagement.

The interviewed PTs identified several additional MLS not captured by the MLSRI-20, consisting of auditory or visual feedback (113-115), analogy learning (116, 117), and dual-
tasking (26, 117). The issues and potential changes for each are discussed separately as follows.

“Uses feedback” was an item in the original MLSRI under the Wii category, and referred to the child’s use of augmentative feedback from the video games. This item was removed for the MLSRI-20 because PT raters found it difficult to determine the extent to which children used the feedback due to challenges seeing and hearing the Wii feedback on the videos. Additionally, this construct reflected the child’s actions rather than the therapist’s, which does not align with the MLS construct. The current recommendation to revisit the use of ‘augmentative, visual, and auditory feedback’ is in response to comments from both the interviewed PTs and the PT raters.

There are two computer screens associated with the Lokomat, one where the PT inputs adjustments to gait parameters and selects the features for active video-gaming, and another that outputs augmentative feedback to the child based on the child’s performance (e.g., an avatar walking through an environment or biofeedback graphs). The PT raters expressed challenges interpreting what the PT was entering in the Lokomat computer but did not specifically comment on how the therapist/child interacted with the augmentative feedback screen. In the MLSRI-20, use of augmentative feedback is only captured by the instructions or feedback the PT provides related to the augmentative feedback. However, if the treating PT provides no verbal input while the child uses the augmentative feedback, a MLS would not be recorded on the MLSRI-20. Based on these observations, and the PTs comments about using visual feedback in both treatment approaches, the need to measure augmentative, visual and/or auditory feedback is evident.

‘Analogy learning’ facilitates the learning of complex tasks by using simplified metaphors and is recognized as an effective MLS by ML experts (117). A PT in the interview study described her use of analogy learning when attempting to increase a child’s weight bearing through one lower extremity while bridging. The child was becoming frustrated with other forms of instruction, particularly those with an internal focus of attention. The PT then instructed him to “pretend that there is a $100 bill under your foot and don’t let me take it away”. Using an external focus of attention, cognitive strategies such as this allow the PT to chunk the instructions and reduce the amount of verbal information, thus freeing a child’s working memory for other aspects of the task (12, 116). Currently, cognitive strategies are included within an ‘instruction directing attention to an object/environment’ (item #2), but the MLSRI-20 does not differentiate between cognitive strategies and other instructions using an external focus of
attention. Because analogy learning is a child-friendly way of decreasing the cognitive resources dedicated to task performance, it is important to separate its measurement from other forms of instruction, particularly when aiming to isolate specific MLS that contribute to an effective treatment session.

‘Dual-tasking’ is a MLS that facilitates implicit ML of one motor skill while simultaneously working on a secondary motor or cognitive skill (26, 117), and was frequently discussed in the interview study. While dual-tasking is not specifically evaluated by the MLSRI-20, it can be partially accounted for in ‘progressive practice’ (item #20) if the PT adds to the challenge of a task by introducing a dual task (e.g., maintaining balance on one foot while playing a game of catch). However, item #20 does not allow the rater to distinguish between the use of dual-tasking and other possible methods of progressing the challenge of the task (e.g., the fading of physical guidance, decreasing the child’s stability, or increasing the range of motion the child moves through). Additionally, dual-tasking may not be used to progress the level of challenge of the task. The specific consideration of dual-tasking is important because of its impact on working memory, which is frequently impaired in children with CP (32). Some implicit (e.g., random number generation during a motor task) or explicit (e.g. “I want you catch the ball while you are side stepping along the line”) uses of dual-tasking can be readily observed. The difficulty with its measurement arises when dual tasking is less obvious and perhaps more open to interpretation (e.g., the PT asks the child about their school day to promote dual-tasking while the child balances on one foot). Regardless of the potential challenges associated with measuring dual-tasking, its addition to the MLSRI-20’s list of key MLS should be considered, given its occurrence in everyday activities and the prevalence of working memory challenges children with CP.

5.3.5 Practice guidelines for motor learning strategies use in physiotherapy intervention

The majority of PTs in the interview study identified similar approaches to determining how to instruct and provide feedback to children. Typically, they gave a verbal instruction and, depending upon the child, augmented the verbalizations with physical guidance and/or visual demonstration. They provided feedback in a similar manner to instructions, using verbal, tactile, and visual options. While the PTs recognized the need to adapt their methods of instruction and feedback based on the child’s characteristics and responses, they used varied terminology to
describe their decision-making and did not delve into details regarding the focus of attention they used or their desire to promote explicit/implicit ML. Several MLS, including linking activities in therapy to other activities, encouraging mental practice, recommending practice outside of therapy, and providing education, were mentioned only once or twice across all interviews.

The differing ML terminology and infrequent discussion of some MLS highlight the need to provide PTs with a framework for describing the ML content in their interventions. This issue also supports the use of an assessment tool, such as the MLSRI-20, to ground MLS discussion in a common language. These observations led to the creation, within this project, of a proposed set of Practice Guidelines for MLS Use in Physiotherapy Intervention (Table 5.1, p 96). When implemented in conjunction with the MLSRI-20, these guidelines provide recommendations that promote the intentional use of MLS in physiotherapy intervention and provide a ML foundation for the PT’s clinical decision-making. The guidelines encourage the PT to create a profile of the child’s characteristics, possibly even before meeting the child, based on information provided in their medical chart or referral, such as motor and cognitive abilities. The child’s profile can be updated on an ongoing basis with information provided by parents or other service providers, as well as through the observations the PT makes during intervention. The profile should include the MLS that work effectively or ineffectively within physiotherapy intervention, with the potential to apply this information to other aspects of the child’s life where motor function is involved (e.g., other therapies, home, school, extra-curricular activities).

During the interviews, the PTs emphasized the need to plan treatment sessions based on the child’s goals, not only to improve the child’s functional outcomes but also to maintain their motivation and engagement in the intervention. While the PTs often planned which tasks they would introduce and considered how they would engage the child throughout the treatment session, they did not typically consider what verbal and physical actions they would take to promote ML. Instead they reacted to the child’s responses in the moment and adjusted the MLS accordingly. While there are always reactive factors to consider when selecting a MLS during intervention, there is an opportunity for increased planning prior to intervention of verbal and action-based MLS, based on the child’s characteristics. By reflecting on the child’s known characteristics, including past responses to MLS, the PT can proactively prepare to focus on aspects of implicit and explicit ML. This planning will align the PT’s teaching methods with the child’s unique learning needs and simultaneously lead to more intentional MLS use.
### Table 5.1: Practice Guidelines for MLS Use in Physiotherapy Intervention

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<th>Practice Guidelines for MLS Use in Physiotherapy Intervention</th>
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<tr>
<td>1</td>
<td>Create a profile of the child’s characteristics. Update as you obtain new information.</td>
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</table>
|   | Includes but is not limited to:  
|   | o Physical Presentation  
|   | o Cognitive ability  
|   | o Interests, ways to engage  
|   | o Learning style  
|   | o Behaviours  
|   | o Motivation  
|   | o Responses to specific MLS |
| 2 | Consider the goals. |
|   | o Child’s overall goals for the treatment block  
|   | o PT’s session-specific goals |
| 3 | Decide which goals you would like to address within a single session and select the tasks you need to work on to achieve these goals. |
|   | Environmental considerations:  
|   | o Intervention setting  
|   | o Equipment available  
|   | o Individuals present  
|   | Task considerations:  
|   | o approximate duration  
|   | o possible variations, progressions, modifications |
| 4 | Contemplate the importance of task order. |
|   | o Do you need to build on skills within session?  
|   | o Are your session goals related to immediate performance of a motor skill?  
|   | o How can you promote longer term retention of the skill? (e.g., contextual interference) |
| 5 | Identify possible MLS for introducing a task. |
|   | o How will you initially instruct the child to perform the task?  
|   | o Will you promote implicit or explicit ML?  
|   | o Identify possible ways of adjusting your verbal instructions for an internal or external focus of attention |
| 6 | Anticipate the child’s possible responses after receiving the instructions and consider how you might adjust MLS for each scenario. |
|   | Possible scenarios:  
|   | o Unable to perform task  
|   | o Performs the task with complete/moderate/ minimal/no success  
|   | o Does the child understand what to do? |
| 7 | Decide how you will determine when to switch tasks. |
|   | o Performance  
|   | o Engagement  
|   | o Session goals  
|   | o Time constraints |
| 8 | Think about ways of encouraging ML beyond the PT session. |
|   | o Explain rationale/purpose for a task  
|   | o Give the child PT homework  
|   | o Explicitly link tasks in PT to what the child does in everyday life |
| 9 | Reflect upon the session. |
|   | o Did the tasks address the goals of the session?  
|   | o How did the child respond to the tasks (performance, understanding, engagement, motivation)?  
|   | o What MLS did you use? Is it appropriate to continue to use them or should you try to fade their use?  
|   | o Which MLS were effective/ineffective? |
How you will you adjust for the next session, depending on success/failure and updates to the child’s profile?

What MLS were NOT used? Why? Is there a possible role for them in the next session?

Track MLS use over time.

Which MLS are consistently effective?

Which MLS consistently ineffective?

Are there any MLS that are becoming more effective over time?

The MLS that were infrequently observed in the reliability study and infrequently mentioned during the interviews (e.g., linking an activity being practiced to other activities (#9), encouraging mental practice (#10), recommending practice outside of therapy (#14), and providing education to the child/caregiver (#15)) are items scored on the MLSRI-20 based on the quality of the MLS rather than the frequency that they are observed. While many aspects of MLS use are geared toward making immediate adjustments to motor performance within the treatment session, these less frequently used MLS provide an opportunity to expand a child and family’s awareness and practice of motor skills beyond the treatment session. Planning prior to a treatment session will ensure that they are not overlooked.

### 5.4 Recommendations

Based on PT rater feedback and data collected in the interview study, the suggested changes (section 5.3.4) to the MLSRI-20 will likely enhance its applicability to clinical and research settings, and possibly further improve inter-rater reliability. While the addition of new MLS will require revalidation of the assessment, the MLSRI-20 can be used effectively in its current state with the following minor adaptations: clarify the wording in the MLSRI-20 Instruction Manual to differentiate between verbal instruction and feedback; provide more written examples within the Instruction Manual based on PT rater feedback; and have the treating PT define the tasks in the video-recorded intervention. These adaptations may improve rater ease and confidence in rating and accordingly might be associated with a small positive effect on reliability. In contrast, the impact of the addition of any new MLS is not possible to predict and thus would require a small-scale (e.g., 10 to 20 videos) reliability study to revalidate the assessment. As well, all item changes should be addressed in the MLS Online Training Program. Finally, a scoring guide for the MLSRI-20, based on the MLSRI-20 Instruction Manual and in-class PT rater training sessions, and the Practice Guidelines for MLS Use in Physiotherapy Intervention (Table 5.1)
should be added to the MLS Online Training Program to give PTs a framework for systematically documenting, measuring, and discussing MLS use during intervention.

Because of this development work, PTs can now increase their awareness and intentional implementation of MLS during intervention through use of the MLS Online Training Program in combination with the Practice Guidelines and the MLSRI-20. Planning for and reflecting upon all aspects of MLS use, including the verbalizations and actions the PT uses within an intervention, is an integral aspect in promoting ML using a common MLS language. The MLSRI-20 should be used by clinicians to reflect on their own practice and optimize their MLS use. It can also be used as a framework for training/mentoring new clinicians. Once the reliability of the revised MLSRI-20 is evaluated in physiotherapy, its validity and reliability in other allied health disciplines can be explored. The expansion of the MLSRI-20 to other disciplines providing motor skills-based interventions will promote the use of a common MLS language across the multidisciplinary team working with a child. There is also an opportunity to extend the use of MLS language to interactions with children and their families.

One of the purposes of the MLSRI-20 is to create a profile of ML content with an intervention to permit comparisons within and between clinical trials. Given the current discrepancy between intra- and inter-rater reliability, studies using the current MLSRI-20 or future iterations may more reliably interpret the ML content using a single rater for all participants rather collating results from a group of raters. The current reliability results have demonstrated better reliability when PT raters have been used, as opposed to PT student raters (35) who scored the original MLSRI. While these improvements could be due to the changes to the measure, they could also be related to the raters’ clinical experience. This suggests that to optimize rating accuracy, MLSRI-20 raters should have clinical expertise in the area being studied in addition to being adequately trained in using the MLSRI-20.

While the MLSRI-20 can be used by clinical PTs for self-reflection, there is no published research regarding this aspect of its implementation, thus requiring further study of its reliability in this clinical context. The benefits of using the MLSRI-20 for self-reflection could then be studied by comparing ML content in treatment sessions of clinicians who did or did not use the MLSRI-20 as a reflective tool. Finally, analyzing the differences in MLSRI-20 scores when
sessions are self-rated versus independent rating might provide further insight into implicit MLS use.

Additional MLS research could involve the evaluation of the Practice Guidelines for MLS Use in Physiotherapy Intervention, further investigation into the role of child characteristics and MLS use, and the expansion of MLS use beyond the therapy setting (e.g., home, school, sports). While the primary purpose of creating the MLSRI-20 was to objectively document the ML content of an intervention, there is a role for the MLSRI-20 in ongoing qualitative ML research, such as exploring the perspectives of clinicians, children, families, and/or educators related to the effects of using a common MLS language amongst the multidisciplinary team, or how the MLSRI-20 and Practice Guidelines aid in individualizing a child’s motor skills-based interventions. These differing perspectives would provide an opportunity to expand upon the understanding of the impact of a child’s characteristics on ML, optimize family/caregiver involvement in a child’s ML, and delve into decision making and the perceptions about relative use of the various MLS.

5.5 Limitations

This section recaps the limitations of the two phases of research separately, and also provides a summary of additional limitations related to the overall research design.

The limitations specific to the reliability study as outlined in Chapter 3 (3.4.4) can be summarized by the following issues: the variety of audio challenges associated with rating video-recorded interventions, having an assessment that makes subjective judgments of clinical situations without background information on the child or ability to clarify with the treating PT, and the lack of a fifth online training module for scoring the MLSRI-20 in PT rater training. These limitations have been addressed in sections 3.4.5 and 5.4.

There are some additional limitations that apply specifically to the clinical utility of the MLSRI-20. It is a resource intensive assessment because it requires additional staff to record the treatment sessions, and the subsequent video-rating of an entire treatment session is also time-consuming. However, staff training and resource allocation can help to mitigate these limitations. It is also important to note that the MLSRI-20 was designed to be a point-in-time assessment of a PT’s use of MLS, and was not intended to be used as an outcome measure which evaluates change from baseline to reassessment. Because the profile of scores created by the MLSRI-20 is
not indicative of an inferior or superior treatment session, the change that occurs between two treatment sessions is neither relevant nor interpretable. However, when used appropriately (e.g., as an assessment by a trained individual with clinical experience), the MLSRI-20 can provide valuable information regarding the comparison of MLS content within interventions in either clinical or research settings.

The limitations specific to the interview study, as outlined in Chapter 4 (4.5.1), are as follows: enrolment of PT participants following a research-based intervention protocol rather than working in an ecological clinical setting, the influence of the video clips in the interview on the MLS discussed, and the use of inductive versus deductive questions in the interviews.

The research design of this thesis has additional limitations to acknowledge. If the reliability of the MLSRI-20 had previously been established in physiotherapy interventions for children with CP, a mixed methods study could have directly compared the MLSRI-20 individual item scores with the treating PT’s perspectives within the same treatment session. However, because the reliability of the MLSRI-20 had to be evaluated prior to use in this research, the videos selected for rating via the MLSRI-20 occurred independent of the PTs selected to participate in the interviews. As a result, there were three PTs interviewed in phase two who were not featured in any of the videos rated in the reliability study. While five of the interviewed PTs were shown in the videos used in the reliability study, the video clips used in the interviews were not necessarily from treatment sessions that were rated using the MLSRI-20. Thus, because there was not a direct comparison between the MLSRI-20 profile in a single treatment session and the data collected in the interview with the PT featured in the video, the thesis conclusions were based on the PTs’ general intentions to use MLS and the patterns observed within MLSRI-20 scoring rather than on direct ‘paired’ comparison of item scores.

5.6 Relevance

These research findings have implications for MLS in research and clinical practice. Currently, PTs aim to promote ML during intervention but do not have the framework for describing the content of their interventions. The MLSRI-20 provides a common MLS language that will not only optimize communication between clients, caregivers, schools, and other healthcare professions when discussing motor skills-based function, but has the potential to maximize functional outcomes in children with CP. An awareness of intentional MLS use equips PTs with
the capability of individualizing an intervention based on a child’s needs, which creates an optimal environment for ML. It also allows for explicit collaboration among PTs, which will enhance analysis of clinical situations and potentially lead to adopting new, more effective treatment approaches.

While there are opportunities to further develop the measure, the MLSRI-20 in its current state is capable of measuring the ML content of a motor skills-based intervention in pediatrics. It creates a foundation for determining the effective aspects of ML-based interventions and the ability to compare ML content between treatment approaches, which facilitates in-depth analysis of how a treatment approach or novel technology taps into the ML needs of a particular clinical population. When combined with the newly established Practice Guidelines for MLS Use, the MLSRI-20 can be used as a framework for clinical decision-making and will encourage therapists to reflect upon the MLS they implement during intervention.

5.7 Concluding remarks

The MLSRI-20 can consistently and effectively measure the extent of MLS use within physiotherapy intervention in its current state. However, the results of the reliability and interview studies within this thesis have identified opportunities to expand upon the breadth of MLS measured within it. As such, there is potential to create an expanded version of the MLSRI in the future. There are occasions, when using the MLSRI-20, where there is a difference between the therapist’s intentions to use a MLS and an independent rater’s observation of a MLS, which may indicate MLS are not always being used intentionally. However, with the combined implementation of the MLSRI-20 and Practice Guidelines for MLS use in physiotherapy intervention, PTs can gain a greater understanding of intentionally applying MLS in their treatment sessions, which may lessen this disparity. An increased awareness of MLS and the common language to describe them will facilitate communication both in research and clinical practice, and allow further exploration of how MLS are used to promote ML in children with CP.
References


104. Kleyven M, Moser A, Haarsma FA, Beurskens AJ, Braun SM. Physiotherapists use a great variety of motor learning options in neurological rehabilitation, from which they


##Appendices

###Appendix A: MLSRI-20 Worksheet

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td><strong>A) THERAPIST VERBALIZATIONS</strong></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Provide non-informational encouragement</td>
<td></td>
</tr>
<tr>
<td>2. <strong>Instructions</strong> direct attention to object / environment</td>
<td><strong>Instructions</strong> direct attention to body</td>
<td></td>
</tr>
<tr>
<td>4. <strong>Feedback</strong>: Asks</td>
<td><strong>Feedback</strong>: Tells</td>
<td></td>
</tr>
<tr>
<td>5. <strong>Feedback</strong> relates to movement performance</td>
<td><strong>Feedback</strong> relates to results</td>
<td></td>
</tr>
<tr>
<td>7. Specific <strong>feedback</strong> relates to what was done well</td>
<td><strong>feedback</strong> relates to what was done poorly</td>
<td></td>
</tr>
<tr>
<td>9. Make links to another task or setting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Encourages mental practice</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### B) THE THERAPIST

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>11.</td>
<td>Uses demonstration/modeling</td>
</tr>
<tr>
<td>12.</td>
<td>Uses physical guidance</td>
</tr>
<tr>
<td>13.</td>
<td>Encourages errors VS Limits errors</td>
</tr>
<tr>
<td>14.</td>
<td>Request practice outside of therapy time</td>
</tr>
<tr>
<td>15.</td>
<td>Provide education/training to caregiver</td>
</tr>
</tbody>
</table>

### C) PRACTICE IS

<table>
<thead>
<tr>
<th></th>
<th>TASK LIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.</td>
<td>Repetitive</td>
</tr>
<tr>
<td>17.</td>
<td>Whole (rather than part practice)</td>
</tr>
<tr>
<td>18.</td>
<td>Varied VS Constant</td>
</tr>
<tr>
<td>19.</td>
<td>Random VS Blocked</td>
</tr>
<tr>
<td>20.</td>
<td>Progressive</td>
</tr>
</tbody>
</table>
**Motor Learning Strategy Rating Instrument-20 Score Form**

Please rate the **extent to which** these strategies occur in the session as a whole:

<table>
<thead>
<tr>
<th></th>
<th>Very little 0-5%</th>
<th>Somewhat 6-24%</th>
<th>Often 25-49%</th>
<th>Very often 50-75%</th>
<th>Mostly 76-100%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A) Therapist verbalizations:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21. Provide encouragement</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>22. Direct client’s attention to object or environment</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>23. Direct client’s attention to body movement</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>24. Involve ‘asking’ (rather than ‘telling’)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>25. Relate to movement performance</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>26. Relate to results</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>27. Relate to what was done well</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>28. Relate to what was done poorly</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>29. Link activity being practiced to other activities</td>
<td>0</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>30. Encourage the client to undertake mental practice</td>
<td>0</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td><strong>B) The therapist:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31. Uses demonstration/modeling</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>32. Provides physical guidance</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>33. Provides an environment where errors are a part of learning</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>34. Recommends practice outside of therapy</td>
<td>0</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>35. Provides training or education to client/caregiver</td>
<td>0</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td><strong>C) Practice is:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>36. Repetitive</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>37. Whole (rather than part)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>38. Variable (rather than constant)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>39. Random (rather than blocked)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>40. Progressive</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Appendix C: REB approvals reliability study

Holland Bloorview
Kids Rehabilitation Hospital

Holland Bloorview Research Ethics Board
Ethics Approval Notification

The Holland Bloorview Research Ethics Board operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans, the Ontario Personal Health Information Protection Act, 2004, ICH Good Clinical Practice Consolidated Guideline E6, and Health Canada Part C Division 5 of the Food and Drug Regulations.

Study Title: Inter- and Intra- Reliability of the Motor Learning Strategies Rating Instrument Within Physiotherapy Interventions for Children with Cerebral Palsy

File Number: 16-656

Principal Investigator: Virginia Wright

Co-Investigators: Jennifer Ryan, Danielle Levac, Nick Reed

Original Approval Date: September 30, 2016

Expiry Date: September 30, 2017

Review Type: Delegated

Dear Dr. Wright,

The Holland Bloorview Research Ethics Board (REB) has reviewed the above named study. This was a delegated review. The board is granting ethics approval for a period of one year. The approval of this study includes the following documents:

- Protocol (version 1.1 dated August 7, 2016)
- TAHSN form received September 28, 2016
- Informed Consent Form – Participant, Parent/Guardian (version 1.1 dated August 7, 2016)
- Informed Consent Form – Treating Physical Therapist (version 1.2 dated September 28, 2016)
- Assent Form (version 1.1 dated August 7, 2016)
- Determination of Capacity to Consent (version 1.1 dated August 7, 2016)
- Motor Learning Strategies Rating Instrument (MLSRI-20) Worksheet (version 1.1 dated August 7, 2016)
- Motor Learning Strategies Rating Instrument (MLSRI-20) Score Form (version 1.1 dated August 7, 2016)
- Video Selection Process (version 1.1 dated August 7, 2016)
- Screening Checklist for Video Use (version 1.1 dated August 7, 2016)
- Recruitment Script (version 1.1 dated August 7, 2016)
- PT Rater Recruitment Letter (version 1.1 dated August 7, 2016)
- Video Assignment Process (version 1.1 dated August 7, 2016)
- Motor Learning Strategies Rating Instrument (MLSRI-20) Feedback Form (version 1.1 dated August 7, 2016)

This study must be conducted in accordance with the description in the application and any supplementary documents for which ethics approval has been granted. The REB needs to be notified of any unanticipated or unintentional divergence or departures from the protocol through a “Protocol Deviation Form”. Any intentional changes to the protocol need be submitted through an “Amendment
Form” to the REB for approval before the changes are implemented, except where necessary to eliminate immediate hazards to the participants.

Any adverse events that occur as a result of your study must be reported to the REB by submitting an "Adverse Event/Unanticipated Problem Form”.

If the study is expected to continue beyond the new expiry date, you must request another renewal, at least thirty days prior to the expiry date, by submitting an "Annual Renewal Form". When the study is completed or terminated, you need to submit a "Study Closure Form” to the REB.

Best wishes for the successful completion of your project.

Sincerely,
PROTOCOL REFERENCE # 33653

October 17, 2016

Dr. Virginia Wright
DEPT OF PHYSICAL THERAPY
FACULTY OF MEDICINE

Ms. Jennifer Ryan
DEPT OF PHYSICAL THERAPY
FACULTY OF MEDICINE

Dear Dr. Wright and Ms. Jennifer Ryan,

Re: Administrative Approval of your research protocol entitled, "Inter- and Intra-rater reliability of motor learning strategies rating instrument within physiotherapy interventions for children with cerebral palsy"

We are writing to advise you that the Office of Research Ethics (ORE) has granted administrative approval to the above-named research protocol. The level of approval is based on the following role(s) of the University of Toronto (University), as you have identified with your submission and administered under the terms and conditions of the affiliation agreement between the University and the associated TAHSN hospital:

- Graduate Student research - hospital-based only
- Storage or analysis of De-identified Personal Information (data)

This approval does not substitute for ethics approval, which has been obtained from your hospital Research Ethics Board (REB). Please note that you do not need to submit Annual Renewals, Study Completion Reports or Amendments to the ORE unless the involvement of the University changes so that ethics review is required. Please contact the ORE to determine whether a particular change to the University's involvement requires ethics review.

Best wishes for the successful completion of your research.

Yours sincerely,

REB Manager
INFORMED CONSENT FORM

STUDY TITLE: Inter- and Intra- Reliability of the Motor Learning Strategies Rating Instrument within Physiotherapy Interventions for Children with Cerebral Palsy

Study Researchers:
Jennifer Ryan, PT
Virginia Wright, PT, PhD
Danielle Levac, PT, PhD
Nick Reed, OT Reg.(Ont.), PhD

WHAT IS THIS STUDY ABOUT?

We are doing a research study at Holland Bloorview Kids Rehabilitation Hospital that looks at physiotherapy treatment in children with cerebral palsy. The study is about motor learning and the teaching methods that a physiotherapist (PT) uses during a therapy session to teach new motor skills to children. These methods include things like what the PT says, what the PT does, and the types of exercises the PT uses. Motor learning occurs when a child is able to take the skills they learn in physiotherapy and use them in his/her everyday life. To learn whether motor learning teaching methods actually help children learn new motor skills, we first need a way to measure which methods are being used and how much they are used in a therapy session.

Researchers at Holland Bloorview have helped to create a tool called the Motor Learning Strategies Rating Instrument (MLSRI-20) to measure the motor learning teaching methods a PT uses during a therapy session. It involves having a different PT watch a video recording of a therapy session. The PT uses the MLSRI-20 to rate how often she sees the therapist in the video using each of the different motor learning teaching methods.

Before we can use the MLSRI-20 to compare the teaching methods used in therapy, we need to test how well different PTs can use the MLSRI-20. We can test the PTs by using videos from the Lokomat® robotic gait training studies that are happening at Holland Bloorview. Motor learning teaching methods are already being used in the Lokomat and “regular” physiotherapy sessions for the Lokomat studies. We hope to use 30 videos of children ages 6 to 17 years who are or were involved in one of the Lokomat studies. Our goal is to have a group of videos of children with CP who have different walking abilities.

HOW WILL YOU BE INVOLVED IN THE MLSRI-20 STUDY?

***For parents reading this form, “you” means “your child”.

This new MLSRI-20 study will NOT take up any more of your time. All children in the Lokomat studies at Holland Bloorview already have at least two of their treatment sessions video
recorded. These videos may be from a regular physiotherapy session, a Lokomat physiotherapy session, or both. We would like your permission for the PTs in our study to watch your videos. The PTs will use the MLSRI-20 to count how often they see your PT using different teaching methods in the video. By doing this study, we will see if different PTs can come up with the same answers using the MLSRI-20. Your video will also help us better understand differences in motor learning teaching methods in ‘regular’ therapy sessions and sessions with the Lokomat.

Only videos where we can hear and see what you and the PT are saying and doing can be used. If you have already finished therapy in a Lokomat study, your videos have already been recorded. Our Lokomat research coordinator, Gloria Lee, has already checked the quality of the videos. If you are still participating in a Lokomat study and the videos are still being made, the video(s) will be checked by Gloria Lee to be sure we can see and hear what is happening during the session. Your video(s) may not be used for the study if we cannot see and hear what is happening during the session.

WILL ANYONE KNOW WHAT YOU DO IN THIS STUDY?

All information we collect about you is confidential. The MLSRI-20 scores from your video be linked with a study number, not your name. We will not make anything public that might identify you, unless legally required to do so. If the results of the study are published, your name will not be used and no information that discloses your identity will be released.

The videos from the Lokomat study will not be changed in any way. We cannot hide your face in the video, but only the members of our research team will see the videos. The videos and all data will be kept in Virginia Wright's office in a locked file drawer. Virginia is a senior scientist here in the Bloorview Research Institute. The computer video file and data will be saved on Holland Bloorview’s password protected computer network. Only the research team members will have the password. We will destroy the score sheets, videos, and computer files seven years after the study ends as required by the Bloorview Research Institute.

WHAT ARE THE RISKS AND BENEFITS?

There are no additional risks or benefits of being in this study that we know of. We do not know whether the amount of motor learning teaching methods used during physiotherapy actually results in better motor skills. We also do not know if there will be a difference between the motor learning teaching methods used with the Lokomat and regular physiotherapy treatment. This is why we are doing this study.

DO YOU HAVE TO DO THIS?

If you decide not to take part in the study, that is okay. Your decision will not affect your clinical care at Holland Bloorview and it will not affect your participation in the Lokomat study. If you say ‘yes’ now, but change your mind at any time, that is also okay. Contact Jennifer Ryan at ___________________ if you no longer want to take part in the study. Jennifer will ensure that your videos are removed from the study and any information already collected is destroyed.
WHAT IF WE HAVE QUESTIONS?

Please ask us to explain anything you don’t understand before signing the consent form. Please contact Virginia Wright at _____________. If you leave a message, we will return your call within 48 hours. If you have any questions about your rights as a research participant, please contact the Holland Bloorview Research Ethics Board at ____________________.

Thank you for thinking about helping us with this project.

Yours truly,

Virginia Wright
Clinician Scientist

Jennifer Ryan
Physiotherapist

(version 1.1: Aug 7, 2016)
PARENT/GUARDIAN CONSENT

STUDY TITLE: Inter- and Intra- Reliability of the Motor Learning Strategies Rating Instrument within Physiotherapy Interventions for Children with Cerebral Palsy

Study Researchers: Virginia Wright, PT, PhD, Jennifer Ryan, PT, Danielle Levac, PT, PhD, Nick Reed, OT Reg.(Ont.), PhD

I have read over the Informed Consent Form dated August 7, 2016 and understand what this research study is about. I have no questions to ask to help me decide whether to allow my child to take part.

I understand that participants in the study will have one or more of their video recorded treatment sessions from a Lokomat study at Holland Bloorview Kids Rehabilitation Hospital used for observing the physiotherapist’s treatment methods. I understand that all data and identifiable information are confidential and that the video will be seen only by the research team.

By signing this document, I do not give up any legal rights I may have in the case of negligence of anyone who is involved with the study. I understand that my child may drop out of the study at any time and I do not need to say why. This decision would not have any impact on clinical care at Holland Bloorview or my child’s participation in the Lokomat study.

I agree to participate and allow my child to participate in this study. I also agree to allow researchers to watch my child’s video recorded physiotherapy session from the Lokomat study for the purposes described in the information letter.

______________________________  ____________________  _______
Parent’s Name (please print)   Signature                               Date

______________________________  ____________________  _______
Researcher’s Name (please print) Signature                               Date

I have translated the details of this research study and the participant understands and appreciates the information contained in the information letter and consent form. The participant is fully informed and has freely agreed to participate.

______________________________  ____________________  _______
Translator’s name (if used)     Signature                               Date
PARTICIPANT CONSENT FORM

STUDY TITLE: Inter- and Intra- Reliability of the Motor Learning Strategies Rating Instrument within Physiotherapy Interventions for Children with Cerebral Palsy

Study Researchers: Virginia Wright, PT, PhD, Jennifer Ryan, PT, Danielle Levac, PT, PhD, Nick Reed, OT Reg.(Ont.), PhD

I have read over the information package dated August 7, 2016 and understand what this research study is about. I have no questions to help me decide whether to take part.

I understand that videos from my Lokomat or regular physiotherapy sessions in the Lokomat study will be used to understand how my physiotherapist is teaching me new skills. I understand that all my information and results are confidential and that the video will be seen only by the research team.

I understand that I may drop out of the study at any time. I do not need to say why. This decision would not affect my clinical care at Holland Bloorview or my participation in the Lokomat study.

I agree to participate in this study.

By signing this document, I do not give up any of my legal rights in the case of negligence of anyone who is involved with the study.

______________________________        __________________________        _________________________
Participant’s Name (please print)        Signature        Date

I talked with ____________________________ about this study. S/he understood it and wants to take part.

______________________________        __________________________        _________________________
participant’s name        Signature        Date

Researcher’s Name (please print)        Signature        Date

I am aware that my child is taking part in this study and I support his/her decision.

______________________________        __________________________        _________________________
Parent’s Name (please print)        Signature        Date

(version 1.1: Aug 7, 2016)
CHILD ASSENT FORM

STUDY TITLE: Inter- and Intra- Reliability of the Motor Learning Strategies Rating Instrument within Physiotherapy Interventions for Children with Cerebral Palsy

Study Principal Investigators: Virginia Wright, PT, PhD, and Jennifer Ryan, PT

What is this study about?
We are doing research to learn about how your physiotherapist teaches you new things. We want to look at the types of things your PT says, how your PT helps you, and the different activities you work on in therapy.

What do I need to do?
You don’t need to do anything extra for this study. When you do your therapy for the Lokomat study, some of your therapy sessions are videoed. We would like to look at those videos to see how your PT teaches you.

What are the good and bad things about doing this?
We do not think there are any good or bad things about being in this study.

Will anyone know that I did this study?
We will not share anything you say or do on the video with anyone who is not part of this study unless we talk to you and your family first. Your video and anything we write about your video won’t include your name. The video will be labelled with a number instead of your name.

Do I have to do this?
You do not have to let us watch the video. If you say no, that is okay. Your choice will not change any of the care that you get at Holland Bloorview.

What if I am not sure?
You can ask us questions. Your parents know about this study too. You can ask them questions. If you let us watch your video and then change your mind, that is okay. Just let us know and we won’t use your video in our study.

Thank you for thinking about helping us.
Yours truly,

Virginia Wright
Clinician Scientist

Jennifer Ryan
Physiotherapist

(.version 1.1: Aug 7, 2016)
Appendix E: Treating PT informed consent forms reliability study

TREATING PT INFORMED CONSENT FORM

STUDY TITLE: INTER- AND INTRA- RELIABILITY OF THE MOTOR LEARNING STRATEGIES RATING INSTRUMENT WITHIN PHYSIOTHERAPY INTERVENTIONS FOR CHILDREN WITH CEREBRAL PALSY

Study Researchers:
Jennifer Ryan, PT
Virginia Wright, PT, PhD
Danielle Levac, PT, PhD
Nick Reed OT Reg.(Ont.), PhD

Sponsor: Bloorview Children’s Hospital Foundation Chair in Pediatric Rehabilitation

WHAT IS THIS STUDY ABOUT?

We are doing a research study at Holland Bloorview Kids Rehabilitation Hospital that looks at physiotherapy treatment in children with cerebral palsy (CP). This study is about motor learning and the treatment techniques that a physiotherapist (PT) uses during a therapy session to teach new motor skills to children. These techniques are called motor learning strategies (MLS) and include what the PT says, what the PT does, and how the PT organizes the session. It is said that motor learning occurs when a child is able to take the skills they learn in physiotherapy and transfer them to everyday life. Before we can understand whether motor learning strategies actually help children learn new motor skills, we first need a way to measure which strategies are being used and how much they are used in a therapy session.

Researchers at Holland Bloorview have helped to refine a tool called the Motor Learning Strategies Rating Instrument (MLSRI-20) that measures the MLS a PT uses during a therapy session. We are now doing the first stage of validation work with the MLSRI-20. The first phase of this study will assess the inter- and intra-rater reliability of the MLSRI-20 in children with CP. A research study PT who has been trained to use the MLSRI-20 will watch a video recording of a Lokomat or physiotherapy session. The PT uses the MLSRI-20 to rate how often (s)he sees the therapist in the video using each of the different MLS.

WHY IS THIS STUDY IMPORTANT?

There are many new treatment technologies being used in physiotherapy in children with CP. Often these technologies and/or treatment approaches claim to be motor-learning based but don’t indicate HOW they are motor learning based. The MLSRI-20 is a means of quantifying the MLS a PT uses in a treatment session. Documenting the use of MLS in a consistent way from
one treatment approach to another is the first step in determining if motor learning techniques are an effective way of teaching children with neuromotor conditions.

The Lokomat is a treatment technology that claims to be motor-learning based. A number of Lokomat studies have taken place for children with CP at Holland Bloorview. We have the unique opportunity to look at video recordings from these treatment sessions and rate them using the MLSRI-20. This will allow us to test the inter- and intra-rater reliability of the MLSRI-20. These MLSRI-20 scores will also allow us to objectively compare how the use of MLS varies between traditional physiotherapy intervention and intervention using the Lokomat.

**HOW WILL YOU BE INVOLVED?**

You have been contacted because you are currently or have previously participated as a treating PT in one of the Lokomat studies for children with CP at Holland Bloorview. With your consent, research coordinator, Gloria Lee, will screen all of the treatment videos you are involved in for past and current Lokomat studies using a screening checklist. This checklist focuses only on the audio and visual quality, as well as the type of treatment intervention (Lokomat or traditional physiotherapy), not the content of the session. Co-primary investigator, Jennifer Ryan, will select videos to enroll in the reliability study based only on the screening checklist. Jennifer will not watch the video at the time of enrolment. While all treatment videos will be screened, not all videos will end up being used in the study. A total of thirty videos from a combination of Lokomat treatment sessions and traditional physiotherapy sessions will be selected for rating using the MLSRI-20. In order to capture a diversity of treatment styles from a variety of physiotherapists, we will only include videos of you with up to four different Lokomat participants. We value your ongoing involvement in pediatric rehabilitation research and will invite you to hear about the results of our study once it concludes.

**WHO WILL SEE YOUR WORK?**

All information we collect is confidential. The MLSRI-20 scores from your video be linked with a study number, not your name. We will not make anything public that might identify you, unless legally required to do so. If the results of the study are published, your name will not be used and no information that discloses your identity will be released.

The videos from the Lokomat study will not be changed in any way. We cannot hide your face in the video, but only the members of our research team will see the videos. The videos and all data will be kept in Virginia Wright's office in a locked file drawer. The computer video file and data will be saved on Holland Bloorview’s password protected computer network. Only the research team members will have the password. We will destroy the score sheets, videos, and computer files seven years after the study ends as required by the Bloorview Research Institute.

Two of the four PT raters involved in this reliability study will rate each video enrolled into the study. Only these two raters and Gloria Lee will view your video at this point in the study. (Pending Research Ethics approval, future phases of this project may involve study researchers...
viewing your video(s) and contacting you to discuss your experiences with MLS use in a confidential interview.)

**DO I HAVE TO DO THIS?**

There are no foreseeable risks to including your videos in this research study. You are not obligated to participate in this study. If you consent to participate, you are free to withdraw your consent to use your videos at any time. Withdrawal from the study will not affect your employment at Holland Bloorview and/or Bloorview Research Institute.

As a treating PT, you have been free to structure your treatment sessions in the Lokomat studies as you see appropriate for the child you are treating. A MLS education session took place for treating PTs in January 2016. Therefore, it is possible that treatment sessions prior to January 2016 could have less MLS than sessions videoed after the education session. Including videos from earlier treatment sessions with potentially fewer MLS used is important for testing the reliability of the MLSRI-20 as it may allow us to use a greater breadth of the scale. Your performance as a treating PT in these videos will not be judged and the use of your video(s) in this study will not affect your employment at Holland Bloorview.

**WHAT IF I HAVE QUESTIONS?**

Please feel free to contact Jennifer Ryan if you have any questions about this study at ______________ or the phone number below. If you have any questions about your rights as a research participant, please contact the Holland Bloorview Research Ethics Board at ______________. Thank you for thinking about helping us with this project.

Yours truly,

Virginia Wright
Clinician Scientist

Jennifer Ryan
Physiotherapist

(version 1.2: September 28, 2016)
TREATING PT CONSENT

STUDY TITLE: Inter- and Intra- Reliability of the Motor Learning Strategies Rating Instrument within Physiotherapy Interventions for Children with Cerebral Palsy

I have read over the Treating PT Informed Consent Form dated September 28, 2016.

I understand that as a treating PT in one of the Lokomat studies at Holland Bloorview, one or more of the video recorded treatment sessions may be used in this reliability study. I understand that all data and identifiable information are confidential and the video(s) will be seen only by the research team.

By signing this document, I do not give up any legal rights I may have in the case of negligence of anyone who is involved with the study. I understand that I can withdraw my consent at any time without explanation. Withdrawal from the study will not affect my employment at Holland Bloorview in any way.

I agree to participate in this study by allowing video(s) of my treatment sessions from any of the Lokomat studies at Holland Bloorview to be used in this study.

☐ I am also interested in being contacted about future phases of MLS research at Holland Bloorview.

Physiotherapist’s Name (please print) ________________________________ Signature ________________________________ Date __________

Researcher’s Name (please print) ________________________________ Signature ________________________________ Date __________

(version 1.2: September 28, 2016)
Appendix F: Screening checklist for video use form

SCREENING CHECKLIST FOR VIDEO USE:
MLSRI-20 RELIABILITY STUDY

Screening Date: _____________________
Video Identifier: _____________________

Please review the entire video of the physiotherapy intervention and indicate if the video meets the following criteria:

☐ The child has a diagnosis of cerebral palsy and is between 6-17 years old at the time of the video

☐ Lighting enables the viewer to see the physiotherapist (PT), child, and equipment adequately

☐ Camera angles and the field of view enables the viewer to see the PT, child, and/or equipment adequately

☐ Audio quality enables the viewer to hear the PT clearly

☐ Audio quality enables the viewer to hear the child clearly

☐ The duration of the physiotherapy intervention on the video is between 20 and 40 minutes long

☐ There are no significant disruptions that impacts the physiotherapy session (eg., child behaviour or illness, equipment malfunction, etc…)

☐ There are videos of the child in both traditional physiotherapy intervention and physiotherapy using the Lokomat®

     If there is only one video of the child, indicate which type of intervention it is:
     ☐ traditional physiotherapy    ☐ Lokomat

☐ The PT is the same PT in both the traditional and Lokomat physiotherapies for this child
Appendix G: Video assignment process

1. De-identify four PT raters
   - PT rater A
   - PT rater B
   - PT rater C
   - PT rater D

2. Random pairing of two PT raters for entire study
   - Pair 1
   - Pair 2

3. Blocked random assignment within PT rater pairing determines 1st & 2nd rater for each video

4. Blocked Random Assignment of Video-Recorded Physiotherapy Intervention

5. Repeat until 30 videos rated

6. 1st PT Rater of a pair independently rates video

7. > 1 week later and 2 other videos rated

8. Independently rates video a second time

9. 2nd PT Rater of a pair independently rates video

10. Repeat until 30 videos rated
Appendix H: MLSRI-20 feedback form

Video #: _____________  PT Rater ID: __________________________

MOTOR LEARNING STRATEGIES RATING INSTRUMENT (MLSRI-20)
FEEDBACK FORM

1. Length of time to complete video rating: _____________ minutes

2a) The degree of difficulty in rating “What the Therapist SAYS”:
   ________________________________________________________________
   Very difficult  No trouble at all!

Comments: (Please include particular item numbers, if any, that influenced your rating)
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

2b) Your confidence while rating “What the Therapist SAYS”:
   ________________________________________________________________
   Very difficult  No trouble at all!

Comments: (Please include particular item numbers, if any, that influenced your rating)
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

3a) The degree of difficulty in rating “What the Therapist DOES”:
   ________________________________________________________________
   Very difficult  No trouble at all!

Comments: (Please include particular item numbers, if any, that influenced your rating)
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
3b) Your confidence while rating “What the Therapist DOES”:

______________________________________________________________________________

Very difficult                                    No trouble at all!

Comments: (Please include particular item numbers, if any, that influenced your rating)
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

4a) The degree of difficulty in rating “Practice IS”:

______________________________________________________________________________

Very difficult                                    No trouble at all!

Comments: (Please include particular item numbers, if any, that influenced your rating)
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

4b) Your confidence while rating “Practice IS”:

______________________________________________________________________________

Very difficult                                    No trouble at all!

Comments: (Please include particular item numbers, if any, that influenced your rating)
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
Appendix I: REB approvals for MLS interview study

Holland Bloorview
Kids Rehabilitation Hospital

Holland Bloorview Research Ethics Board
Ethics Approval Notification

The Holland Bloorview Research Ethics Board operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans, the Ontario Personal Health Information Protection Act, 2004, ICH Good Clinical Practice Consolidated Guideline E6, and Health Canada Part C Division 5 of the Food and Drug Regulations.

**Study Title:** Exploring Physiotherapists’ Treatment Approaches During Gait-Based Physiotherapy Intervention for Children with Cerebral Palsy: A Comparison of Traditional Physiotherapy with Lokomat Robotic-assisted Gait Training

**File Number:** 17-706

**Principal Investigator:** Virginia Wright

**Co-Investigators:** Jennifer Ryan, Danielle Levac, Nick Reed

**Original Approval Date:** June 5, 2017

**Expiry Date:** June 6, 2018

**Review Type:** Delegated

June 6, 2017

Dear Dr. Wright,

The Holland Bloorview Research Ethics Board (REB) has reviewed the above named study. This was a delegated review. The board is granting ethics approval for a period of one year. The approval of this study includes the following documents:

- Protocol (version 1.2 dated May 31, 2017)
- TAHSN form received April 26, 2017
- Informed Consent Form – Physiotherapist (version 1.2 dated May 31, 2017)
- Informed Consent Form – Participant (version 1.2 dated May 31, 2017)
- Assent Form (version 1.2 dated May 31, 2017)
- Determination of Capacity to Consent (version 1.2 dated May 31, 2017)
- PT Selection Process for Interviews (version 1.2 dated May 31, 2017)
- Recruitment Script (version 1.2 dated May 31, 2017)

This study must be conducted in accordance with the description in the application and any supplementary documents for which ethics approval has been granted. The REB needs to be notified of any unanticipated or unintentional divergence or departures from the protocol through a “Protocol Deviation Form”. Any intentional changes to the protocol need to be submitted through an “Amendment Form” to the REB for approval before the changes are implemented, except where necessary to eliminate immediate hazards to the participants.

Any adverse events that occur as a result of your study must be reported to the REB by submitting an “Adverse Event/Unanticipated Problem Form”.

If the study is expected to continue beyond the new expiry date, you must request another renewal, at least thirty days prior to the expiry date, by submitting an “Annual Renewal Form”. When the study is completed or terminated, you need to submit a “Study Closure Form” to the REB.

Best wishes for the successful completion of your project.

Sincerely,
PROTOCOL REFERENCE # 34788

July 4, 2017

Dr. Virginia Wright  Ms Jennifer Ryan
DEPT OF PHYSICAL THERAPY  DEPT OF PHYSICAL THERAPY
FACULTY OF MEDICINE  FACULTY OF MEDICINE

Dear Dr. Wright and Ms Jennifer Ryan,

Re: Administrative Approval of your research protocol entitled, "Exploring physiotherapists' treatment approaches during gait-based physiotherapy interventions for children with cerebral palsy: A comparison of traditional physiotherapy with Lokomat robotic-assisted gait training"

We are writing to advise you that the Office of Research Ethics (ORE) has granted administrative approval to the above-named research protocol. The level of approval is based on the following role(s) of the University of Toronto (University), as you have identified with your submission and administered under the terms and conditions of the affiliation agreement between the University and the associated TAHSN hospital:

- Graduate Student research - hospital-based only
- Storage or analysis of De-identified Personal Information (data)

This approval does not substitute for ethics approval, which has been obtained from your hospital Research Ethics Board (REB). Please note that you do not need to submit Annual Renewals, Study Completion Reports or Amendments to the ORE unless the involvement of the University changes so that ethics review is required. Please contact the ORE to determine whether a particular change to the University's involvement requires ethics review.

Best wishes for the successful completion of your research.

Yours sincerely,

REB Manager
PARENT/GUARDIAN CONSENT

STUDY TITLE: Exploring Physiotherapists’ Treatment Approaches During Gait-Based Physiotherapy Interventions for Children with Cerebral Palsy: A Comparison of Traditional Physiotherapy with Lokomat® Robotic-assisted Gait Training.

Study Researchers: Virginia Wright, PT, PhD, Jennifer Ryan, PT, Danielle Levac, PT, PhD, Nick Reed, OT Reg.(Ont.), PhD

I have read over the Informed Consent Form dated May 31, 2017 and understand what this research study is about. I have no questions to ask to help me decide whether to allow my child to take part. I understand that participants in the study are allowing us to show video clips from one or more of their video recorded treatment sessions from a Lokomat study at Holland Bloorview Kids Rehabilitation Hospital to their Lokomat PT. The PT will be asked questions about their choices in treatment methods. I understand that all data and identifiable information are confidential and that the video will be seen only by the research team and one or both of your treating PTs from the Lokomat study.

By signing this document, I do not give up any legal rights I may have in the case of negligence of anyone who is involved with the study. I understand that my child may drop out of the study at any time and I do not need to say why. This decision would not have any impact on clinical care at Holland Bloorview or my child’s participation in the Lokomat study. I agree to participate and allow my child to participate in this study. I also agree to allow researchers to watch my child’s video recorded physiotherapy sessions from the Lokomat study for the purposes described in the information letter.

____________________________  ________________  ________________
Parent’s Name (please print)  Signature  Date

____________________________  ________________  ________________
Researcher’s Name (please print)  Signature  Date

I have translated the details of this research study and the participant understands and appreciates the information contained in the information letter and consent form. The participant is fully informed and has freely agreed to participate.

____________________________  ________________  ________________
Translator’s name (if used)  Signature  Date

(version 1.2: May 31, 2017)
PARTICIPANT CONSENT FORM

STUDY TITLE: Exploring Physiotherapists’ Treatment Approaches During Gait-Based Physiotherapy Interventions for Children with Cerebral Palsy: A Comparison of Traditional Physiotherapy with Lokomat® Robotic-assisted Gait Training.

Study Researchers: Virginia Wright, PT, PhD, Jennifer Ryan, PT, Danielle Levac, PT, PhD, Nick Reed, OT Reg.(Ont.), PhD

I have read over the information package dated May 31, 2017 and understand what this research study is about. I have no questions to help me decide whether to take part.

I understand that video clips from my Lokomat or regular physiotherapy sessions in the Lokomat study will used to talk to my physiotherapist and see how she is teaching me new skills. I understand that all my information and results are confidential and that the video will be seen only by the research team and my Lokomat physiotherapists.

I understand that I may drop out of the study at any time. I do not need to say why. This decision would not affect my clinical care at Holland Bloorview or my participation in the Lokomat study.

I agree to participate in this study.

By signing this document, I do not give up any of my legal rights in the case of negligence of anyone who is involved with the study.

______________________________  ____________________  ___________
Participant’s Name (please print)  Signature  Date

I talked with ___________________ about this study. S/he understood it and wants to take part.

______________________________  ____________________  ___________
Researcher’s Name (please print)  Signature  Date

I am aware that my child is taking part in this study and I support his/her decision.

______________________________  ____________________  ___________
Parent’s Name (please print)  Signature  Date

(Version 1.2 May 31, 2017)
STUDY TITLE: Exploring Physiotherapists’ Treatment Approaches During Gait-Based Physiotherapy Interventions for Children with Cerebral Palsy: A Comparison of Traditional Physiotherapy with Lokomat® Robotic-assisted Gait Training.

Study Principal Investigators: Virginia Wright, PT, PhD, and Jennifer Ryan, PT

What is this study about?
We are doing research to learn about how your physiotherapist teaches you new things. We want to look at the types of things your PT says, how your PT helps you, and the different activities you work on in therapy.

What do I need to do?
You don’t need to do anything extra for this study. When you do your therapy for the Lokomat study, some of your therapy sessions are videoed. We would like to look at those videos to see how your PT teaches you.

What are the good and bad things about doing this?
We do not think there are any good or bad things about being in this study.

Will anyone know that I did this study?
We will not share anything you say or do on the video with anyone who is not part of this study unless we talk to you and your family first. Your video and anything we write about your video won’t include your name. The video will be labelled with a number instead of your name.

Authorized representatives of the following organizations may look at your original research records at the site where these records are held:
- The Holland Bloorview Research Ethics Board who oversees the ethical conduct of this study
- Holland Bloorview representatives to check that the information collected for the study is correct and follows proper laws and guidelines.

Do I have to do this?
You do not have to let us watch the video. If you say no, that is okay. Your choice will not change any of the care that you get at Holland Bloorview.

What if I am not sure?
You can ask us questions. Your parents know about this study too. You can ask them questions. If you let us watch your video and then change your mind, that is okay. Just let us know and we won’t use your video in our study.

Thank you for thinking about helping us.
Yours truly,
Appendix K: PT informed consent- MLS interview study

PHYSIOTHERAPIST INFORMED CONSENT FORM

STUDY TITLE: Exploring Physiotherapists’ Treatment Approaches During Gait-Based Physiotherapy Interventions for Children with Cerebral Palsy: A Comparison of Traditional Physiotherapy with Lokomat® Robotic-assisted Gait Training

Study Researchers:
Jennifer Ryan, PT
Virginia Wright, PT, PhD
Danielle Levac, PT, PhD
Nick Reed OT Reg.(Ont.), PhD

Research Coordinators:
Gloria Lee
Emily Brewer

Sponsor: Bloorview Children’s Hospital Foundation Chair in Pediatric Rehabilitation

WHAT IS THIS STUDY ABOUT?
We are doing a research study at Holland Bloorview Kids Rehabilitation Hospital that looks at physiotherapy treatment in children with cerebral palsy (CP). This study is about the treatment approaches that a physiotherapist (PT) uses during a therapy session to teach new motor skills to children. In this study, we will be individually interviewing some of the PTs who have treated children with CP in one of the Lokomat studies at Holland Bloorview to explore their clinical decision-making. Before we can understand how these two types of intervention help children accomplish their gait-related goals, we need to explore what specific approaches a PT uses during a treatment session.

WHY IS THIS STUDY IMPORTANT?
There are many new treatment technologies, such as the Lokomat, used in physiotherapy for children with CP. Often these technologies and/or treatment approaches claim to improve walking and gait-related abilities but don’t indicate how it differs from traditional physiotherapy. A number of Lokomat studies have taken place for children with CP at Holland Bloorview. We have the unique opportunity to look at video recordings that already exist from some of these treatment sessions and discuss them with the treating PT in the video. This will allow us to explore how the PT varies the approaches they use to help a child learn depending on the child and the type of intervention.
HOW WILL YOU BE INVOLVED?

You have been contacted because you are currently or have previously participated as a treating PT in one of the Lokomat studies for children with CP at Holland Bloorview and previously indicated an interest in being contacted about future projects related to motor learning. We are inviting you to participate in a confidential 1:1 interview with co-primary investigator, Jennifer Ryan. The interview will be approximately 45-60 minutes in length and will be audio-recorded to allow for accurate data analysis. The interview will involve discussing your thoughts and opinions regarding physiotherapy intervention for children with CP. We will use short video clips from a number of your treatment sessions in the Lokomat study to jog your memory and stimulate the discussion. We plan to interview eight PTs to explore a range of perspectives. We value your ongoing involvement in pediatric rehabilitation research and will invite you to hear about the results of our study once it concludes. You will be compensated for the time spent in the interview.

WHO WILL HAVE ACCESS TO YOUR INTERVIEWS/VIDEOS?

All information we collect is confidential. The interviews will be audio-recorded and transcribed. Your name will not be indicated on interview transcripts, only your study number. We will not make anything public that will identify you, unless legally required to do so. If the results of the study are published, your name will not be used and no information that discloses your identity will be released.

Your video clips will only be used in your interview. Other PTs in this study will not see video clips of you providing treatment. All hard copies of data collected in the interviews will be kept in a locked file drawer at Holland Bloorview. Video files and data will be saved on Holland Bloorview’s secure computer network. Members of the research team have received training in privacy and confidentiality. Only research team members who need access to this data to carry out their jobs will have access to these files.

Authorized representatives of the following organizations may look at your original research records at the site where these records are held:

- The Holland Bloorview Research Ethics Board who oversees the ethical conduct of this study
- Holland Bloorview representatives to check that the information collected for the study is correct and follows proper laws and guidelines.

We will destroy all interview transcripts, videos, and any additional computer files seven years after the study ends as required by the Bloorview Research Institute.

DO I HAVE TO DO THIS?

There are no foreseeable risks to participating in this research study. You are not obligated to participate in this study. If you consent to participate, you are free to withdraw your consent at any time. What you say in the interviews or any decision to withdraw from the study will not affect your employment at Holland Bloorview and/or Bloorview Research Institute.
As a treating PT, you have been free to structure your treatment sessions in the Lokomat studies as you see appropriate for the child you are treating. Your performance as a treating PT in the video clips will not be judged and will not affect your employment at Holland Bloorview.

WHAT IF I HAVE QUESTIONS?
Please feel free to contact Jennifer Ryan if you have any questions about this study at ______________________ or the phone number below. If you have any questions about your rights as a research participant, please contact the Holland Bloorview Research Ethics Board at ________________. Thank you for considering participating this project.

Yours truly,
Virginia Wright
Clinician Scientist

Jennifer Ryan
Physiotherapist

(version 1.2: May 31, 2017)
PHYSIOTHERAPIST INFORMED CONSENT FORM

STUDY TITLE: Exploring Physiotherapists’ Treatment Approaches During Gait-Based Physiotherapy Interventions for Children with Cerebral Palsy: A Comparison of Traditional Physiotherapy with Lokomat® Robotic-assisted Gait Training

I have read over the Physiotherapy Informed Consent Form dated May 31, 2017.

I understand that as a participant in this interview, I will be discussing my experiences as a physiotherapist in one of the Lokomat studies at Holland Bloorview. I understand that the interview also involves watching video clips from one or more of my treatment sessions in the Lokomat studies. I understand that all data and identifiable information are confidential and the video clip(s) of me will be seen only by myself and the research team.

By signing this document, I do not give up any legal rights I may have in the case of negligence of anyone who is involved with the study. I understand that I can withdraw my consent at any time without explanation. Withdrawal from the study will not affect my employment at Holland Bloorview in any way.

I agree to participate in this study.

______________________________  ________________  ___________
Physiotherapist’s Name (please print)  Signature  Date

______________________________  ________________  ___________
Researcher’s Name (please print)  Signature  Date

(version 1.2: May 31, 2017)
Appendix L: Interview guide

Thank you for taking the time to meet with me today. As you know there are several Lokomat studies taking place at Holland Bloorview (HB) for children with cerebral palsy (CP). We are interested in learning about the individual experiences of the treating physiotherapists (PT) in both the traditional gait-based physiotherapy sessions in the gym and the physiotherapy sessions that take place in the Lokomat. Your contribution as a PT is extremely valuable and by interviewing different PTs, we hope to get a wide range of opinions and observations. This interview will be audio-recorded and transcribed. The transcripts will not be associated with your name, so your opinions will remain anonymous.

1. Can you tell me a little bit about your involvement in the Lokomat studies for children with CP at HB to date?
   a. How long have you worked in pediatric physiotherapy, particularly working with children with CP?
   b. When did you start providing treatment for one of the Lokomat studies?
   c. Approximately how many children have you treated so far in the Lokomat studies?
   d. What are the GMFCS levels of the children you have treated?
   e. Would you say you have primarily provided treatment in the traditional physiotherapy arm, the Lokomat arm, or has it been evenly distributed between both treatment arms?

2. What kinds of things do you think about when planning your treatment sessions in these Lokomat studies?
   a. For traditional gait-based physiotherapy sessions? Can you give me an example?
   b. For Lokomat physiotherapy sessions? Can you give me an example?
   c. Is there a difference between how you plan for a Lokomat session compared to a traditional physiotherapy session?
   d. Have any of the study treatment restrictions (eg, time constraints, inability to use adjuncts like kinesiotape, electrical muscle stimulation, etc, or restricted use of the treadmill, etc…) affected how you planned your sessions?

3. Do you have specific approaches that you like to use in treatment sessions to teach a child a motor skill? What factors contribute to why you tend to use them?

4. Are there specific approaches that you are aware of but don’t usually use very often? What factors contribute to why you tend not to use them?

5. Are there approaches that you like to use outside of this study but found difficult to apply in this setting?
a. What aspects of this setting make these techniques difficult to use? 
b. Can you provide an example?

6. Are there differences in the approaches you use to teach a child motor skills in a traditional physiotherapy session compared to a Lokomat session? 
   a. How so? 
   b. Examples? 
   c. Are these differences specific to the child or to the type of intervention?

7. Are there certain approaches that are difficult to use in: 
   a. Traditional physiotherapy? Can you provide any examples? 
   b. Lokomat? Can you provide any examples?

8. When you use a specific approach to teach a child a motor skill, what type of response(s) are you looking for to determine if it was effective or ineffective? Can you give an example? 
   a. How do you respond if you think the approach was ineffective?

9. Do the types of approaches you use for a particular child change over time or do they stay the same? Can you give an example?

10. Here are a few clips of you working with client X. After watching video: Can you describe your thoughts around some of the teaching approaches you used in these clips? 
    a. Can you recall specific approaches that were effective or easy to use with client X? 
    b. Can you recall specific approaches that were ineffective or challenging to use with client X? 
    c. If clips available for both Lokomat and traditional PT sessions: Can you recall if there were differences in how you were able use teaching approaches with this client between traditional PT and Lokomat sessions?

11. Here are a few clips of you working with client Y. Repeat questions from #10.
Appendix M: MLSRI-20 intervention log for treating therapists

**MLSRI-20 Intervention Log for Treating Therapists**

1. Record the **tasks** completed in the treatment session in the order that they were performed.
2. Include any relevant **task details** such as repetitions, variations, progressions, amount of assistance provided, how it relates to goals, etc…
3. For each task, place a ‘1’ in the box indicating the focus of the task and a ‘2’ in ALL other boxes any secondary foci in this session.

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<th>Task</th>
<th>Duration (min)</th>
<th>Stability/balance</th>
<th>Coordination</th>
<th>Strength</th>
<th>Gait (all aspects)</th>
<th>Fitness</th>
<th>Other (specify in the box)</th>
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<td>2. Side stepping</td>
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</table>

Task Details:
- Hands free with minimal assistance x 1 (10 reps x 2 sets)
- Independently with both hands on activator poles (10 reps x 2 sets)

Details:
- In parallel bars with hands on a bar, focus on left foot alignment, facilitated at pelvis (6 lengths)
- Added 4” stool to step up and over (4 lengths)

Details:
- Standing on unstable surface with minimal support
- Forced use with R foot on 6” block; sustained while reach+throw beanbags
### MLSRI-20 Intervention Log for Treating Therapists (continued)

<table>
<thead>
<tr>
<th>Task</th>
<th>Duration (min)</th>
<th>Stability/balance</th>
<th>Coordination</th>
<th>Strength</th>
<th>Gait (all aspects)</th>
<th>Fitness</th>
<th>Other (specify in the box)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Ambulation</td>
<td>10</td>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
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<tr>
<td><strong>Task Details:</strong></td>
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<tr>
<td></td>
<td>Walking down the hall with the activator poles and moderate assistance x 1; constant facilitation at left arm, intermittent at trunk</td>
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<tr>
<td></td>
<td>Mental practice of walking down the hall at school; focus on posture, foot placement, and looking ahead</td>
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<tr>
<td></td>
<td>Asked Lisa and her mother to mentally practice walking in different environments before she goes to bed at night</td>
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<tr>
<td>5. Sit to stand</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>2 (functional transition)</td>
</tr>
<tr>
<td><strong>Details:</strong></td>
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<tr>
<td></td>
<td>Independently with activator poles on a bench in the hallway</td>
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<td></td>
<td>Increased verbal feedback to ensure equal weight bearing through feet (fatigue?)</td>
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</tbody>
</table>

Details: