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Examining the Impact of Varying the Pace of Instruction on Skill Acquisition and Off-Task Behaviour in Young Children with Autism and Down Syndrome

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Abstract

Considerable research has shown significant impairments in how children with developmental disabilities learn. A particular focus for these children has been on improving instruction, so that it maximizes acquisition. Modifying pace is one approach to tailoring intervention to meet the needs of these children. This study examined the effects of varying the pace of instruction during behaviour- analytic intervention while measuring acquisition and off task behaviour in young children with developmental disabilities. Five intervention target skills were randomly assigned to one of five paces of instruction and a single-subject adapted alternating treatments design was used to evaluate skill acquisition. In all three children, slower paces of instruction led to children mastering the target in fewer trials. Whereas, children showed idiosyncratic differences in off-task behaviour. This research may highlight directions for future approaches when determining the most effective pace of instruction during intervention for young learners with developmental disabilities.

Keywords: applied behavioural analysis, developmental disabilities, autism spectrum disorder, down syndrome, discrete trial teaching, interstimulus interval

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Examining the Impact of Varying the Pace of Instruction on Skill Acquisition and Off-Task Behaviour in Young Children with Autism and Down Syndrome

Developmental disabilities are a group of conditions, beginning in childhood, which result in functional limitations in major life activities (Government of Canada, 2018). Autism spectrum disorder is a developmental disorder diagnosed based on the presence of two core characteristics: social-communicative impairment, and restricted, repetitive patterns of behaviour, interests or activities (American Psychiatric Association, 2013). Current statistics indicate that one in every 66 children are diagnosed with autism spectrum disorder (ASD) in Canada (Government of Canada, 2018). Down syndrome (DS), also a developmental disability is the most common genetic cause of intellectual disability and occurs in approximately 1.08 per 1000 live births (Centers for Disease Control and Prevention, 2018). It is caused by an abnormal cell division involving chromosome 21. Phenotypic characteristics of individuals with DS include relative stability in visuospatial processing but a significant delay in nonverbal cognitive development; individuals with DS typically qualify for an intellectual disability (Fidler, 2005).

Research suggests that a significant number of individuals with DS share common challenges with children who have ASD. These shared characteristics indicate elevated levels of behavioural challenges/aggression, and higher rates of language deficits including both receptive and expressive delays (Warner et al., 2017; Warner et al, 2014). Challenges in communication are considered to be paramount for both diagnoses, as they interfere with the capability to initiate meaningful relationships with others (Larue et al., 2016). As our awareness and clinical expertise continues to advance, so does the need to establish interventions tailored to address these needs. A particular focus for these children has been on improving instruction, so that it maximizes their skills and strengths. The purpose of the current study will be to manipulate the pace of instruction, measuring acquisition of communication skills and off-task behaviour in children who have a diagnosis of DS or ASD.

Applied Behaviour Analysis (ABA) Theoretical Framework

Applied Behavioural Analysis (ABA) is a theoretical framework and the science of applying the principles of behaviour to the improvement of specific behaviours and evaluating whether or not any changes noted are attributable to the process of application (Baer et al., 1968). Discrete-trial training (DTT), is an instructional method based on the principles of ABA where instructors break down skills into small, discrete components (Hamdan, 2018). DTT is characterized by repeated, or massed trials that have a definite beginning and end. Within DTT, the use of antecedents and consequences is carefully planned and implemented. There are six parts to a discrete trial: an antecedent, a prompt, a response, a consequence for a correct response, a consequence for an incorrect response, and an inter-stimulus interval (ISI; Hamdan, 2018). The inter-stimulus interval can be defined as the time in between target presentations. The instructional trial begins when the instructor gives an instruction, which evokes a target behaviour. For instance, the instructor may ask the child to “pick up the cup”. If needed, the instructor would follow up the instruction with a physical or vocal prompt like pointing to the cup. If the child provided a correct response, positive praise and/or tangible rewards would be used to reinforce the desired skill (Hamdan, 2018).

The effectiveness of DTT, an evidence-based procedure (ONTABA, 2017), in developmental disabilities including both ASD and DS has been well documented through past research by using single-subject methodology (Bauer & Jones, 2014; Bauer, Jones, & Feeley, 2013; Hamdan, 2018; Jones, Feeley, & Blackburn, 2010). Thus, among the many methods available for treatment and education of people with developmental disabilities, DTT has become a widely accepted approach.

Effects of Instructional Pace on Behavior

Francisco and Hanley (2012), suggest that the timing of learning opportunities is an extremely important factor for acquisition of skills. There is research which suggests that the pace of instruction during DTT, affects the outcomes of intervention for individuals with developmental disabilities (Francisco & Hanley, 2012). Pace has often been manipulated for the potential impact this component has on acquisition, maintenance, generalization, and problem behaviour (Cariveau et al., 2016).

Most research has involved comparisons of relatively fast paces during teaching and have collectively showed the advantage of using faster paces. Faster paces of instruction may facilitate faster rapid acquisition, maintenance and generalization of skills (Cariveau et al., 2016; Koegel et al., 1980). Koegel, Dunlap and Dyer (1980) investigated the influence of pace on the performance of children who have ASD during teaching situations. The children were taught under the same conditions existing in their regular programs, except that the length between trials was systematically manipulated. Two paces were employed: fast paces with the target given following 1 s after the reinforcer for the previous trial, versus slow paces with the target presented for 4 or more seconds following the reinforcer for the previous trial (Koegel et al., 1980). Faster paced instruction was associated with fewer trials to mastery, improvements in performance, and rapid acquisition compared to minimal or no change with slower paced instruction (Koegel et al., 1980).

Further, Cariveau et al. (2016) compared the effects of three paces of instruction on skill acquisition. More specifically, they compared the effect of short (e.g., 2 s), progressive (e.g., 2 s to 20 s), and long (e.g., 20 s) time between instruction on participants' mastery of textuals or intraverbals presented in massed-trial instruction and varied-trial instruction for two children with ASD. Both students were receiving ABA-based intervention in a university-based clinic for more than 6 months at the time of the intervention. Results indicated that participants mastered all targets regardless of the pace or instructional format. The fast paced instruction, however, required the least amount of instructional time to teach skills presented in these formats for both participants. Both participants also required less training time per target during training with varied trials, regardless of pace (Cariveau et al., 2016).

There is less research displaying the effectiveness of slower paced instruction. More specifically, slower paced instruction is less likely to facilitate growth among participants because the individual is more likely to attend to irrelevant stimuli as a result of taking a lengthy break in-between trials. The individual is also at risk of engaging in more distracting and problematic behaviours, as well as demonstrating poor task concentration (Francisco & Hanley, 2012).

Even though this research may give evidence to support the benefit of using short ISIs in intervention sessions, Koegel, Dunlap and Dyer (1980) suggest that many variables contribute to a precise determination of optimal pace of instruction. Among the most directly relevant variables are task characteristics such as the level of task complexity and child characteristics, such as age, memory span, attention, and level of off-task behaviour (Koegel et al., 1980). Watson (1967), suggested that the memory span of very young children for discriminated operants may be very brief, indicating that a brief ISI is most preferential and helpful for optimal learning to occur. Shorter ISIs and faster paced instruction then seem more applicable to children with ASD and DS, who often have greater challenges recalling information and are very distractible (Koegel et al., 1980). Overall, the literature suggests that manipulations of ISI duration may provide a meaningful improvement in the efficiency of teaching children with various developmental disabilities language and skill acquisition.

Much of the research mentioned above speaks to the effects of pace on individuals with ASD predominantly. However, pace of instruction also affects acquisition for children with DS. Neil and Jones (2015), manipulated trials to mastery, holding how often sessions occurred, and aspects of the intervention (i.e., who conducts intervention, where intervention occurs, and the ratio of students to interventionists) constant in a study with two children. For certain targets like “wave”, “arms up”, and “arms down” they found on average it took 9 sessions for children to reach mastery with slow- paced instruction and seven sessions during the fast-paced instruction (Neil & Jones, 2015). Conversely, for targets such as “thumbs up”, “dad”, and “drink” it took an average of 17 sessions to reach mastery in the fast-paced instruction condition and 27 sessions during the slow- paced instruction condition (Neil & Jones, 2015).

In addition, the slow- paced condition involved more intrusive prompts utilized between one and three times for each target. This did not occur in the fast- paced condition (Neil & Jones, 2015). More specifically, the fast- paced condition produced faster acquisition of language. The opportunities to mastery showed a positive relationship with increasing pace, where the greatest number of opportunities to mastery (i.e., 277 opportunities) occurred in the fast-paced condition when session duration was held constant (Neil & Jones, 2015). Ultimately, fast-paced instruction produced fewer errors, and took fewer minutes to mastery, while targets remaining un-mastered were delivered using slow-paced instruction (Neil & Jones, 2015).

Effects of Instructional Pace On Off-Task Behaviour

To date, literature suggests that the pace of instruction affects acquisition of skills in individuals with developmental disabilities. Another aspect that may affect learning acquisition is off-task behaviour. Studies show that a disproportionate number of children with developmental disabilities emit higher rates of escape and avoidance behaviours during instructional sessions (Carbone, et al., 2010). Smith (2001) suggest that children with ASD may attempt to escape or avoid teaching situations, as well as requests that adults make of them. Moreover, Pierce and Courchesne (2001) found that the presence of self-stimulatory and repetitive behaviours in children with ASD negatively impact learning and simple discrimination tasks. They found that when self-stimulatory behaviour was decreased, learning occurred at a faster and higher rate, than when self-stimulatory behaviour was at a high rate.

Likewise, recent work suggests that there may be characteristics of the DS behavioural phenotype that moderate pace of instruction, such as their greater levels of escape-motivated problem behaviour (Fey et al., 2006; Yoder and Warren, 2002). Research suggests that the high demand requirements of DTT are the same conditions that also typically evoke problem behaviour in the form of tantrums, flopping, off-task behaviour, high rates of stereotypy, aggression and self-injurious behaviour (Neil & Jones, 2015).

To date, there are currently no studies that have measured the effects of varying the pace of instruction on off-task behaviour among individuals with both DS and ASD. However, Neil and Jones (2015) reported discrepancies in the number of correct responses, and differences in problem and off-task behaviour as a function of the pace with individuals with DS. Roxburgh and Carbone (2012) found that pace affects problem and off-task related behaviour in individuals with ASD. Interventions that were delivered at a faster pace were also shown to produce lower rates of problem behaviour, and higher frequencies of instructional demands for children with ASD (Roxburgh & Carbone, 2012). These findings are also consistent with the results reported by several previous studies (Carnine, 1976; Dunlap et al., 1983; Koegel et al., 1980) who also found less disruptive behaviour as a function of fast-paced instruction. Despite these findings, Smith et al., (1995) showed that increased rates of problem behaviour occurred during faster rates of instructional demands. Previous research has found variable results in the effects of pace on challenging behaviour during instruction; this may suggest a preferred level of pace at which both children of ASD and DS acquire successful language skills while maintaining on-task behaviour.

Currently, only a small literature exists that examines pace of treatment specifically. Moreover, there is very seldom and even more limited research directly addressing pace of treatment focused on specific developmental disabilities, such as DS. Much of the existing research predominantly focuses on ASD, independent from other developmental or intellectual disabilities. As a result, interventions and services are typically tailored directly to this population alone. The current study seeks to address this gap in the literature by tailoring the intervention sessions to individuals who have a primary diagnosis of either ASD or DS. Furthermore, the current study will contribute to ABA research by looking at off-task behaviour as a function of the pace of instruction. Manipulating the pace of instruction could lead to more successful interventions while maintaining on-task behaviour and fostering on-task behaviour. The current research question will explore whether different paces of DTT instruction affect acquisition and off-task behaviour in young children with developmental disabilities.

Current Study

The purpose of this study is to manipulate the pace of DTT instruction while measuring skill acquisition and off-task behaviour in three children with developmental disabilities. In the past, off-task behaviour has been defined by repetitive vocal behaviour (i.e., saying the same sound over and over), bolting from the table, running or walking from the instructional setting, inappropriate requests that interfered with instructional demands, and self-injurious or aggressive behaviours (Roxburgh & Carbone, 2012). For the purposes of this study, off-task behaviour will be defined as pausing, looking around, and engaging in irrelevant activities with the materials for longer than two consecutive seconds. Intervention targets were taught using five assigned intensities and a single-subject alternating treatment design. A single-subject adapted alternating treatments design was used to compare different targets for each child assigned to one of five different paces of instruction (150 s, 120 s, 60 s, 40 s, 30 s).

Method

Participants

The Western University Institutional Review Board approved this study and parents provided informed and voluntary consent for participation. Three children with a developmental disability participated in the study. Jacob had a diagnosis of DS, where William and Melanie had a diagnosis of ASD. All children were between the ages of 2 and 6 years old. Participants were volunteers recruited via flyers distributed to listservs of agencies supporting families with an individual with a developmental disability and the listserv of a local Down syndrome advocacy organization. Sampling was purposive; participants were only selected to take part in the study if they met the following criteria: (a) The individual was between the ages of 2-6 years old and (b) had a diagnosis of either ASD or DS as reported by parents. Prior to intervention, participants were evaluated using The Preschool Language Scales, Fifth Edition (PLS-5; Zimmerman, Steiner & Pond, 2011), The Vineland Adaptive Behaviour Scales, Third Edition (Vineland-III; Sparrow, Cicchetti, & Saulnier, 2016). The PLS-5 (Zimmerman et al., 2011) is designed for use with children to assess language development and to identify children who have a language delay or disorder. The PLS-5 consists of two standardized scales: Auditory Comprehension (AC), to evaluate the scope of a child's comprehension of language, and Expressive Communication (EC), to determine how well a child communicated with others. The PLS-5 yields norm referenced scores including standards scores, percentile ranks and age equivalents for the AC and EC scales.

The Vineland-III (Sparrow et al., 2005) evaluates adaptive functioning in four domains: Communication, Daily Living Skills, Socialization and Motor Skills. Parents/caregivers completed the "Parent/Caregiver Rating Form" by rating each item with respect to how often the child demonstrated the behaviour on a scale of 0 (*no, never*), 1 (*sometimes, or partially*), 2 (*yes, usually*), or DK (*don't know*), although some items may be rated N (*no opportunity*).

Prior to intervention Jacob spontaneously manded and tacted vocally using one word and, occasionally, two word phrases. Jacob used simple known intraverbal phrases during songs and spontaneously used non-specific intraverbals such as "I got it". Echolalia was heard frequently. Similarly, William primarily communicated with gestures and words. He spontaneously vocally manded for a moderate number of preferred items (approx. 40) and had been observed to tact items, numbers, and letters. Echolalia was frequently observed. Finally, Melanie primarily communicated with gestures and vocalizations, spontaneously manding for a small number of preferred items and actions using vocalizations (approx. 20). She labeled a variety of preferred objects without prompts. She also manded for specific actions, including "stop", "here", and “sit”. Table 1 summarizes pre-intervention characteristics and their respective scores on the PLS and Vineland measures for each participant.

Setting and Interventionist

The intervention took place in the participants’ homes. The interventionist sat opposite to the children who were seated on a chair at a table or on the floor. Task materials were laid out on the floor or the table next to the interventionist. A video camera was set up on a tripod next to the instructional area to record each session. Three of the interventionists were master’s level graduate students in Applied Behaviour Analysis, and one interventionist was an undergraduate student with previous experience in ABA. Interventionists participated in a 3-hour training prior to intervention where each interventionist achieved fidelity of 90% or higher during a single role-play.

Materials

The interventionist video recorded all of the sessions for coding the frequency of target behaviours, intervention integrity, and interobserver agreement. For coding purposes, all videos were randomly selected using an online random number generator (Urbaniak & Plous, 2013).

The Reinforcement Assessment for Individuals with Severe Disabilities (RAISD; Fisher et al., 1996) was administered to parents as a list of preferred items to deliver as reinforcers during a single session. The RAISD is a structured parent interview that asks parents/caregivers to identify and rank potential reinforcers in order of preferences and selectivity. Preferred items were validated via a multiple stimulus without replacement preference assessment prior to intervention sessions.

Design

Five intervention target skills were randomly assigned to one of five paces of instruction. Paces were those that produced the greatest rates of acquisition in previous studies (Neil & Jones, 2015). Table 2 shows the different ISI durations assigned to each target for each child. Selected targets were taught using five different paces of instruction (30s, 40s, 60s, 120s, and 150s) during the intervention. A single-subject adapted alternating treatments design was used to evaluate skill acquisition and off-task behaviour while manipulating the pace of instruction.

Response Measurement

Skill acquisition. The targets varied across participants. The interventionist recorded child performance on one-step instructions (knock, blow kiss), textuals (labelling numbers), and intraverbals (social questions) on data sheets during each session. On each opportunity, the interventionist delivered the target intended for the child to master. Table 2 lists each participant's target, along with its respective pace of instruction. The interventionist marked an independent correct response when the child produced the target response without prompting within 3 s of the instruction. The interventionist recorded a prompted response when the child produced the target response after the target that included a prompt, which is defined later. An incorrect response was recorded when the child either did not produce the target response or produced a response other than that identified as the target response, such as engaging in off-task behaviour.

We measured three summative acquisition outcomes: trials to mastery, time to mastery and percentage of correct responding. The child achieved mastery when they gave independent correct responses during three consecutive trials within a session followed by a correct response on the first trial presented in the subsequent session (four independent correct trials). Trials to mastery was the sum of the trials presented once the intervention commenced (after baseline) through the four trials on which the child met mastery criteria. Time to mastery, was calculated by multiplying the ISI for the condition by the total number of trials to master a skill. Percentage of correct responding was the number of the correct responses throughout intervention (prompted and independent) divided by the sum of correct (prompted and independent) and incorrect responses during intervention and multiplied by 100%. These were calculated for each target when the child achieved mastery.

Off-task Behaviour. A master's level student recorded the child's behaviour 10 s before the administration of each instruction, as well as 10 s after the instruction was delivered. Before the instruction, the researcher recorded whether the child was engaged in attending behaviour, described as listening to the instructor before instruction indicative by their facial expression, level of eye contact, and responsiveness to interventionist. The child was oriented towards interventionist prior to instruction ready to receive information. After the instruction was delivered, the researcher recorded whether the child engaged in on-task, off-task, or problem related behaviour at any time during the 10 s interval following instruction. On-task behaviour was defined as sitting on the floor or seat, oriented toward the interventionist or materials, following or attempting the interventionist's directives, or seeking help in an appropriate manner (e.g., raising hand). Off-task behaviour was defined as pausing, looking around, and engaging in irrelevant activities with the materials. Lastly, problem behaviour was defined as engaging in forms of aggression (e.g., kicking, hitting, throwing objects) and disruptive behaviours during session (e.g., talking out, being out of chair, making noise, playing with objects, making faces, behaviours that interfere with task completion). Thirty-one percent of Jacob's, 33% of William's and 29% of Melanie's intervention, and maintenance sessions were randomly sampled and coded for these behaviours prior and following intervention administration. The off-task data recording sheet can be found in Appendix F.

Total percentage of attending behaviour was the number of times the child engaged in attending behaviour prior to the directive divided by the total amount of trials sampled multiplied by 100. Percent duration of off-task, on-task, and problem related behaviour was calculated by dividing the sum of seconds spent performing each behaviour, by total seconds sampled multiplied by 100.

Interobserver Agreement. To identify the interobserver agreement (IOA) for children's acquisition performance during baseline and intervention, an undergraduate student observer independently scored each child's performance during each opportunity. The interventionist provided the observer with written definitions of correct/incorrect target responses, as well as prompts given. Agreements occurred when the observer and the interventionist scored the child's response in the same way. The trial by trial IOA was calculated by dividing the number of agreements by the total number of agreements plus disagreements multiplied by 100. IOA was determined for 22.22%, 41.18%, and 34.69% of Jacob's, William's, and Melanie's sessions, respectively. Mean agreement was 86.79% (40-100%) for Jacob, 88.07% (33-100%) for William, and 88.63% (40-100%) for Melanie. IOA was determined for 50% of maintenance sessions for each participant. Agreement for Jacob was 85.5% (20-100), William was 92.5% (50-100) and Melanie was 82% (20-100). Low agreement occurred during the initial sessions and coding differences were resolved in a meeting where consensus was reached between interventionists and observers. IOA was determined for 31%, 33%, and 29% of Jacob's, William's and Melanie's sessions for attending, on-task, off-task, and problem related behaviour respectively. Partial interval recording IOA was calculated by dividing total count between coders multiplied by 100 for attending behavior in each session. Duration IOA was calculated by dividing total duration (s) of each behavior (on-task, off-task, problem related) between coders multiplied by 100. Mean agreement was 84.05% (32-100%) for Jacob, 89.95% (53-100%) for William, and 91.2% (50-100%) for Melanie.

Procedures

Pre-assessment. In a single 1.5 hr session, the interventionist obtained parental consent as well as verbal assent from the child. The interventionist explained the study to the participant, providing all the pertinent information (purpose, procedure, risks, benefits, alternatives to participation, etc.). The interventionist allowed for the parent or guardian of the child to ask as many questions as necessary. Before consent and assent, the child was given a simple explanation of what would happen to him/her and what he/she would be asked to do. Following, the child was administered the PLS-5 (Zimmerman et al., 2011) and parents completed the Vineland-III (Sparrow et al., 2005), and the Reinforcement Assessment for individuals with Severe Disabilities (RAISD; Fisher et al., 1996).

Target selection. For each alternating treatment design, five targets were identified (intraverbals, textuals, or one-step instruction targets) for the child. Targets were tailored to the child according to current areas of need based upon pre-assessment data as well as the input from the parent. Targets were selected to ensure age appropriateness, but not yet quite within the child's current communicative ability. For example, William was taught one-step responses, such as "blow kiss" and "knock" based on input from parents, pre-assessment data, and age appropriateness.

Baseline. Baseline sessions consisted of 6 trials spaced 5 minutes apart during a 30-minute session. This represented a dose that did not mirror any of the intervention conditions examined in this study. Each participant completed two baseline sessions. During each baseline trial, the interventionist presented the antecedent verbal stimulus and provided the child with a 3-s interval to produce the response. The interventionist did not deliver any kind of feedback to the child following their response (correct response, no response, or other response). The targets were all presented in a pre-determined randomized order. Praise for sitting, attending, or looking was provided noncontingently at 30 s intervals during the baseline sessions. Between opportunities, the child was presented with items identified as moderately preferred on the MSWO (Appendix B), the child's response did not influence whether these items were provided. The baseline data sheet can be found in Appendix A.

Intervention. Following the pre-assessment and baseline measures, the intervention began. Sessions occurred for 1 hour, 1-3 times per week. Each pace of instruction (150 s, 120 s, 60 s, 40 s, 30 s) was administered across five different trials during each session. For example, in the 150 s condition, the interventionist asked Melanie "What's your mom's name?" five times each spaced 150 s apart (Table 2).

Instruction occurred using DTT format. The interventionist presented structured opportunities for the child to respond. As such, at the beginning of each intervention, preference for items identified on the RAISD was assessed using a 5-item multiple-stimulus without replacement preference assessment. In an MSWO preference assessment (Appendix B), the interventionist placed an array of items in front of the child, and ask them to pick one. After the child played with the item, the interventionist removed it from the array. Each time the interventionist presented the array, was known as one trial. The interventionist repeats trials until there were no items left in the array, or until the child refuses to make any further selections. Typically, the items that child selected during the first few trials were the child's highest preferred items of the array, and the items the child selected last are the child's lowest preferred items.

The interventionist used a most-to least prompt fading hierarchy and 3-s time delay. To prompt a correct response, the interventionist used a full vocal model with the inclusion of a visual cue (a cue card with the response written). After three correct responses in a row, the interventionist faded to a partial prompt with a partial vocal model and a visual cue for Jacob and Melanie. Whereas, William received physical prompting to facilitate a correct response. After three correct responses in a row, the interventionist paused to allow the child to respond within 3-s of the prompt. If the child did not respond independently following the 3-s delay, the interventionist provided the partial prompt again. The child achieved mastery when he or she emitted an independent correct response during 3 consecutive trials within a session plus a correct response on the first trial of the next session. Intervention for each target stopped when the child met mastery criteria.

When a child demonstrated a correct response, the interventionist engaged in high quality social interactions (e.g., social praise) and provided the most preferred object identified on the MSWO conducted at the beginning of session. In contrast, incorrect responses resulted in the delivery of feedback; the interventionist said, “nice try” or “next time” and did not engage with the child for 1-3 s. The interventionist avoided the occurrence of problem related activity and did redirect the child to the task at hand. When opportunities were not being presented and reinforcement was not being delivered, the interventionist did play with the participants in an activity that the interventionist and parents identified as not highly preferred (e.g., blocks, colouring, puzzles, cards) and low on the MSWO. The session instructions can be found in Appendix C, while the intervention data sheet can be found in Appendix D.

Maintenance. One week, two-week, one month, and two month follow up probes were conducted following mastery of each target response for all participants. Maintenance was conducted following the same procedures as intervention for all conditions, however, prompts and reinforcement were not provided.

Intervention Integrity. The same observers for IOA assessed video recordings for the accurate presentation of each of the three components of intervention (i.e., presentation of opportunities, prompting procedure, and provision of appropriate consequences) on each opportunity and adherence to the pace of instruction in terms of number of opportunities, spacing, and session duration. Observers assessed 30.82% and 50% of sessions in intervention and maintenance, respectively, for procedural fidelity. The number of times the interventionist correctly presented the intervention component was divided by the total number of correct plus incorrect presentation of that component, multiplied by 100, to obtain the percentage of correctly implemented intervention procedures. Table 3 shows a comparison of the intended duration, ISI and opportunities for each manipulation with the observer's calculation of the mean session duration, ISI and number of opportunities and fidelity for the intervention steps for each pace of instruction across all children. An integrity checklist can be found in Appendix E.

Results

Skill Acquisition

During baseline, none of the children displayed the target responses in any of the five conditions. Figures 1-3 shows the cumulative independent trials during baseline and intervention for the five different paces of instruction (i.e., 150 s, 120 s, 60 s, 40 s, 30 s) using an adapted alternating treatment design for Jacob, William, and Melanie. Table 4 presents the trials to mastery, minutes to mastery, and the percentage of correct responses during intervention and maintenance phases for all participants for all ISIs.

Jacob. Jacob reached mastery (i.e. four independent correct trials consecutively) in the fewest number of trials in the “What number?” “4” condition when an opportunity was administered every 150 s (21 trials, 52.5 minutes to acquisition, responses were maintained at follow up). The second fewest trials to mastery was observed in the “What number?” “2” manipulation administered every 40 s (29 trials, 19.33 minutes, responses were maintained across three follow up conditions). These were followed by “What number?” “6” administered every 120 s (41 trials, 82 minutes to acquisition, generally maintained across follow up conditions), “What number?” “3” administered every 30 s (88 trials, 44 minutes to acquisition, generally maintained across follow up conditions), and “What number?” “5” administered every 60 s (110 trials, 110 minutes to acquisition, responses were maintained across three of the follow up conditions). Jacob’s results demonstrated that the slowest pace of instruction required fewer trials to mastery.

William. William reached mastery in the fewest number of trials in the “Show me knock” condition when an opportunity was administered every 150 s (11 trials, 27.5 minutes to acquisition, responses were maintained across all follow up conditions) and in the “Show me blow kiss” condition when an opportunity was administered every 120 s (11 trials for, 22 minutes to acquisition, responses maintained across all follow up conditions). The conditions that led to the fastest acquisition following these were “Show me tap table” administered every 60 s (13 trials, 13 minutes to acquisition, responses maintained across all follow up conditions), “Show me clap” administered every 40 s (22 trials, 14.67 minutes to acquisition, maintained targets 60% of the time across three follow up conditions), and lastly “Show me wave” administered every 30 s (86 trials, 43 minutes to acquisition, generally did not maintain targets across follow up conditions). Similar to Jacob, William's results demonstrated that slower paces of instruction required fewer trials to mastery.

Melanie. Melanie reached mastery (i.e. four independent correct trials consecutively) in the fewest number of trials in the "What's your mom's name" condition when an opportunity was administered every 150 s (29 trials, 72.5 minutes to acquisition for this target item, responses maintained across three follow up conditions). The target "How old are you?" administered every 120 s was mastered next (33 trials, 66 minutes to acquisition, responses maintained across follow up conditions). These were followed by "What city do you live in?" administered every 40 s (36 trials, 24 minutes to acquisition, responses generally maintained across follow up conditions), "What's your dad's name?" administered every 60 s (49 trials, 49 minutes to acquisition, 60% correct at one week and one month, responses generally maintained across follow up conditions), and lastly "What do you like to drink?" administered every 30 s (71 trials, 35.5 minutes to acquisition, responses maintained across three of the follow up conditions). Likewise, Melanie's results demonstrated that the slowest pace of instruction required fewer trials to mastery.

Two measures of the acquisition rate included the number of trials and time to mastery. For all children, when the ISI was longer, children mastered the target in fewer trials, compared to when the ISI was shorter. For an example, Jacob mastered his target in 21 trials when the ISI was 150 s, compared to 88 trials when the ISI was 30 s. Similarly, William mastered his target in 11 trials when the ISI was 150 s compared to 86 trials when the ISI was 30 s (Table 4). Therefore, it can be said that slower paced instruction is a more efficient pace for maximizing acquisition, when measuring acquisition by the number of trials.

When measuring acquisition by time to mastery, results were variable among the children. However, results did suggest that when the ISI was 40 s, a fast pace of instruction, children did seem to produce acquisition in less time compared to when the ISI was 150 s, a slower pace of instruction. For an example, Jacob mastered his target in 19.33 minutes when the ISI was 40 s compared to 52.5 minutes when the ISI was 150 s (Table 4). Consequentially, both Jacob and Melanie produced acquisition in the least amount of time when an opportunity was administered every 40 s, representing a faster pace of instruction. However, for William when an opportunity was administered every 60 s, he acquired acquisition in the least amount of time. Results varied across participants when measuring acquisition by minutes to mastery, suggesting no overall trend with respect to the pace of instruction and time to mastery.

Another variable to consider is the quality of acquisition across the varying paces of instruction, measured by percentage of correct responding. For both Jacob and William, the percentage of correct responses is higher when there was an opportunity delivered every 150 s and 120 s. For an example, on average Jacob demonstrated correct responding on 71% of trials when the ISI was 150 s, and 71% of trials correct when the ISI was 120 s. William, on average, achieved 100% of trials correct when the ISI was 150 s, versus 91% of trials correct when the ISI was 120 s. The data illustrate a somewhat decreasing trend in percentage of correct responses with increasing pace. Average of correct responding ranged between 30% and 100% across all conditions for all children (Table 4).

Attending Behaviour, On-task, Off-task, and Problem-Related Behaviour

We observed 31%, 33%, and 29% of both intervention and maintenance sessions for the percentage of duration in which Jacob, William, and Melanie, respectively engaged in attending behaviour, on-task behaviour, off-task behaviour, and problem-related behaviour for each condition (Table 5).

Jacob. For Jacob, the percentage of trials with attending behaviour did not differ drastically as a function of pace. Jacob demonstrated attending on the greatest number of trials when the ISI was 30 s, where he attended to the interventionist 84% of the time, and was the least attentive when the ISI was 60 s, attending 54% of the time. Although Jacob's attending behaviour was fairly stable across different paces of instruction, there were big differences between paces in which he responded correctly. For an example, Jacob attended 80% of the time when the ISI was 40 s, and responded correctly 70% of the time. In comparison, he attended 80% of the time when the ISI was 150 s, but only responded correctly 50% of the time. Overall, percentage of correct responding was generally lower than his level of attending behaviour. When the ISI was manipulated every 60 s, Jacob attended to the interventionist 54% of the time. This is also the condition that took Jacob the longest to achieve acquisition.

When investigating Jacob's overall percentage of on-task, off-task, and problem related behaviour results demonstrated variability across measures. For Jacob, results show that he demonstrated the most on-task behaviour when the ISI was manipulated every 120 s when Jacob was on-task 93% of the time. Both slow (150 s) and fast (30 s) paced instruction produced similar percentages of overall on-task behaviour, whereas on-task behaviour seemed to decrease during moderate paces of instruction (40 s ISI and 60 s ISI). When investigating Jacob's overall percentage of off-task behaviour, a similar pattern forms. When the ISI was 120 s, Jacob demonstrated the least amount of off-task behaviour where he was off-task 7% of the time. Similar levels of off-task behaviour were reported for both fast (150 s) and slow (30 s) paced instruction. Moderate paces of instruction (40 s ISI and 60 s ISI) produced the most off-task and problem related behaviour. This is in accordance with his percentage of on-task behaviour. For Jacob, the results illustrate the benefit of a relatively slow pace of instruction delivered every 120 s. This condition produced adequate attending behaviour, the highest percentage of on-task behaviour, lowest percentage of off-task behaviour, and no problem- related behaviour.

William. For William, the percentage of attending behaviour did change as a function of pace. For an example, when we manipulated the ISI to a 150 s interval, William attended to the interventionist 100% of the time prior to instruction. In like manner, when the ISI was 120 s, William attended to the interventionist 80% of the time. In contrast, when the ISI was 60 s, 40 s, and 30 s William was attentive for 50%, 2%, and 48%of the opportunities respectively. Like Jacob, there were differences in the same conditions in which he responded correctly. For an example, William was attentive 100% of the time when the ISI was 150 s, and responded correctly 100% of the time. In contrast, William was attentive for only 50% of the time when the ISI was 60 s, yet also responded correctly 100% of the time. Even though William shows a somewhat decreasing trend in his ability to attend to the interventionist as a result of increasing pace, he was still able to respond correctly over 50% of the time. Moreover, even though the 60 s ISI condition was responsible for the fastest acquisition in the least amount of trials, William only attended half of the time.

William’s overall percentage of on-task, off-task, and problem related behaviour demonstrate a similar pattern. Notably, William was on-task more often when there was more time between opportunities, or when the target was delivered at a slower pace. For an example, William was reported on-task 100% of the time when the ISI was 150 s, compared to 44% of the time when the ISI was 30 s. Moreover, off-task behaviour also heightened as the pace of instruction became faster. For instance, William was off-task 0% of the time when the ISI was

150 s, compared to 56% of the time when the ISI was 30 s. Despite the percentage of time William engaged in off-task behaviour, he did not exhibit any problem related behaviour 10 s following intervention. Collectively, William's results may advocate for slow paced instruction when teaching new skills, and maintaining task persistence.

Melanie. For Melanie, the percentage of attending behaviour also changed depending on the pace of instruction. For an example, when we manipulated the ISI to a 150 s, and 120 s, Melanie attended to the interventionist 60% of the time prior to instruction. When the ISI was of shorter duration, Melanie seemed to become more responsive to the interventionist. As such, when the ISI was 40 s long, Melanie was demonstrating attending behaviour 100% of the time, compared to 90% in the 30 s condition and 87% in the 60 s condition. In contrast to both Jacob, and William, Melanie may be the most attentive when intervention is taught at a faster pace, rather than slower pace. However, even though Melanie results indicate the benefit of a past paced instruction, there are discrepancies in correct responding. For an example, even though Melanie was able to attend to the interventionist 100% of the time in the 40 s condition, she only responded correctly 40% of the time. Even when Melanie was attending to the interventionist 60% of the time (150 s ISI and 120 ISI) there was drastic differences in correct responding. For an example, Melanie was able to correctly respond 70% of the time when the ISI was 120 s, compared to only 10% of the time when the ISI was 150 s.

Following the administration of intervention, Melanie engaged in the most on-task related behaviour when the ISI was shorter compared to longer. For an example, Melanie was on-task 100% of the time when the ISI was 40 s, in opposition to 51% when the ISI was 150 s. Her overall percentage of off-task behaviour models a similar paradigm. Melanie was off-task 30% of the time when the ISI was 150 s, compared to 0% when the ISI was 40 s. Melanie also demonstrated the most problem-related behaviour when the ISI was longer at 150 s. Melanie achieved acquisition in the fewest amount of trials when the ISI was 40 s. This condition also seemed optimal for producing the most attending and on-task behaviour, and the least amount of off-task and problem related behaviour.

Discussion

In the current study, we employed an adapted alternating treatments design for evaluating which pace of instruction produced the most efficient skill acquisition for children with developmental disabilities in need of communication intervention. In order to examine how varying intensity levels of a behavior analytic intervention affect acquisition and off-task behaviour, we manipulated five different paces of instruction (30 s, 40 s, 60 s, 120 s, and 150 s) during the intervention.

Results from the three children demonstrated that slower paces of instruction led to children mastering the target in fewer trials. With regards to minutes to mastery, results differed based on the child. For Jacob, a faster pace of instruction (40 s ISI) led to acquisition in the least amount of time. In contrast, for William, a moderate pace of instruction (60 s ISI) led to acquisition in the least amount of time. Melanie achieved mastery in the least amount of instructional time when the pace was relatively fast (40 s ISI). Overall, the pace of instruction that resulted in fastest acquisition in the least amount of time is individualized for each child.

Notable differences were also reported for their overall percentage of correct responses. For both Jacob and William, slower paced instruction was associated with a higher percentage of correct responses. Melanie was more inconsistent in the conditions which produced the highest percentage of trials with correct responses. Children also showed differences as a function of pace in their overall level of attending, on-task, off-task and problem related behaviour. However, the conditions that produced the highest rates of each behaviour varied across children.

Determining how best to meet the needs of learners with developmental disabilities requires modifying the pace of instruction as one approach to tailoring intervention to this population (Cariveau et al., 2016). Previous research on the effects of pace on intervention (Dunlap et al., 1983; Koegel et al., 1980; Neil & Jones, 2015) suggests that the spacing of opportunities, or ISI, is an important predictor of acquisition. Previous examinations of ISIs, showed that shorter ISI durations were associated with fewer trials to mastery (Koegel et al., 1980), fewer minutes to mastery (Carniveau et al., 2016) and higher rates of correct responding during instruction (Carnine, 1976; Dunlap et al., 1983). Inconsistent with the studies mentioned above, we did not find that shorter ISI durations were associated with fewer trials to mastery. Rather, we found that shorter ISI durations were associated with more trials to mastery, and lower rates of correct responding for both Jacob and William. Alternatively, longer ISI durations produced the fewest number of trials to acquisition, and higher rates of correct responding for Jacob and William but not Melanie. Contrary to the literature, there was no consistent trend found with respect to pace and time to mastery.

An explanation as to why our results did not align with findings in previous literature may be a result of pre-intervention differences among our participants. In the present study, all children had no previous exposure to early behavioural intervention (EIBI). EIBI is based on the principles of ABA, and is an intensive home-based intervention involving comprehensive programming for upwards of 40 h per week (Reichow, 2012). In previous studies (Cariveau et al., 2016; Neil & Jones, 2015; LaRue et al., 2016; Roxburgh & Carbone, 2012) most of the children had received EIBI or prior community-based, home-based, or school-based intervention using the principles of

ABA. These earlier mediation efforts may have contributed to faster paced instruction producing fewer trials to mastery. Empirical results of the effects of EIBI also show that children maintain the skills they learned through EIBI for a long time. For an example, Reichow and Wolery (2009), demonstrated that children maintained skills taught for six years following intervention. Therefore, it is likely that future intervention outcomes will be influenced by prior participation. It is possible that children who received prior EIBI respond more positively to some paces in comparison to others. Consequentially, perhaps slower paces of instruction produced acquisition in the least amount of trials for children in this study because it was the first time they were exposed to this type of intervention. Paces at which they performed well in in the past, could have a direct impact on which pace is the most efficient for maximizing learning now.

Understanding which pace of instruction results in more efficient skill acquisition depends on how acquisition is measured. Neil and Jones (2015), discuss the benefits of including multiple measures of acquisition when manipulating ISI length. One benefit of incorporating multiple acquisition outcomes allows for the identification of the most appropriate pace for maximizing learning. For an example, in some contexts, it is crucial for learning to occur in a condensed amount of time (e.g., to teach a student a new concept to better prepare them for a test; Neil & Jones, 2015); in this situation, for Melanie, a faster pace of instruction would be warranted. In other situations, minimizing the number of opportunities may take priority (e.g., in a setting where the instructor has to multi-task between helping students; Neil & Jones, 2015); in this situation, for all participants a slower pace of instruction is more ideal. Based on the results of our analysis, offering intervention at a pace that accounts for learning in both the fewest amount of trials and minutes may be the condition that is the most optimal. In the present study, when the ISI was manipulated every 40 s, children mastered their target in few minutes and trials. For these children, a moderately fast pace of instruction maximized the efficiency of acquisition according to multiple measures.

There may also be characteristics associated with both ASD and DS that moderate the effects of pace. Persons with ASD and DS often engage in challenging behaviours. For children with ASD and DS the instructional demands presented during intervention typically evoke off-task behaviour through forms of aggression, destruction, screaming, and or disruptive behaviours (Roxburgh & Carbone, 2012). We assessed the effect of off-task behaviour as a function of pace.

When we manipulated the pace of instruction, results varied for Jacob, William and Melanie. The conditions which produced the most efficient learning did not produce the greatest percentage of attending behaviour or the lowest rates of off-task behaviour. Results from this study may suggest that pace alone may not impact attending and off-task behaviour. Throughout intervention sessions, there were variables that could have impacted the child's ability to attend to the interventionist. Specifically, the child seemed more distracted when playing with the reinforcer from the previous trial. At times, removal of these reinforcers were the exact conditions that produced off-task behaviour and/or problem-related behaviour. Additionally, because the intervention took place in participant homes, it was expected that parents were interested in their child's ABA program. For the most part, parents weren't present during intervention sessions. However, on occasion, the parent was within the child's immediate view. As a result, their child seemed more distracted and every so often displayed more off-task and problem behaviour. In consequence, parental presence occasionally interfered with their child's ability to attend to the interventionist's directives. Noteworthy, as well, were environmental stimuli (i.e., DVD players, floor mats, and other toys) that ultimately made it more difficult for them to remain on- task, ready to receive instruction. In an attempt to limit parental presence and environmental stimuli present during instruction, future research should be more cautious when choosing an intervention setting. For an example, choosing a room that is not in a common area of the home, and that does not contain objects that are appealing to the child will be most optimal for learning to occur.

Previous research has found variable results in the effects of pace on challenging behaviour during instruction. For example, Roxburgh and Carbone (2012) found greater rates of off-task behaviour with faster paces of instruction, while other studies found that off-task behaviour diminishes as the pace of instruction increases (Dunlap et al., 1983; Carnine, 1976). Smith et al. (1995) warned, however, that these results may be difficult to interpret because faster paced sessions always included a greater number of demands. Therefore, pace is often confounded by a number of demands, rendering interpretation difficult.

Limitations and Future Research

There may be uncontrolled aspects of pace that affected the outcomes. Therefore, there are a number of limitations that should caution the interpretation of the results. Among the most directly relevant variables are characteristics of the child, and how those characteristics interact with pace. None of the children that participated in the current study received prior behavioural intervention. It is possible that this absence of previous intervention had an effect on pace. As such, children who receive EIBI are at an advantage because they have a learning history with the same type of instruction as presented in this study compared to children who don’t have previous exposure to EIBI. Research suggests, that it is possible for a child who has received EIBI in their past, to make large gains in IQ and/or adaptive behaviour (Reichow, 2012; Eldevik et al., 2009; Makrygianni & Reed, 2010; Reichow & Wolery, 2009).

Ensuring equal difficulty of targets is fundamental to conducting a valid comparison with an adapted alternating treatments design. Within our procedures, we selected targets in the same domain which appeared to be of similar difficulty, and randomly assigned them to an ISI manipulation. With respect to the child, there is a chance that some targets were easier to achieve than others. For an example, we did not control for the fact that the child may have had previous exposure to one target more than the other. Ultimately, the child's level of familiarity with the target may have resulted in differences in acquisition rates. Additionally, we could not control for individual target differences despite belonging to the same domain. Despite equalizing across categories, there were different qualities about the target that could have influenced the level of target difficulty. For instance, for spoken words, some phonemes may be harder to produce. All together, these uncontrolled aspects may have influenced the child's off-task and on-task behaviour measures; a child may have engaged in more on-task behaviour if asked to produce a less difficult response. A follow up study may replicate these procedures using a between-group randomized experiment. In this way, targets can be assigned randomly or counterbalanced across strategies. Acquisition targets can be taught at both fast and slow paces with different children, ensuring the difficulty is the same for both paces of instruction.

Designing intervention studies and identifying relevant outcome measures is only one of the challenges of intervention research. Although we have discussed potential child characteristics that might interfere with learning, another complication arises when characteristics of the interventionist interferes and has a direct impact on pace of instruction. Anecdotally, we noticed differences throughout sessions in the interventionists' ability to remove distracting stimuli, interact with the child in between trials, and maintain consistency in level of praise and recognition following a correct response. Even though procedural fidelity was high (Table 3) across conditions controlling for this validity threat, the nature of the design may make these components difficult to maintain due to the rapid iterative alternation between conditions. Future research should explore whether discrepancies found in interventionist responding affects learning and off-task behaviour among children with developmental disabilities.

Ledford et al. (2015) indicate that partial interval recording has been widely used in behavioural sciences for estimating behaviour occurrences. However, it also serves as a possible limitation. For this research, attending behavior was analyzed through partial-interval time sampling 10s prior to intervention to measure count. Serious weaknesses of partial interval recording include inaccurate estimates of count, and an overestimate of the child's behavior. It is possible that partial-interval time sampling did not capture a true estimate of the occurrence of all levels of our dependent variable. In addition, only 30% of intervention and maintenance sessions were sampled, thus it is possible that our sample does not reflect a true estimate of behavioural occurrence. Although IOA for off-task behavior was satisfactory (i.e., above 80%), there is always a level of subjectivity involved in coding behaviors. Ultimately, this subjectivity between coders was reflective in the overall ranges of IOA across participants in this study, making the data less reliable.

Future Directions

These findings can be useful for both practitioners in community agencies, as well as educators within the school system. More specifically, results from this study can help guide clinicians in developing effective intervention instruction for children with ASD and DS. Practitioners need to balance the need for children to learn quickly with other behaviours occurring during intervention, like their level of off-task and on-task related activity. Generally, off-task behaviour did not decrease even in the most favourable condition for learning. Therefore, over time, these behaviours may have a direct impact on the child's ability to learn effectively.

Results may be useful in determining how best to meet individual learning needs. This relatively brief intervention may serve as a tool when investigating how other children learn best and most effectively. This model could serve as a brief assessment method for differentiating instruction. The use of an adapted alternating treatments design (ATD) allows us to compare which intervention is most effective by looking at response differentiation across conditions. Another desirable characteristic of using ATDs, allows for ruling out threats to internal validity to further provide evidence for the functional relation between the behaviour of interest and the treatment condition. Follow-up studies should investigate whether results produced during initial alternation of conditions also predict long-term responding.

Contributions & Conclusion

Currently, there is only a small body of literature that addresses varying paces of instruction during discrete trial teaching. Moreover, discrete trial teaching research typically focuses on specific disorders like ASD more frequently than DS. Research surrounding DS is limited and as a result many interventions fail to deliver services to this population. This study extends previous research on treatment intensity by the inclusion of children with different diagnoses. Furthermore, few studies, among individuals with developmental disabilities address the effects of pace of instruction on maintenance and generalization. Given that varying the level of pace produces variable results in acquisition during intervention, it follows that pace of instruction could affect how long skills are maintained, and whether or not that skill persists in a variety of contexts. The current study adds to the research by including maintenance conditions for each child at one week, two weeks, one month and two months later.

Investigating pace of intervention requires both careful consideration, and effective research designs to understand the complexity of treatment intensity. Understanding which pace of instruction children learn best in depends on how we measure acquisition. Using five different paces of instruction, this research suggests that children acquired skills in fewer trials when the pace of instruction was slower. Likewise, both Jacob and William had a higher percentage of correct responding when the pace of instruction was slower. On the other hand, there were individual differences found for all children with respect to the amount of time spent before mastery and off-task behavior. It is likely, however, that different interventions, different individual characteristics, and different targeted skill areas will produce different findings. In sum, we hope results from this study, can help inform future research that will address the needs of children with developmental disabilities with respect to pace of intervention treatment.

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Table 1

Pre-intervention participant characteristics.

Participant	Jacob	William	Melanie
Age	4	2	5
Diagnosis	DS	ASD	ASD
PLS-5 (EL)	60	77	55
PLS-5 (AC)	63	57	50
PLS-5 (TOT)	59	65	50
PLS-5 Age Equivalent	2yr 4mo	1yr 6mo	1yr 11mo
Vineland (COMM)	71 (3rd percentile)	54 (<1st percentile)	63 (1st percentile)
Vineland (SOC)	70 (2nd percentile)	69 (2nd percentile)	79 (8th percentile)
Vineland Composite	70 (2nd percentile)	55 (<1st percentile)	68 (2nd percentile)

Table 2

Targets assigned to each pace of instruction.

ISI	Jacob	William	Melanie
150s	What number? “4”	Knock	“What is your mom’s name?”
120s	What number? “6”	Blow Kiss	“How old are you?”
60s	What number? “5”	Tap Table	“What is your dad’s name?”
40s	What number? “2”	Clap	“What city do you live in?”
30s	What number? “3”	Wave	“What do you like to drink?”

Table 3

Pace manipulations and procedural fidelity during intervention and maintenance.

Programmed Pace			Obtained Pace			
			Intervention		Maintenance	
ISI (s)	Duration (s)	Trials	Mean ISI (s)	Mean steps delivered correct (%)	Mean ISI (s)	Mean steps delivered correct (%)
150	750 (12.5 min)	5	150 (149-150.75)	96.19 (93.56-98.37)	153.21 (150.88-155.25)	96.80 (94.95-98.15)
120	600 (10 min)	5	119.75 (115.00-131.25)	93.82 (89.13-98.37)	120.95 (120.38-121.46)	95.52 (93.73-98.27)
60	300 (5 min)	5	66.40 (60.25-75.25)	91.62 (86.51-96.11)	70.96 (61.00-90.25)	91.23 (81.95-100)
40	200 (3.33 min)	5	50.88 (47.25-57.13)	91.59 (81.93-98.37)	42.54 (40.13-46.50)	95.39 (92.18-97.30)
30	150 (2.5 min)	5	32.97 (30.63-35.30)	93.14 (91.34-94.51)	35.92 (30.38-46.88)	93.57 (87.26-96.76)

Table 4

Opportunities to mastery, minutes to mastery, % correct responding, and follow-up at one week, two weeks, one month, and two months for each pace of instruction for Jacob, William and Melanie.

	Intervention			Maintenance			
ISI (s)	Opportunities to Mastery	Minutes to mastery	% Correct	1 Wk (%)	2 Wk (%)	1 Mo (%)	2 Mo (%)
Jacob							
150	21	52.5	71	100	100	80	100
120	41	82	71	100	80	60	100
60	110	110	58	0	100	80	80
40	29	19.33	69	100	100	40	100
30	88	44	61	80	60	100	100
William							
150	11	27.5	100	80	100	100	100
120	11	22	91	100	80	100	80
60	13	13	92	100	100	100	100
40	22	14.67	59	60	100	60	60
30	86	43	52	40	20	20	20
Melanie							
150s	29	72.5	48	100	40	100	100
120s	33	66	76	100	80	100	100
60s	49	49	33	60	100	60	80
40s	36	24	50	100	60	80	80
30s	71	35.5	30	100	60	100	100

Table 5.

Attending Behaviour, On-task Behaviour, Off-task Behaviour, and Problem- Related Behaviour for each pace of instruction for Jacob, William and Melanie.

ISI	Percentage of Attending Behaviour	Percentage of On-task Behaviour	Percentage of Off-task Behaviour	Percentage of Problem Related Behaviour
Jacob				
150s	80	80	20	0
120s	80	93	7	0
60s	54	55	26	19
40s	80	59	41	0
30s	84	82	17	1
William				
150s	100	100	0	0
120s	80	95	5	0
60s	50	85	15	0
40s	2	67	33	0
30s	48	44	56	0
Melanie				
150s	60	51	30	19
120s	60	88	10	2
60s	87	85	15	0
40s	100	100	0	0
30s	90	86	9	6

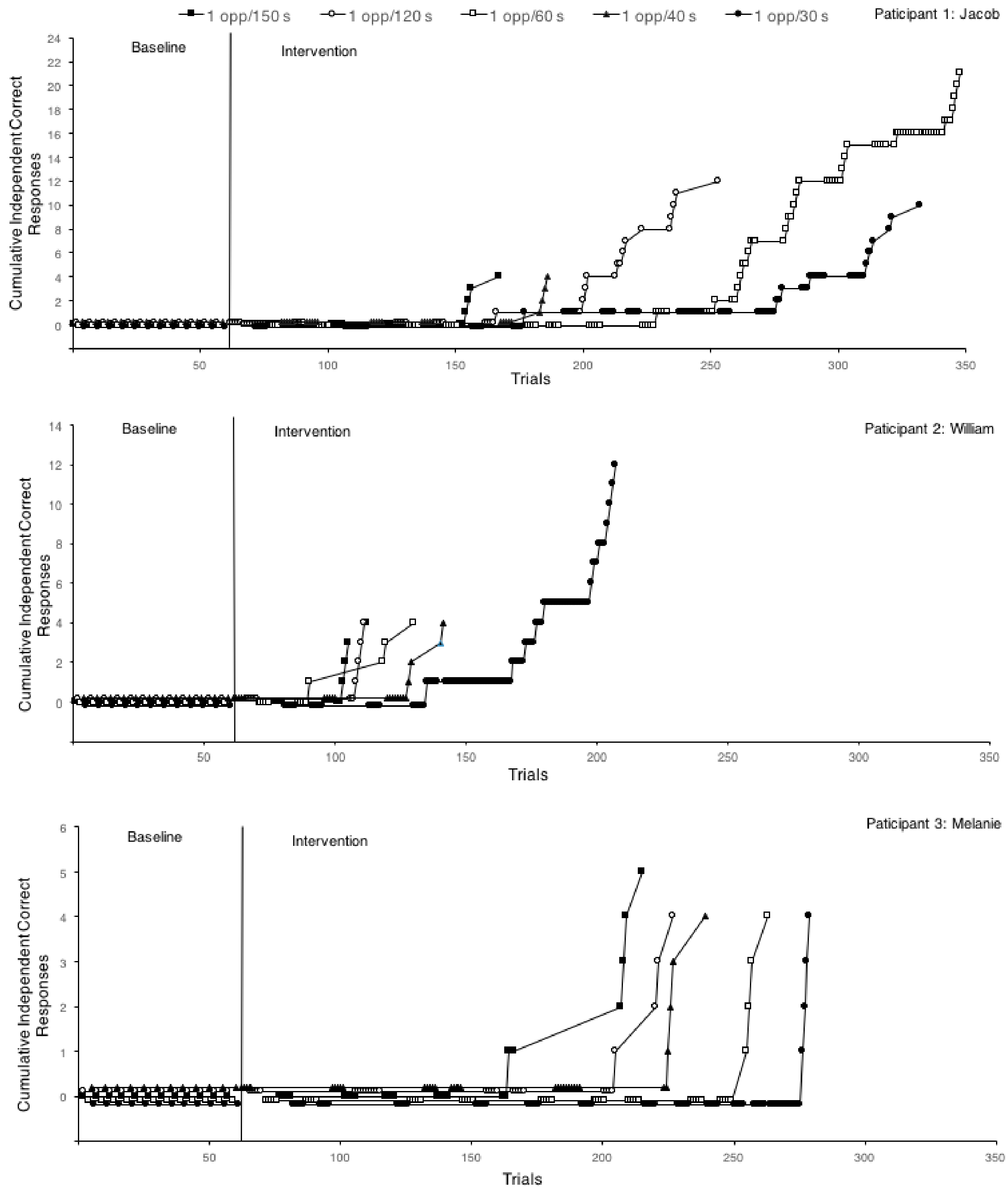

Figure 1. Cumulative independent correct responses for with Jacob, William and Melanie for each intervention target for each ISI

Appendix A

Baseline Data Sheet

Participant #:________Instructor Initials: _________Date: ___________ Session #:_______

1. Instructor will sit across from or beside child
2. Provide appropriate S^d (e.g. “Do this”)
3. Wait 3 seconds for the child to respond
4. **Correct:** Provide no response, **Incorrect**: Provide no response
5. Provide R+ (e.g. tangibles, praise) for sitting, attending, looking, every 30 s

Skill Area:
S^d:
Correct Response: Child provides appropriate response in 3 s

Session #1						
Date:						
Time:	**0:00**	**5:00**	**10:00**	**15:00**	**20:00**	**25:00**
	Probe 1	**Probe 2**	**Probe 3**	**Probe 4**	**Probe 5**	**Probe 6**
Target						
	+ −	+ −	+ −	+ −	+ −	+ −
	+ −	+ −	+ −	+ −	+ −	+ −
	+ −	+ −	+ −	+ −	+ −	+ −
	+ −	+ −	+ −	+ −	+ −	+ −
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	+ −	+ −	+ −	+ −	+ −	+ −

Session #2						
Date:						
Time:	**0:00**	**5:00**	**10:00**	**15:00**	**20:00**	**25:00**
	Probe 1	**Probe 2**	**Probe 3**	**Probe 4**	**Probe 5**	**Probe 6**
Target						
	+ −	+ −	+ −	+ −	+ −	+ −
	+ −	+ −	+ −	+ −	+ −	+ −
	+ −	+ −	+ −	+ −	+ −	+ −
	+ −	+ −	+ −	+ −	+ −	+ −
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	+ −	+ −	+ −	+ −	+ −	+ −

	+ −	+ −	+ −	+ −	+ −	+ −

Generalization Data Sheet

Participant #:________Instructor Initials: _________Date: ___________ Session #:_______

1. Instructor will sit across from or beside child
2. Provide appropriate S^d (e.g. "Do this")
3. Wait 3 seconds for the child to respond
4. **Correct:** Provide no response, **Incorrect**: Provide no response
5. Provide R+ (e.g. tangibles, praise) for sitting, attending, looking, every 30 s

Skill Area:
S^d:
Correct Response: Child provides appropriate response in 3 s

Session #1						
Date:						
Generalization Person:						
Time:	**0:00**	**5:00**	**10:00**	**15:00**	**20:00**	**25:00**
	Probe 1	**Probe 2**	**Probe 3**	**Probe 4**	**Probe 5**	**Probe 6**
Target						
	+ –	+ –	+ –	+ –	+ –	+ –
	+ –	+ –	+ –	+ –	+ –	+ –
	+ –	+ –	+ –	+ –	+ –	+ –
	+ –	+ –	+ –	+ –	+ –	+ –
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Session #2						
Date:						
Generalization Person:						
Time:	**0:00**	**5:00**	**10:00**	**15:00**	**20:00**	**25:00**
	Probe 1	**Probe 2**	**Probe 3**	**Probe 4**	**Probe 5**	**Probe 6**
Target						
	+ –	+ –	+ –	+ –	+ –	+ –
	+ –	+ –	+ –	+ –	+ –	+ –
	+ –	+ –	+ –	+ –	+ –	+ –
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	+ −	+ −	+ −	+ −	+ −	+ −
	+ −	+ −	+ −	+ −	+ −	+ −

Appendix B

MSWO for 5 items

Item A: ______________________________ Sum of trial #s for A:______________________

Item B: ______________________________ Sum of trial #s for B:______________________

Item C: ______________________________ Sum of trial #s for C:______________________

Item D: ______________________________ Sum of trial #s for D:______________________

Item E: ______________________________ Sum of trial #s for E:______________________

Date:		
Child name:		
Teacher name:		
Trial #	**Item selected**	**Placement of item selected**
1		X X X X X
2		X X X X
3		X X X
4		X X
5		X

Date:		
Child name:		
Teacher name:		
Trial #	**Item selected**	**Placement of item selected**
1		X X X X X
2		X X X X
3		X X X
4		X X
5		X

Date:		
Child name:		
Teacher name:		
Trial #	**Item selected**	**Placement of item selected**
1		X X X X X
2		X X X X
3		X X X
4		X X
5		X

Date:		
Child name:		
Teacher name:		
Trial #	**Item selected**	**Placement of item selected**
1		X X X X X
2		X X X X
3		X X X
4		X X
5		X

Highest preferred items (lowest summed trial #s):
Moderately preferred items (moderate summed trial #s):
Lowest preferred items (highest summed trial #s):

Appendix C

Session Instructions:

Arrival/Greetings at the home:	Arrive 15 minute early for scheduled session.
	Greet the family by saying "hello" and briefly discuss the child's day.
	Make any notes specific information reported by caregivers on the specific day.
Prior to beginning session:	Determine an appropriate workplace for the session with a table and chairs.
	Set up the camera and test the camera to make sure it is recording and the child is in view on the camera.
	Gather necessary materials: i.e. data sheets, timer/buzzer, pen, highlighters etc.
	Gather potential reinforcers that will be included in the preference assessment.
	Place token board visibly on the table.
	Double check condition order/data sheet order.
Session with the child:	Greet the child!
	Spend ~5 minutes pairing with the child whereby no/little demands are placed on the child. Be enthusiastic and have fun with the child!
Preference Assessment:	Conduct a (brief) MSWO to identify potential reinforcers.
	Record the stimulus selected on the MSWO data sheet.
	Determine what the child is working for and write it on the token board.
Discrete Trial Teaching:	Step-by-step Instructions for Implementation: 1. Place materials in front of learner 2. Present SD 3. Prompt (as specified) 4. Response 5. Reforce (Consequence for a correct or incorrect response) 6. Inter-trial interval See treatment integrity checklist for further instructions.
	Record data after each trial and record the inter-trial interval time.
Completion of Session:	Stop recording on the camera once all trial are completed.
Clean up:	Have the child clean up any toys they were playing with during the session.
	Complete a communication log and discuss with the parents skills to work on at home for the week.
Departure:	Say "goodbye" to the child.
	Gather all materials and leave the household.

Appendix D

Participant #:________Session #: _________Date: ___________Interventionist #:________

Intervention Data Sheet – Number of Opportunities Held Constant

1. Instructor will sit across from or beside child
2. Provide appropriate S^d (e.g. "Do this")
3. Provide appropriate prompt
4. Wait 3 seconds for the child to respond
5. **Correct:** Deliver reinforcer (Praise, preferred items) **Incorrect**: Provide error correction procedure

Skill Area:
S^d:
Correct Response:

FP = Full prompt **PP = Partial prompt** **NP = No prompt**

Target: **Order: ___________** **1 opportunity/2.5 minutes**		
Trial #	**Correct (+) Incorrect (-)**	**Prompt Provided**
1.	+ −	
2.	+ −	
3.	+ −	
4.	+ −	
5.	+ −	
Target: **Order: ___________** **1 opportunity/2 minutes**		
Trial #	**Correct (+) Incorrect (-)**	**Prompt Provided**
1.	+ −	
2.	+ −	
3.	+ −	
4.	+ −	
5.	+ −	
Target: **Order: ___________** **1 opportunity/1 minutes**		

Target: **Order: ___________** **1 opportunity/40 seconds**		
Trial #	**Correct (+) Incorrect (-)**	**Prompt Provided**
1.	+ −	
2.	+ −	
3.	+ −	
4.	+ −	
5.	+ −	
Target: **Order: ___________** **1 opportunity/30 seconds**		
Trial #	**Correct (+) Incorrect (-)**	**Prompt Provided**
1.	+ −	
2.	+ −	
3.	+ −	
4.	+ −	
5.	+ −	

Trial #	**Correct (+) Incorrect (-)**	**Prompt Provided**
1.	+ −	
2.	+ −	
3.	+ −	
4.	+ −	
5.	+ −	

Appendix E
TRAINING PROCEDURAL INTEGRITY CHECKLIST: TEMPLATE

TRAINING PROCEDURAL INTEGRITY CHECKLIST: (TEMPLATE)

Staff:____________ Observer:______________ Student Initials: __________
Date: ___________ Time start/end: _________

Total Items: __________	Key: + happened - Did not happen N/A if not applicable
Total Items marked: __________	
PI Ratio: ___________	

#	Procedure	Check
Prior to Intervention:		
1	Data collection materials ready	
2	Data sheet has child's initial, teacher, date and time indicated	
3	Table & seating arrangement set up	
4	Materials/items ready	
5	Child is seated and attending to interventionist before starting trials	
MSWO Procedures:		
6	Places 5 Items on Table and say, "Pick one".	
7	Waits for child response and provides child with 10 s of item access	
8	Removes all items	
9	Places 4 items on table and says, "Pick one"	
10	Waits for child response and provides child with 10 s of item access	
11	Removes all items	

12	Places 3 items on table and says, “Pick one”	
13	Waits for child response and provides child with 10 s of item access	
14	Removes all items	
15	Places 2 items on table and says, “Pick one”	
16	Waits for child response and provides child with 10 s of item access	
17	Removes all items	
18	Places 1 items on table and says, “Pick one”	
19	Waits for child response and provides child with 10 s of item access	
20	Removes all items	

Intervention Administration:

	Trial #									
	1	2	3	4	5	6	7	8	9	10
21	Set Timer for ___ seconds using motivador timer.									
22	Present the appropriate S^d									
23	Provide appropriate prompt									
24	Wait 3 s for response									
25	Provide correct consequence (reinforcement “that’s right it’s a ___” or or for an incorrect response “nice try”)									
26	Remove Previous Item(s) Presented									
27	Deliver next trial immediately after timer goes off. (Indicate the time (numerical value) taken to present next trial)									

	Target Interstimulus Interval: | | | | | | | | | | | **Observed Interstimulus Interval:** | | | | | | | | | | | Calculate the average interstimulus interval for each trial: ___________	
28	Exchanges token board after ___ trials and delivers 1 min of access to preferred item	
29	Provides 5 minute break in between sessions	
Notes or Comments:		

Interstimulus Interval Held Constant:

TRAINING PROCEDURAL INTEGRITY CHECKLIST: Interstimulus Interval Held Constant		
Staff:____________ Observer:______________ Student Initials: __________ Date: ___________ Time start/end: _________		
Total Items: __________ Total Items marked: __________ Percent Correct: ___________ Key: + happened - Did not happen N/A if not applicable		
#	**Procedure**	Check
Prior to Intervention:		

1	Data collection materials ready	
2	Data sheet has child's initial, teacher, date and time indicated	
3	Table & seating arrangement set up	
4	Materials/items ready	
5	Child is seated and attending to interventionist before starting trials	
MSWO Procedures:		
6	Places 5 Items on Table and say, "Pick one".	
7	Waits for child response and provides child with 10 s of item access	
8	Removes all items	
9	Places 4 items on table and says, "Pick one"	
10	Waits for child response and provides child with 10 s of item access	
11	Removes all items	
12	Places 3 items on table and says, "Pick one"	
13	Waits for child response and provides child with 10 s of item access	
14	Removes all items	
15	Places 2 items on table and says, "Pick one"	
16	Waits for child response and provides child with 10 s of item access	
17	Removes all items	
18	Places 1 items on table and says, "Pick one"	
19	Waits for child response and provides child with 10 s of item access	
20	Remove all items	
Intervention Administration:		
	Trial #	

1	2	3	4	5	6	7	8	9	10

21	Set Timer for ___ seconds using motivador timer.	
22	Present the appropriate S^d	
23	Provide appropriate prompt	
24	Wait 3 s for response	
25	Provide correct consequence (reinforcement “that’s right it’s a ___” or or for an incorrect response “nice try”)	
26	Remove Previous Item(s) Presented	
27	Deliver next trial immediately after timer goes off. (Indicate the time (numerical value) taken to present next trial) **Target Interstimulus Interval:** 30 30 30 30 30 **Observed Interstimulus Interval:** Calculate the average interstimulus interval for each trial: ___________	
28	Exchanges token board after ___ trials and delivers 1 min of access to preferred item	
29	Provides 5 minute break in between sessions	
Notes or Comments:		

Appendix F:

Intervention Data Off-task Sheet

	Target: 1 opportunity/2.5 Minutes					
Trial #	**Correct (+) Incorrect (-)**	**Time**	**Attending behavior (10 seconds before)**	**On-task behavior**	**Off-task behavior**	**Problem behavior**
1.	+ −					
2.	+ −					
3.	+ −					
4.	+ −					
5.	+ −					

Target: 1 opportunity/40 seconds						
Trial #	**Correct (+) Incorrect (-)**	**Time**	**Attending behavior (10 seconds before)**	**On-task behavior**	**Off-task behavior**	**Problem behavior**
1.	+ −					
2.	+ −					
3.	+ −					
4.	+ −					
5.	+ −					

Target: 1 opportunity/1 minute						
Trial #	**Correct (+) Incorrect (-)**	**Time**	**Attending behavior (10 seconds before)**	**On-task behavior**	**Off-task behavior**	**Problem behavior**
1.	+ −					
2.	+ −					
3.	+ −					

4.	+ −					
5.	+ −					

Target: **1 opportunity/2 minutes**						
Trial #	**Correct (+) Incorrect (-)**	**Time**	**Attending behavior (10 seconds before)**	**On-task behavior**	**Off-task behavior**	**Problem behavior**
1.	+ −					
2.	+ −					
3.	+ −					
4.	+ −					
5.	+ −					

Target: **1 opportunity/30 seconds**						
Trial #	**Correct (+) Incorrect (-)**	**Time**	**Attending behavior (10 seconds before)**	**On-task behavior**	**Off-task behavior**	**Problem Behavior**
1.	+ −					
2.	+ −					
3.	+ −					
4.	+ −					
5.	+ −					

Carly Esipu

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Bachelor of Arts (*Psychology Honours Specialization, major Sociology)* 2012-2016
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- Thesis: Exploring Gender Stereotypes Through Self- Determination Theory and Psychological Well-being
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Master of Arts (*M.A in Counselling Psychology)* 2017-2019
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Academic Awards:

Dean's Honour List, King's University College	2013, 2014, 2015, 2016
Entrance Scholarship, King's University College	2012, 2013, 2014, 2015,
Graduate Student Assistantship Contract	2017, 2018

Related Experience:

Psychological Services, TVDSB	2018/2019
Facilitator, London Family Court Clinic	2018/2019
St. Joseph's Hospice, London	2018-/2019
Co Facilitator, The University of Western Ontario	2017
Intervenor, Deaf Blind Ontario Services London	2017
Direct Support Professional, Community Living London	2016- 2019
Direct Support Professional, Participation House London	2016
LaRose Psychology, Private Practice, London	2016
Couch Crew/ Event Volunteer, HIV/AIDS Connection	2016
Peer Support Mentor, Connect for Mental Health/LHSC	2015
Dale Brain Injury Services, London	2015