Spring 2020

Evaluating Changes in PEAK and IQ Scores in Children With Autism Following a PEAK Treatment Program

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EVALUATING CHANGES IN PEAK AND IQ SCORES IN CHILDREN WITH AUTISM FOLLOWING A PEAK TREATMENT PROGRAM

A Master's Thesis

Presented to

The Graduate College of

Missouri State University

In Partial Fulfillment

Of the Requirements for the Degree

Master of Science, Applied Behavior Analysis

By

Megan Nicole Kimzey

May 2020

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Psychology

Missouri State University, May 2020

Master of Science

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ABSTRACT

The present study evaluated the relationship between scores on the *Promoting the Emergence of Advanced Knowledge Pre-Assessments* (Equivalence & Transformation Modules; PEAK) in one individual with autism spectrum disorder (ASD) and their corresponding performance on standardized IQ tests (WPPSI-IV Short Form), their performance on PEAK assessments following 10 weeks of treatment with four hours per week, and the corresponding obtained relational deceleration coefficient. The data indicated a strong, significant relationship between participation in PEAK treatment and an increase in scores on PEAK and IQ tests. The relational deceleration coefficient score did not change significantly. These results have the implications PEAK treatment is reliable and valid and should be used to help teach relational responding to children with developmental disabilities.

KEYWORDS: autism spectrum disorder, derived relational responding, discrete trial training, PEAK-E assessment, PEAK-T assessment, relational deceleration coefficient, verbal behavior

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INTRODUCTION

Verbal Behavior Approaches to Autism Treatment

Language deficits and delays are often a symptom of autism spectrum disorders (ASD; American Psychiatric Association, 2013). Language plays a significant role in adaptive functioning, allowing people to mediate the actions of others and solve simple and complex problems. Due to the significance of language, it is critical to teach children with ASD language skills as early as possible to establish foundational learning skills and bring children closer to typically developing peers (Sundberg & Michael, 2001). Applied Behavior Analysis (ABA) is the applied subfield of behavior analysis, and researchers within ABA have developed several protocols that target early language skills (Ackley, Subramanian, Moore, Litten, Lundy, & Bishop, 2019). Many of these programs were developed by Skinner's account of *Verbal Behavior* (Skinner, 1957). Along with verbal behavior, another challenge that can arise when working with children who have ASD is problem behavior. In order to address these problem behaviors, it is important to understand the function of each specific behavior the child may exhibit. In order to do this, there are many behavior assessments, indirect and direct, that allow for therapists and clinicians to pinpoint the function of a problem behavior. The Questions About Behavior Function (QABF) is an indirect behavior assessment that can be filled out by parents, teachers, therapists, or those who work closely with the child (Paclawskyj, Matson, Rush, Smalls, & Vollmer, 2000). By using the QABF to identify a function of behavior (social attention, escape, tangible reinforcement, physical discomfort, or nonsocial reinforcement), clinicians are better able to develop treatments that are effective (Paclawskyj et al., 2000).

Another indirect behavior assessment is the PEAK Autism Symptoms and Behavioral Observation Summary (PAS-BOS), which also includes a Challenging Behavior Index (CBI). The PAS-BOS allows for clinicians and therapists to identify factors that may affect an individual's functioning in their daily life. Factors that are included within the PAS-BOS are social interaction, communication, and repetitive behaviors. These indirect behavior assessments were used within this study to identify an individual that would not exhibit intense or frequent problem behaviors during treatment and assessments, however the main focus of the present study was on verbal behavior.

Skinner defined verbal behavior as any response reinforced by the mediating behavior of another person (Skinner, 1957). Within Skinner's theory of verbal behavior, he outlined verbal operants that are frequently used to help establish language repertoires for children with ASD (Greer & Ross, 2008). Some verbal operants described by Skinner included the mand, echoic, intraverbal, and tact (Johnson, Kohler, & Ross, 2016). The man can be defined as a verbal response that is under the functional control of relevant conditions of deprivation in which the individual is then given access to a specified item; such as saying, "Milk", followed by the child receiving the milk (Johnson et al., 2016). A verbal response is considered to be echoic when the child has imitated a vocal model. An example of an echoic would occur if a therapist said, "cat", and the child repeats, "cat" (Johnson et al., 2016). An intraverbal is a response that follows a question or a statement from another person. An example of an intraverbal would be a person asks, "How old are you?" and the child responds with, "I'm 7". Skinner defined tacting as a verbal response that is under the control of a nonverbal stimulus and provides generalized conditioned reinforcement; such as when a child labels an item and hears, "That's right!" from a parent (Skinner, 1957). The verbal behavior approach to autism treatment is comprised of well-

regulated training environments and highly preferred reinforcers and/or activities following correct responses (Carr & Firth, 2005).

Two common approaches to verbal behavior treatment are delivered through discrete-trial training (DTT) and natural environment training (NET; Carr & Firth, 2005). DTT is a familiar technique within early behavioral interventions for children with autism (Geiger, Carr, Leblanc, Hanney, Polick, & Heinicke, 2012). The information in the discrete trial is presented rapidly to maximize the learning opportunities within each training session (Geiger et al., 2012). During DTT, a correct response results in immediate reinforcement, such as praise, edibles, or toys, whereas an incorrect response results in extinction or error correction (Geiger et al., 2012). DTT can be used to teach vocal and motor imitation, simple and condition discrimination, tacting, and intraverbals, along with other language and academic skills (Smith, 2001; Sundberg & Partington, 1999). NET focuses on using intrinsically motivating materials, teaching in natural contexts, and focusing on the child's immediate interests to guide instruction (Weiss, 2001). In a study done by Miranda-Linné and Medlin (1992), they compared DTT to incidental teaching. Incidental teaching is similar to NET in which the environment is arranged to attract the desires of the children and language instruction is based off of the child's motivating operations (Mcgee, Morrier, & Daly, 1999). The study found that when using DTT, the children acquired the targeted skills more quickly, had higher correct response frequencies during acquisition probes, were taught more efficiently, and the children were able to generalize more rapidly and at higher levels at home and with parents (Miranda-Linné & Medlin, 1992). The research conducted within the current article used the DTT method only.

Assessments and protocols used for delivering verbal behavior treatment are becoming increasingly prevalent and include (but are not limited to): Assessment of Basic Language and

Learning Skills-Revised (ABLLS-R), Early Start Denver Model (ESDM), SKILLS, The Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP), and the PEAK Relational Training System (Ackley et al., 2019). There are similarities across assessments and considerable variability in the amount of empirical support generated for each. ABBLS-R is an assessment protocol and curriculum guide for children who show language abilities up to a first grade level. The skills that are evaluated are learning skills, social skills, and daily living skills (Ackley et al., 2019). The ABLLS-R is a tool that is used routinely within ABA treatments, however there is limited data supporting that the assessment is reliable or valid, or that treatment guided by the assessment is likely to be effective (Ackley et al., 2019). ESDM is intended to focus on skills across many different areas for children ages 1-5 that have autism, and there have been several studies conducted at the group level that support the effectiveness of the model (Ackley et al., 2019). Although there have been studies to support ESDM, there are also many critics of the curriculum (Princiotta & Goldstein, 2013). Critics of ESDM argue that the manual is too technical for some audiences, such as proposing specific arrangements for the therapy room even though ESDM is supposed to take place in a "natural environment" (Princiotta & Goldstein, 2013). Critics also question the design of the RCTs that have been done for ESDM (Warren, McPheeters, Sathe, Foss-Feig, Glasser, & Veenstra-VanderWeele, 2011), and suggest that there is more research that needs to be conducted (Princiotta & Goldstein, 2013). SKILLS is an assessment and curriculum protocol that is online. This protocol uses ABA techniques and is targets towards individuals with ASD. There are currently no data supporting the effectiveness of SKILLS (Ackley et al., 2019). The VB-MAPP is an assessment protocol that is based on Skinner's verbal behavior theory and is designed to assess the language ability of the child as well as help select language targets for the client. Although this is a widely used assessment

protocol, there is no data that addresses the reliability (Ackley et al., 2019). There has been one study that assessed criterion validity (Ackley et al., 2019). This study compared the scores on the VB-MAPP to scores from PEAK and they found there was a high correlation between overall scores (Ackley et al., 2019). However, the study also suggested there was a ceiling effect present in VB-MAPP scores indicating that although both assessments appeared to measure skills effectively, the PEAK assessment may be able to examine a larger set of skills (Ackley et al., 2019). Promoting the Emergence of Advanced Knowledge Relational Training System (PEAK) is an assessment and curriculum protocol that focuses on complex language skills of individuals with autism. There are currently several studies that have been conducted, supporting the validity and reliability of the first PEAK module (Ackley et al., 2019).

As noted by Ackley et al. (2019), currently PEAK and ESDM are the only ABA curricular packages that target language that could be considered 'evidence-based', whereas other tools have not been empirically tested and therefore should be considered as potentially based on ABA techniques (though, not necessarily). ESDM and PEAK differ considerably in their delivery method, where ESDM is conducted within an NET arrangement and PEAK is delivered through DTT. DTT affords the advantage of delivering a high volume of controlled trials to ensure stimulus control is achieved. Therefore, although empirical support is present for ESDM, PEAK will be the main foci of the current paper and experimental research. Second, although several studies have evaluated several facets of the verbal behavior approach for establishing simple skills in children with significant language learning challenges, Dymond, O'Hora, Whelan, and O'Donovan (2006), and Dixon, Small, and Rosales (2007) have noted several limitations of this approach. Results from a citation analysis of Skinner's Verbal Behavior showed that the majority of citations came from nonempirical articles, which is a

limitation itself (Dymond et al., 2006). Another limitation is that the very foundation of Skinner's work, i.e., his definition of verbal behavior is arguably too broad (Dymond et al., 2006). Dixon et al. (2007) discussed how the majority of research on verbal behavior has been conducted only with children with developmental disabilities, and that cannot sustain the dependence on verbal behavior as a conceptualization of human language. There is a need to expand this research to typically developing individuals (Dixon et al., 2007). Research in derived relational responding has been done with its fair share of children with developmental disabilities, but there are also various research on typically developing individuals as well (Heagle & Rehfeldt, 2006; Dalvin, Rehfeldt, & Lovett, 2011; Rosales, Rehfeldt, & Lovett, 2011). Although the current study is focused on children with developmental disabilities (specifically ASD), derived relational responding has been shown to increase relations in multiple populations. Because of this, a major focus of PEAK is incorporating advances in derived relational responding, namely within the final two modules of the PEAK system (PEAK Equivalence and PEAK Transformation).

Stimulus Equivalence and Derived Relational Responding

By centering all attention simply on the verbal operants described above that were brought about by Skinner, as well as utilizing some of the assessments and protocols listed above that have failed to produce empirical evidence, it is difficult to see the immense amount of research that has been published on derived relational responding and stimulus equivalence (Dixon, Belisle, McKeel, Whiting, Speelman, Darr & Rowsey, 2017a). There is research to state that 80% of articles that cite Skinner's Verbal Behavior is non-empirical, whereas 55% of research on derived relational responding is empirical (O'Connor, Farrell, Munnelly, &

McHugh, 2017; Raaymakers, Garcia, Cunningham, Krank, & Nemer-Kaiser, 2019). The research available on derived relational responding places an emphasis on the following areas: grammar, derived tacts, derived intraverbals, deictic frames, and metonymical tacts (Cullinan & Vitale, 2008; McHugh & Reed, 2008; Daar, Negrelli, & Dixon 2015). Instead of focusing on verbal operants that are taught by means of direct training, derived relational responding provides the opportunity for verbal operants to be taught without directly training each question or item (May, Hawkins, & Dymond, 2013). Belisle, Palilunas, Lauer, Giamanco, Lee, and Sickman (2020) conducted a literature review on derived relational responding and found that there are many studies that have emphasized the development of untrained verbal operants, including derived mands and derived intraverbals, representing a synthesis of Skinner's theory and more contemporary theories of language development (Belisle et al., 2020).

According to Barnes-Holmes, Finn, Mcenteggart, and Barnes-Holmes (2017), the work of Murray Sidman brought about the concept and research on derived stimulus relations in which Sidman called "stimulus equivalence". The initial goal of the work with stimulus equivalence was to generate techniques for teaching basic reading skills (Barnes-Holmes et al., 2017). Stimulus equivalence is defined as the development of untrained/unreinforced responses based on a small set of responses that were trained (Barnes-Holmes et al., 2017). The procedures of stimulus equivalence have been utilized to help children build complex verbal behavior repertoires that include derived textual responses, derived intraverbals, derived categorical responses, and qualifying autoclitics (Dixon et al., 2017a; May et al., 2013). When there is a pattern of unreinforced (derived) responses, the stimuli within that pattern form what is called an equivalence class (Barnes-Holmes et al., 2017). One central approach to creating equivalence relations is called match-to-sample. Match-to-sample (MTS) is a technique of teaching relations

that is presented through discrete trials (Dube, Mcilvane, & Green, 1992). Teaching relations through MTS as well as other ways of teaching relations can produce arbitrarily applicable relational responding (AARR; Johansson, 2019). AARR is defined as abstract response patterns that have the attributes of mutual entailment, combinatorial entailment, and transformation of stimulus function, that are controlled by contextual cues and learned through a history of multiple exemplar training (Johansson, 2019). Multiple exemplar training (MET) is used in order to make sure the learner has mastered the task by systematically delivering examples of related stimuli until the learner no longer needs to be instructed on each relation (Dixon, 2015). Learning how to respond relationally to stimuli and events is a critical aspect to building an individual's repertoire of verbal behavior (Johansson, 2019). AARRing is necessary for symbolic or human language and it is a vital contribution of Relational Frame Theory (Johansson, 2019). The continuation to the work on stimulus equivalence and derived relational responding brought about relational frame theory (Hayes, 1991).

Relational frame theory (RFT) insisted that stimulus equivalence could be a generalized relational operant and that various classes of operants were possible and actually common in ordinary human language (Barnes-Holmes et al., 2017). RFT consists of three major attributes, which include mutual entailment, combinatorial entailment, and the transformation of functions. Mutual entailment involves symmetry, in that if you teach a person that stimulus A is related to stimulus B, then they will be able to derive that B is related to A (A=B then B=A; Barnes-Holmes et al., 2017). Combinatorial entailment involves transitivity, in that if a person is taught that stimulus A is related to stimulus B, and stimulus B is related to stimulus C, they will be able to derive that stimulus A is related to stimulus C without being directly taught (A=B and B=C, then A=C; Dixon, 2015). The transformation of stimulus function involves the altering of a

function of a stimulus due to an entailed relationship with another stimulus, which allows us to respond to situations in a meaningful way without being directly taught how to respond (Dixon, 2015).

The goal of RFT is to show how language and cognition affects responses in everyday lives rather than just providing an analysis of logical or abstract human reasoning (Barnes-Holmes et al., 2017). According to RFT, many of the basic or simple functions of stimuli that we encounter have been acquired through a history of relational framing (Barnes-Holmes et al., 2017). Typically it is seen that a child with a developmental disability may not be able to make derivations and have the complex language skills that their peers may have. As mentioned in the beginning of this article, it is critical and important that children with ASD are taught language and communication skills as early as possible. Once the child with ASD is able to acquire a simple language repertoire, it is also important to keep building on the foundation of communication and expand it to include derived textual responses, derived intraverbals, derived categorical responses, and qualifying autoclitics (Dixon et al., 2017a).

Applications of Derived Relational Responding with Children with Autism

As discussed previously, children with a diagnosis of ASD generally show a significant deficiency in language and cognitive repertoires (American Psychiatric Association, 2013; Moran, Walsh, Stewart, Mcelwee, Ming, 2015). RFT would argue that the deficiency seen in language and cognitive repertoires of these children with ASD might be due to an inability to make derived relations (Moran et al., 2015). This is the reason why teaching children with language deficits how to engage in derived relational responding is crucial and paramount to expanding and improving the individuals' language skills (Moran et al., 2015).

There has been a multitude of research done on stimulus equivalence and derived relational responding, showing the importance of these skills, as well as how learning these skills helps children with autism (Dixon, Belisle, & Stanley, 2018; Sidman 2009; Murphy, Barnes-Holmes & Barnes-Holmes, 2005; Mullen, Dixon, Belisle, & Stanley, 2017; Still, May, Rehfeldt, Whelan, & Dymond, 2015; May et al., 2013). In a study done by Dixon et al. (2018), they showed how derived relational responding and intelligence are related. Individuals that exhibited derived relational responding also showed considerably better scores on the IQ tests that were used (Dixon et al., 2018). These results suggest that if a child can be taught how to acquire derived relations, they are more likely to see an increase in intelligence (Dixon et al., 2018). Belisle, Dixon, and Stanley (2018) extended this research by determining whether participant results on the PEAK-E-PA served as a mediating variable for a relationship between results on the PEAK-DT-A and IQ. The results replicated previous findings by suggesting a significant correlation between PEAK-DT-A and IQ (Belisle et al., 2018). The correlation between PEAK-DT-A and IQ may be accounted for by the degree to which participants' respond in accordance with derived relations (Belisle et al., 2018). These findings produce two implications, one being theoretical and the other being practical (Belisle et al., 2018). The theoretical implication is that data support the position put forward by Hayes, Barnes-Holmes, and Roche (2001), that intelligence may be accounted for by simply a few arbitrarily applicable relational operants (Belisle et al., 2018). The practical implication is that given the results of this study, improving IQ scores could be achieved through the use of instructional strategies that promote the emergence of relational responding (Belisle et al., 2018).

Another study involved teenage boys that were institutionalized due to severe mental retardation (Sidman, 2009). These boys had minimal language repertoires and they were not able

to read, therefore they were not able to match words to their corresponding pictures (Sidman, 2009). The experimenters began by simply teaching the boys how to sit quietly, stay seated, point out specified items, and discriminate straightforward lines and shape. From here, the match-to-sample procedure that was described earlier was used (Sidman, 2009). By the end of the procedures, the boys with severe mental retardation were able to relate words to pictures even though they were not directly taught how to do so. The boys were also able to read with comprehension even though they had never been directly taught or reinforced to do so (Sidman, 2009).

In another study, it was suggested that it is possible to institute derived manding in children who have ASD (Murphy et al., 2005). The study states that following the presentation of detailed instructions, six out of seven participants were able to demonstrate derived mands and derived reinforcers (Murphy et al., 2005). Murphy et al. (2005) also looked at the effects of exemplar training when 1 out of the 7 participants was unsuccessful in deriving mands. They found that after the presentation of three exemplars of direct training, the participant was then able to show a derived transfer of mand functions (Murphy et al., 2005). This information is fundamental in the teaching of children with developmental disabilities, such as ASD. Although some individuals may require multiple exemplars in order to be successful, the end results are still the same; derived mands, derived reinforcers, and derived relational responding can still be taught.

In a study done by Mullen et al. (2017), they were successful in replicating findings that showed a transfer of stimulus function could also occur with tactile stimuli. The participants consisted of two young males who had been diagnosed with ASD and developmental delay (Mullen et al., 2017). Vocal words (A), tactile stimuli (B), and visual symbols (C) were used in

order to create six relations that were tested during the study. The relations tested consisted of A-B, B-A, B-C, C-B, A-C, and C-A (Mullen et al., 2017). The study alternated between baseline and training conditions with additional probes within the training sessions. The only difference between the training sessions and the baseline sessions was that praise and edibles were delivered contingent upon correct responses and prompts were delivered upon incorrect responses (Mullen et al., 2017). Mullen et al. (2017) was able to replicate the previous research by showing that tactile stimuli can be used in order to teach equivalence relations to individuals who have autism and/or developmental delays.

Still et al. (2015) were able to show how to teach children with autism to mand for items without being directly taught. All of the children within the study exhibited deficits in their vocal repertoire (Still et al., 2015). In order to teach the children to produce mands, a computer-based relational completion procedure (RCP) was used and taught the children to mand for missing items that were needed in order to play with a preferred toy/item (Still et al., 2015). Relations A-B (dictated names to pictures) and A-C (dictated names to printed words) were taught. By the end, the participants demonstrated derived relations and derived manding, supporting the previous research on this topic (Still et al., 2015).

In another study, the purpose was to increase intraverbal responses in three male individuals with ASD by using comprehensive tact training (May et al., 2013). The participants were instructed on how to tact the name of a cartoon character, as well as the cartoon character's favorite food. Subsequently to the tact training, test probes showed the development of vocal intraverbals that had not been directly trained or taught (May et al., 2013). The participants were able to state the name of the cartoon character when they were only given the food item and vice

versa. The finding of this study is just another example of the growing published writings on derived relational responding and stimulus equivalence (May et al., 2013).

Through all of the studies discussed in this article, it is clear that derived relational responding plays a critical role in language and cognition repertoires (Moran et al., 2015). Having an empirically based assessment and protocol for teaching children with ASD derived relational responding is critical to the development of language.

PEAK Relational Training System: Equivalence Module

Due in part to this increasing research on applications of DRR in autism treatment, and because of increased consumer demand for protocols that target symbolic and referential language extending well beyond a Skinnerian verbal behavior approach, PEAK incorporates advances in equivalence and in RFT (Dixon et al., 2017a). There are four in-depth training modules within the PEAK relational training system that includes the *Direct Training* module, the *Generalization* module, the *Equivalence* module, and the *Transformation* module (Dixon et al., 2017a). The first two modules of PEAK address a contingency-based foundation of language development. The second two modules of PEAK address a method to teaching language that corresponds with relational frame theory (Dixon et al., 2017a). PEAK relational training system is a combination of traditional Skinnerian verbal operant training as well as post-Skinnerian methods that help to produce derived relational responding (Dixon et al., 2017a). Within each module, there are 184 separate programs that are intended to summarize a distinct learning modality (Dixon et al., 2017a). Each program has specific instructions on how to complete all necessary steps from the initial assessments to placing the child into an appropriate skill range for beginning treatment (Dixon et al., 2017a). Goals for the child, materials to help facilitate

learning, and instructions on data collection are all things that are also included in the PEAK relational training system (Dixon et al., 2017a).

The PEAK relational training system: equivalence module (PEAK-E) emphasizes the emergence of stimulus equivalence and derived relational responding, and its protocols align with the views of RFT (Dixon, Belisle, Rowsey, Speelman, Stanley, & Kime, 2017b). This module tests for the development of basic reflexive (A-A), symmetrical (If A=B, then B=A), and transitive responding (If taught that A=B and B=C, then A=C is derived; Dixon, 2015). Within this module, it also accounts for complex stimulus class formations, and transformation of function between stimuli (Dixon et al., 2017b). Not only is this module important for the continuation of language development in children with autism, but it is also the only comprehensive manualized protocol for derived relational responding in children with ASD that is peer-reviewed (Dixon et al., 2017b). The equivalence module of PEAK has been shown to help children develop a more complex verbal repertoire without having to directly train each individual exemplar (Dixon et al., 2017b). This is possible due to the functions for specific stimuli becoming equivalent with each other, causing the individual to respond in a similar way as in the prior situation in which it was reinforced (Dixon, 2015). A verbal human engages in derived relational responding daily, using it across various situations. A nonverbal human or a human who may have language delays may not be able to derive these relations on their own (Dixon, 2015). PEAK-E has shown that children with autism can be directly taught two relations, yet the child will walk away knowing four relations (Dixon, 2015).

PEAK uses many techniques in order to teach derived relations, one being MET in which was briefly described earlier. MET involves the continuous presentation of examples of related stimuli until the individual begins to derive symmetrical or transitive relations (Dixon, 2015).

Research has shown that exposure to multiple exemplars during early language development is critical in the development of specific relational frames (Barnes-Holmes et al., 2017). PEAK also uses the train/test strategy along with a discrete trial training (DTT) method for presenting trials (Dixon, 2015). The individual is directly taught relations between specific stimuli and then tested on the emergence of derived relations (Dixon, 2015). As stated in the PEAK-E module, training relations is crucial to the emergence of derived relations because without a directly trained relation the individual will have no foundation for inferring the appropriate derived relations (Dixon, 2015).

In an article written by Dixon et al. (2018), they assessed the relationship between the PEAK-E Pre-assessment and IQ with individuals who have ASD. The results from this study suggested that performance on the PEAK-E Pre-assessment is related to performance on standardized IQ tests (Dixon et al., 2018). The implications from these results are that PEAK-E Pre-assessment scores can be used to provide beneficial targets for relational training, with the possibility of increasing the individuals' IQ (Dixon et al., 2018). In another study done by Dixon, Belisle, Stanley, Daar, and Williams (2016a), they assessed the efficacy of equivalence-based instruction as detailed in the PEAK-E curriculum for promoting the development of derived geometry skills in children who had ASD. They found that the individuals were able to derive a relation between the shape names (stimulus A) and shape pictures (stimulus C), even though the individuals were only directly taught the A-B relation (Dixon et al., 2016a). The results from this study suggest that you can use equivalence-based instruction for teaching equivalence relations in many contexts, including geometry and mathematics. The results also show that PEAK-E clearly checks for the emergence of untrained relations, whereas other curricula may not do so (Dixon et al., 2016a). This study used a specific section of the PEAK-E program, which was *5E*-

Symmetry: Shape Names, and states that this section seems to be an effective guide for eliciting the emergence of equivalence responding (Dixon et al., 2016a).

The training procedures from the PEAK-E curriculum were also used in a study to teach children with autism to make coordinated cross-modal conditional discrimination (Belisle, Dixon, Stanley, Munoz, & Daar, 2016). PEAK-E was also used in this study to evaluate the derivation of symmetrical and transitive relations made by the children with autism (Belisle et al., 2016). By the end of this study, the children were able to master directly trained materials, show symmetrical relations, and two participants were able to demonstrate derived transitive relations (Belisle et al., 2016). Following this study, the training procedures and stimuli from PEAK-E were used in order to show that representational drawings could be used in the evaluation of naming (Dixon et al., 2017b). In a study done by Dixon, Belisle, Stanley, Speelman, Rowsey, Kime, and Daar (2016b), they used the PEAK-E curriculum in an effort to establish derived categorical responding in children with ASD. By using this curriculum, the three boys with autism were able to engage in receptive categorical responding as well as derived categorical responding (Belisle et al., 2016).

Overall, the equivalence module of the PEAK relational training system has had success in using stimulus equivalence-based procedures to build repertoires of equivalence class formation in children with autism and other developmental disabilities (Daar, et al., 2015; Dixon et al., 2016a).

Purpose of the Present Study

The purpose of the present study was to assess whether PEAK-E and PEAK-T effectively teach the targets that it's intending to teach to children with autism. These are the last two

modules of the PEAK relational training system that focus on the emergence of derived relational responding (Dixon, 2015). There were multiple goals this study hoped to address, the first being for the individual to show an increase in PEAK scores following PEAK training procedures. We wanted to show that the PEAK relational training system teaches what it is supposed to teach and can be used with children who have a developmental disability, such as autism. The second goal was for the individual to have an increase in IQ related to the increases seen in PEAK scores. We wanted to see how using the last two modules of PEAK (E and T) that uses a treatment model that aligns with RFT could help to increase IQ. Another goal of this study was to compare the obtained relational deceleration coefficient to the scores obtained on the PEAK assessment, to see if one was an accurate measure for the other. We also wanted to see improvements of DRR in the participant. DRR is an important skill to have in order to build upon basic skills and to acquire a repertoire of more complex language and cognitive skills. Lastly, we wanted to evaluate whether several target skills could be taught to the participant in a 10-week period of time.

METHODS

Participant

The participant for this study was a 7-year old male named Connor. The participant had an autism diagnosis and was recruited from a community provider's waitlist through a flyer that was made by graduate students at Missouri State University. This study was approved on August 29, 2019 by the Missouri State University IRB (IRB-FY2020-33; see Appendix A). The initial assessments completed on Connor included the following direct assessments: PEAK-E, PEAK-T, IQ, and the method for obtaining the relational deceleration coefficient. Connor's PEAK score including both the equivalence and transformation module was 16. Connor showed he was not able to derive symmetrical (if A=B, then B-A) or transitive relations (If A=B and B=C, then A=C). Connor's estimated full-scale IQ was 45. Indirect assessments included the following: PEAK-DT, PEAK-G, QABF, PAS-BOS, and the CBI. For PEAK-DT, which was filled out by the parent, Connor's total score was 45 out of 184, and we identified 127 age norm targets. For PEAK-G, which was also filled out by the parent, Connor's total score was 7 out of 184, and we identified 68 age norm targets. During the assessment time, Connor's parent completed the QABF indirect assessment. Following the assessment, staff completed the PAS-BOS, and the CBI. The PAS-BOS and CBI were filled out based on staff observation from the initial assessment session. For the QABF, the target behavior was crying, and Connor received a score of 12/15 for escape and 11/15 for physical (see Figure 1). These results suggest that the function of crying for Connor is most likely to be escape maintained, as well as maintained by physical ailments (i.e., when in pain, uncomfortable, not feeling well, etc.). Although the QABF gave

suggested functions for Connor's behaviors, we did not see any problem behaviors throughout the 10-weeks. The PAS-BOS completed by staff included sections for social interaction, communication, and restricted or repetitive behaviors, and assessed frequency of the behavior as well as the intensity of the behavior (see Figure 2). Connor's highest score was obtained in the communication section, which was 14/20, suggesting that communication is a barrier that may affect his daily living. Connor's total score on the CBI was 2/20, which is considered to be a very low score and indicated to staff that behaviors should not interfere with his ability to perform and learn tasks (see Figure 2).

Setting and Materials

The initial assessments were conducted in an 8ft by 4ft room that contained an adjustable table, two chairs, a shelf with various toys, edible reinforcers, the participant's notebook with current programs, pens, stimuli for each program (a mixture of cards created by staff using Publisher), and 3 iPads. The room also contained a token board that was a picture of a car, cut into 5 different pieces. The token board was used in order to maintain attention and provide reinforcement while still keeping Connor at the table. All three iPads served a different purpose during this study; one iPad Pro was used to run assessments, one mini iPad was used as a reinforcer for the participant, and one mini iPad was mounted on the wall and used to video the session. The video from the mini iPad was routed through Zoom to a computer that was on the other side of a one-way mirror. The video was used in order to conduct IOA measures. Treatment (which occurred during two-hour sessions twice a week) and post-assessments were conducted in a larger room (10ft x 8ft) that included all of the same materials listed above. Within the larger treatment room, there was not a one-way mirror, however sessions were still

recorded and parents were able to observe the session through the mounted iPad in the treatment room that was routed through Zoom. The live video of the session appeared on the desktop computer in the adjacent room. When it was time for probes and assessments, the room also contained all assessment material needed, such as stimulus flip-books for PEAK-E and PEAK-T, instructional PEAK-E and PEAK-T books, PEAK data sheets, the iPad with the method for obtaining the relational deceleration coefficient, IQ stimulus flip-books, IQ instructional books, and IQ data sheets for each subtest completed. For the middle IQ probe, different stimuli were used in order to reduce test re-test effects. The stimuli made was different, however similar in difficulty level (i.e., replacing a dog with a cat). Staff created this stimuli by using Publisher, printing the cards, and cutting the cards. The same process was done with the method for obtaining the relational deceleration coefficient. A different set of stimuli was created that was the same difficulty level as the original set of stimuli, but was used in order to avoid the effects of repeated exposure to the test. For these stimuli, PowerPoint was used in order to create the test. PEAK-DT and PEAK-G materials were not needed other than the initial indirect assessment packet, as the main focus were the final two modules of PEAK (E and T). PEAK-E and PEAK-T are the two modules that pinpoint DRR and create a more comprehensive treatment, whereas the first two modules of PEAK (DT and G) focus on more traditional ABA treatment strategies.

Dependent Variable and Interobserver Agreement

The dependent variables in the study were the scores the participant acquired on the PEAK assessment as well as the other assessments conducted, such as subtests from the Wechsler Preschool and Primary Scale of Intelligence – Fourth Edition, Short-Form (WPPSI-IV), the method to acquire the relational deceleration coefficient, and the PEAK-E and PEAK-T

receptive pre-assessments. Another dependent variable for the present study were the scores for each program that was introduced. For the full PEAK assessments, the responses were scored by circling “yes” or “no”. For treatment, the PEAK scoring system was based on a number scale including 0, 2, 4, 8, and 10 (Dixon, 2015). If there was no response after multiple attempts at prompts it was recorded as a “0”, if multiple prompts or reduced stimulus array eventually produced a response it was recorded as a “2”, if two prompts at most produced the response with a full stimulus array it was recorded as a “4”, if one single prompt of either verbal or visual nature elicited a response it was recorded as a “8”, and if there was independent accuracy on response it was recorded as “10” (see Appendix B) (Dixon, 2015). The scores received within each trial block were then converted into percentage correct for each trial block. The percentage correct for each trial block was used to graph the data. The three subtests that were conducted within the WPPSI-IV were matrix reasoning, picture memory, and information. Each question on the subtests used in the WPPSI-IV has a score ranging from 0-1. For the matrix reasoning subtest, the “1” was given when the individual elicited the correct response. The “0” was given when the individual responded incorrectly (Wechsler, 2012). For the picture memory subtest, the “1” was given when the individual selected the correct picture that was previously shown to them. The “0” was given when the individual selected a picture that is not correct (Wechsler, 2012). For the information subtest, the “1” was given if the participant gave a correct response. The “0” was given when the participant provided an incorrect response (Wechsler, 2012). In the matrix-reasoning subtest of the WPPSI-IV, the participant viewed a matrix that was incomplete and they selected the option that would complete the matrix (Wechsler, 2012). During the picture memory subtest of the WPPSI-IV, the therapist showed the participant a picture for three seconds, switched to the following page, and then asked the participant which picture was

previously shown to them (Wechsler, 2012). The information subtest of the WPPSI-IV included verbal items and picture items. The verbal items included questions such as, “How old are you?” and “What do people use to chew their food”. The picture items included showing the participant a field of pictures and saying things such as, “Show me what you can eat” and “Show me what you take a bath in” (Wechsler, 2012). The PEAK-E pre-assessment is a brief evaluation created to help the therapist determine the necessary skills to directly or indirectly target on the full PEAK-E assessment (Dixon, 2015). The pre-assessment assessed the learner’s ability to indicate arbitrarily applicable relations by testing four main types of relations and three levels of difficulty (Dixon, 2015). To score the pre-assessment, there is a pre-assessment record form in which each program has a score ranging from 0 to 2, each relation type has a score ranging from 0-12, and since there are four relations tested, there was a total score ranging from 0-48 (Dixon, 2015). The relation’s total score was then divided by 2 to provide Relational Scores that could be plotted on the Relational Score Profile and allow for better visualization of the data (Dixon, 2015). The PEAK-T pre-assessment contained an expressive and a receptive subtest and the total number of items for this pre-assessment is 96 (Dixon, 2015). The following study focused solely on the receptive portion of the pre-assessments. The receptive subtest followed the same general pattern of the expressive subtest, however the individual had an array of stimuli presented to them in which they made a selection-based response (Dixon, 2015). All of the items on the receptive subtest had a single correct response and were marked as a 1 or a 0. For each relational frame, there is a total of 16 points possible (Dixon, 2015). Including each relational frame family from both the expressive and receptive subtests, the PEAK-T pre-assessment has a total score of 0-192 and the scores can be plotted just as they were in the PEAK-E pre-assessment (Dixon, 2015). In addition to these tests, there was also a direct measure of relational responding

conducted that resulted in a relational deceleration coefficient. The method for finding the relational deceleration coefficient consisted of training relations via SPOP and MTS and then testing those relations. The relational deceleration coefficient was intended to express the fluency of directly reinforced relations, and then examine how fluency decayed across nodal distance.

Interobserver agreement (IOA) was assessed for 28% of the total trials by having an independent observer record data during those trials. IOA was calculated by comparing the scores of two independent observers. The number of trials on which observers agree on the PEAK score was divided by the total number of trials and multiplied by 100. Agreement was achieved when both observers independently record the same PEAK scores on a given trial. IOA was 88% agreement. Prior to the onset of the study, the assessors were trained to mastery on running the PEAK assessment and running programs for PEAK. During the study, treatment integrity was completed by recording portions of the sessions, watching the videos, and filling out PEAK Relational Training System Fidelity Checklist (See Appendix C). The average score on fidelity for the preparation checklist was 100%. The average score on the implementation checklist was 90.6%.

Procedures

Initial assessments including the PEAK-E and PEAK-T receptive pre-assessment, the three subtests from the WPPSI-IV, and finding the relational deceleration coefficient were completed for every child interested in participating in this study. Each participant's caregiver also completed the QABF assessment. Following each assessment, staff filled out the CBI and PAS-BOS. These behavior assessments were completed in order to ensure there would be minimal problems behaviors interfering with treatment and future assessments, as well as to

identify possible functions of any behaviors that we may have seen. After the initial assessments were completed, one individual (who scored low on the challenging behavior assessment) received 10 weeks of treatment in which PEAK-E and PEAK-T programs were be implemented. These programs were implemented using a train/test strategy, which means that the participant was directly taught relations between specific stimuli and then tested on the emergence of derived relations (Dixon, 2015). The targets during treatment were presented using DTT. This means that feedback for each trial was provided immediately after a response is given (Dixon, 2015). It is also important to note that there was not feedback provided to the individual during assessments of any kind. For programming as well as probes that were completed, stimuli were placed in an organized array of 2-4. An informal preference assessment was conducted prior to each session to ensure the appropriate reinforcer is used during the session and motivation has been established. The preference assessment was completed by simply observing Connor and seeing which toys he was interested in for that session. A token board was also used for the participant to have a clear ending to the instructional period and to increase compliance during this time. The token board was a picture of a car that was cut into five different pieces and he was given a piece of the car on a fixed ratio schedule of 2 trials. Once he completed the picture of the car, he received 2-3 minutes to play on the iPad and have a small snack, such as chips and juice.

A multiple baseline across skills with an embedded multiple probe design was used to evaluate the efficacy of the PEAK-E and PEAK-T curriculum on trained relations and the emergence of derived relations. The probes consisted of scores on the subtests of the WPPSI-IV, the method to acquire the relational deceleration coefficient, and the PEAK-E and PEAK-T pre-assessments. These probes took place four during the 10 weeks. Specifically, probes took place

after three skills were mastered; however if three skills were mastered within three weeks, the probes were completed after three weeks had passed. The scores from the WPPSI-IV were not be used for diagnostic or placement purposes. This design was replicated across modules, as the participant was trained on four programs simultaneously; two programs from PEAK-E and two programs from PEAK-T. For the initial baseline of this experiment, each program within the multiple probe design was tested twice to determine if the participant had mastered the skill. The first test was the initial direct test of the program, and the second test was used to determine if the participant had mastered the program either due to maturation or due to mastering other programs (Belisle, Clark, Welch & McDonald, under review). Baseline testing occurred within modules, which allowed for replication across modules. If the learner showed mastery of the skill (over 90% for two consecutive baseline probes) during the initial probe, the therapist progressed to testing more complex programs. If the baseline probes were not both over 90%, staff progressed to training the skill. Once the learner received over 90% on three consecutive training trial blocks, the program was then tested for mastery. If the learner did not score over 90% on the test, the participant received additional training on that program before testing again. Initial prompting strategies for each program consisted of most to least across trials, while taking into account baseline data for each specific program. If baseline data indicated the participant was not able to complete the task at all (i.e., 0%), staff began prompting at the highest level (i.e., full physical for receptive tasks like matching, pointing, etc.) initially, but then systematically faded the prompting as the participant gained more independence on the skill. If baseline data indicated that the participant was close to mastery on the skill (i.e., 70%), staff would begin using the highest level of prompting that was necessary for the participant (verbal, gesture, etc.). If there was a skill in which the learner was consistently getting the same overall percentage on each trial

block without improving for five trial blocks, staff modified the prompting strategies used in order to better accommodate the learner. The prompting strategies were modified to use errorless learning, in which staff presented the demand and immediately prompted the learner through the skill. This modification of prompting strategies was only needed during one skill, and that skill was not mastered due to having to end the study. In summary, for a program to be considered mastered, the participant had to either (1) obtain a score of over 90% on both baselines conducted or (2) obtain a score of over 90% for three consecutive trial blocks or (3) obtain a score over 90 on a test condition.

Both PEAK-E and PEAK-T include a criterion-referenced list of 184 target skills (368 total). Selection of appropriate targets was based on direct pre-assessment results and direct or indirect teaching of each individual target skill (Dixon, 2016). Once the participant had mastered a program within either module, the implementer conducted the second baseline test probe from the remaining program. Simultaneously, the implementer conducted the first baseline for another program. By doing this, implementers were able to achieve a step-wise progression of baseline testing that contained at least two probes at a time (Belisle et al., under review).

RESULTS

For the initial PEAK assessment, Connor obtained a total score of 16. The portion of the total score obtained from the PEAK-E module suggested that Connor had limited skills in the area of reflexivity, symmetry, transitivity, and equivalence, as he obtained a raw score of 1 out of 6 in each section within PEAK-E (see Table 1). The second portion of the total score was obtained from the PEAK-T module and it suggested that Connor had the skill of coordination, which is the ability to exchange a stimulus for another stimulus as well as transform the relations of a certain stimulus (Dixon, 2016). He received a raw score of 10 out of 16 for the frame family of coordination. However, he did not show mastery of the skills of comparison, opposition, distinction, hierarchical, or deictic (see Table 1). The overall PEAK score was calculated by taking the sum of the points correct on PEAK-E, the sum of the points correct on PEAK-T, and adding the PEAK-T score to the PEAK-E score. The raw scores for each IQ subtest that were completed (information, matrix reasoning, and picture memory) are displayed in Table 2. For the initial IQ test, Connor obtained a raw score of 2 for information, 6 for matrix reasoning, and 3 for picture memory. The subtest scores were then converted into a full-scale IQ score, in which Connor's IQ was 45. Lastly, for the initial assessment for obtaining the d coefficient, Connor obtained a total score of 0. The initial assessment scores indicated that Connor was not able to derive neither symmetrical, nor transitive relations.

Participant performance is summarized in Figure 3-6. During baseline conditions, Connor obtained a range of scores that for 9 out of the 13 programs introduced, indicated that staff should move on to implementing training/testing in order to teach him those skills. For 4 of

the skills introduced, it was evident that Connor already had that particular skill within his repertoire as he received a score of above 90% during baseline. For the skills that Connor obtained over 90% on two consecutive baseline trial blocks, staff considered those mastered and moved on to the next skill. Connor mastered out of 11 total skills during the 10-week treatment. 7 of those programs were from the PEAK-E module that focuses on the emergence of stimulus equivalence and DRR, and includes the frame families of reflexivity, symmetry, transitivity, and equivalence (Dixon, 2015), and 4 of those programs were from the PEAK-T module, which also focuses on DRR and corresponds with RFT and includes that frame families of coordination, distinction, opposition, comparison, hierarchical, and deictic (Dixon, 2016). 2 programs were in progress but were not mastered at the time the study came to an end. For 1 of the programs that was not mastered, he was showing improvement in his scores. The other program that was not mastered was not showing a stable increase in scores, however staff was beginning to implement error correction in order to help Connor understand the skill better. As mentioned previously, for a program to be considered mastered, Connor had to either (1) obtain a score of over 90% on both baselines conducted or (2) obtain a score of over 90% for three consecutive trial blocks or (3) obtain a score over 90 on a test condition. The majority of the programs mastered were taught to 100%. It took an average of 7 training/testing trial blocks in order for Connor to master out of a skill. For programs taken from PEAK-E (symmetry), it took an average of 6 trial blocks in order for Connor to obtain mastery. For programs pulled from PEAK-T (comparison, distinction, opposition, and deictic), it took an average of 8 trial blocks in order for Connor to obtain mastery. Within the symmetry programs, Connor was directly taught a single relation (A-B) and then he was able to derive B-A without being directly taught for each stimuli used (see Table 3). This suggests that Connor was able to make a derived relation in the opposite direction of the

relation that was directly trained (Dixon, 2015). Connor then mastered out of 1 program from the frame family of comparison suggesting that he could make comparison relations when asked questions like, “Which is bigger” (Dixon, 2015), 1 program from the frame family of opposition suggesting that Connor was able to identify things that were opposite such as a full cup versus an empty cup (Dixon, 2015), and 2 programs from the frame family of distinction which suggests Connor was able to transform the relations of a certain stimulus by a certain learning history with another (Dixon, 2015). For comparison, distinction, opposition, and deictic, he was directly taught A-B and then tested on Y-Z, so by only being directly taught one relation he was then able to derive three more, for a total of four relations (see Table 3). There were 2 out of the 11 programs mastered that we saw an initial failure to derive relations. On the program SYM: Superheroes-4D, Connor obtained a score ranging from 84% to 100% on the three previous trial blocks using the training stimuli (A-B), however when staff tested the opposite direction (B-A), Connor’s score dropped to 50%. Following the testing block, staff returned to training the skill for 1 more trial block, in which he obtained 100%. Following the 100%, staff tested the opposite direction once again (B-A), and he scored a 100% suggesting that he was now able to derive that relation. For DIS: Picture Discrimination-3D, Connor obtained scores ranging from 80% to 88% on the previous training trial blocks, however when tested Y-Z, his scores dropped to 30% on the first test. Staff then returned to training for two trial blocks in which he scored 84% and 86%. The second test followed those two trial blocks, and Connor obtained 0%. Following these scores for Y-Z, staff returned to training A-B. Once Connor had obtained scores ranging from 96% to 100% on the training blocks, staff then re-tested Y-Z, in which he then obtained 100%. In both of these situations, there was an initial failure to derive relations. That being said, both of these

programs also suggest that derived relations can be achieved, it simply may take more time and more training trial blocks for some programs versus other programs.

Following the end of treatment were the final PEAK, IQ, and d coefficient probes. Connor obtained a final PEAK score of 26, which is a 10-point increase from the initial assessment. As displayed in Table 1, Connor gained 1-point for reflexivity, 3-points for comparison, and 8-points for deictic. His score stayed the same for the frame families of transitivity and coordination. Lastly, Connor's scores did decrease by 1-point for the frame families of symmetry and equivalence. Overall, Connor's PEAK score increased from the initial test to the final test, and he was able to show improvements in areas that weren't even taught with any of the programs introduced. This suggests that Connor may have learned these skills through learning portions of other programs and applied the knowledge to other situations/tasks. For the IQ test, Connor obtained a final full-scale IQ score of 51, which would be a full-scale IQ (FSIQ) change score of +6 from the initial assessment. The FSIQ change score was calculated by subtracting the initial score from the final score to obtain the difference between the two scores (Dixon, Paliliunas, Barron, Schmick, & Stanley, 2019). Connor's FSIQ change score also corresponded with the findings from Dixon et al. (2019) in which the range of change increase was 6-23. The final d coefficient score was 1, which is a 1-point increase from the initial assessment. Although this increase may seem small, it may have also been a considerable gain taking into account the floor effect that the method to obtaining the relational deceleration coefficient may have, as the test was too difficult for the participant.

DISCUSSION

The results of the present study extend prior research (Dixon, 2015; Dixon et al., 2017b; Dixon et al., 2018; Dixon et al., 2019), suggesting that (1) the PEAK-E and PEAK-T curriculum are able to teach the targets they intend to teach, and (2) DRR is an essential skill to teach all children, especially those whom have developmental disabilities as it is crucial in teaching and improving language skills (Moran et al., 2015). The present study was able to demonstrate teaching children to derive relations through the PEAK curriculum. By teaching DRR through the PEAK curriculum, the participant was able to achieve an increase in PEAK scores as well as achieve an increase in IQ related to increases in the PEAK scores. This replicates previous studies that have shown that individuals who were able to derive relations also produced better scores on IQ tests (Dixon et al., 2018; Dixon et al., 2019). In many previous studies (Dixon, 2015; Dixon et al., 2016b; Dixon et al., 2017b; Dixon et al., 2018) as well as the current one that was conducted, the second two modules of the PEAK assessment and curriculum were shown to help produce DRR.

Along with other studies, this study focused on the development of untrained verbal operants, which included the emergence of derived mands and intraverbals. Teaching in this way and using the PEAK curriculum also allowed us to align with the views of RFT and stimulus equivalence, which involves training a small set of responses which then result in the development of untrained and unreinforced responses (Barnes-Holmes et al., 2017). Aligning with the view of RFT is important because RFT focuses on how language and cognition affects responses in everyday life (Barnes-Holmes et al., 2017), and that is ultimately what we want to happen when we teach children to derive relations. The end goal is for a child with

developmental disabilities who may otherwise struggle with deriving relations and applying that to their everyday life and multiple situations, to now be able to do those things.

The processes and techniques used within this study included a DTT style of teaching and using MET while training. By using DTT, we were able to provide immediate reinforcement for correct responses, and incorporate extinction or error correction procedures for incorrect responses (Geiger et al., 2012). DTT also allowed for us to move at a fast pace, delivering a high volume of controlled trials and teaching as many skills as possible (Ackley et al., 2019). Using MET allowed us to systematically present Connor with examples of stimuli relating to the specific task until he no longer needed to be instructed on each relation (Dixon, 2015).

The results of the present study add to prior research that there is an applied utility of the PEAK assessment and curriculum. PEAK has been shown to have a significant correlation with IQ (Belisle et al., 2018; Dixon et al., 2019), be a useful tool in teaching young individuals with developmental delays to derive relations (Mullen et al., 2017), and more specifically used in order to help individuals demonstrate derived symmetrical and transitive relations (Dixon et al., 2016b). By using PEAK to assess the participant and then follow the PEAK protocol for training and teaching DRR, we were able to not only improve the participant's score on the PEAK assessment, but we were also able to show an increased IQ score. The results of this study supplement current research that the PEAK relational training system, specifically the Equivalence module, helps to build repertoires of equivalence class formation in children with autism (Daar et al., 2015; Belisle et al., 2016).

These results were also obtained following a 10-week treatment that included two-hour sessions occurring twice per week. This would suggest that making improvements in language, cognition, and DRR could be done in a lesser amount of time than most therapies currently

operate by (if the proper programs and protocols are used, such as the PEAK relational training system). Past research has indicated an important element of ABA therapy is the intensity and it is suggested clients receive 30-40 hours per week of intervention (Weiss, 2001), however it is evident that 30-40 hours of therapy per week may not be a necessity to teaching children with ASD complex language and cognition skills. The consequences of not having to spend 30-hours per week in intensive treatment are immense for parents and children. If a child is not spending most of their time at a single therapy (i.e., intensive ABA), they may have more time to attend other therapists such as a speech pathologist, food therapist, or occupational therapist. Not only would it open up time for children to receive other services that they may need, but it would also allow for the child to be in school full-time where they could be more fully integrated into the school system, with same-age peers, and have the same opportunities and experiences as other children. ABA therapies that are less intensive would be beneficial to the child and their family, but it would also be beneficial to the clinics, organizations, and other families who have yet to receive any kind of ABA therapy. It's no secret that wait lists are a huge problem in a lot of clinics that serve the population of children with developmental disabilities. The possibility of improving a child's language and cognition skills in a matter of a few hours a week would allow clinics to see more clients at a time, as well as move through their waitlists at a quicker pace. That being said, therapy and treatment could still be provided in a more condensed manner while not compromising integrity of treatment and still providing every individual with the service and tools they need to be successful following the end of treatment.

Although this study suggests that gains in IQ and other assessment scores can be increased in 2-hours per week over the course of 10-weeks, it is also important to note the possibilities for improvements if using RFT models for intensive treatment. The gains that were

seen within the present study may grow exponentially if the child was receiving 30-40 hours per week of treatment using the same model that was used here (RFT model; i.e., PEAK). Due to the lack of dosage studies done on children with developmental disabilities, we do not know how such a model would affect a child's ability to grow and develop more complex language and cognition skills.

Another implication would be for specifically children with ASD, the results of this study imply that IQ scores do not have to be stagnant and there is a possibility that IQ can be altered and improved by teaching the individual how to learn instead of trying to teach everything directly (Dixon et al., 2019). By implementing the train/test strategy that PEAK enforces, therapists are able to provide individuals with the opportunity to learn relations through prompting and reinforcement strategies, but then apply what they have learned to untrained relations and new situations (Dixon, 2016). This is a major implication, as children with developmental disabilities tend to lack the ability to develop complex verbal behavior repertoires that their same-age peers may have (Dixon et al., 2017a; May et al., 2013).

Another implication of this study would involve reviewing Table 1. Within Table 1, it is clear that although most of the programs mastered were within the frame family of symmetry (within PEAK-E), PEAK scores on the final assessment did not reflect an improvement within symmetry. That being said, PEAK scores on the final assessment did reflect the increase in skills that were not mastered during treatment such as deictic (within PEAK-T). This suggests that it is important to go beyond the Equivalence module of PEAK and incorporate skills from the Transformation module as well. It is critical that we don't stop at teaching the skills that are taught within the Equivalence module, such as symmetry, but that we go further in order to expand the language and cognition of the individuals we work with. Furthermore, the largest

gains seen in PEAK scores were within the frame families of comparison and deictic and the largest gains seen IQ were from the subtests of picture memory, with matrix reasoning and information closely behind. It is possible that the gains seen in PEAK and the skills learned through the PEAK curriculum helped Connor build the necessary complex problem solving skills to be able to improve his scores on IQ subtests such as picture memory or matrix reasoning.

Despite the results obtained in the current study, there are several limitations that should be addressed in future research. First, due to the clinic running through a University and having limited space for therapy, there were multiple sessions that were missed due to the participant being sick, the University being closed for a holiday, or therapists being gone for school functions. Due to the limited space, sessions that were missed could not be rescheduled. Due to the treatment being 10-weeks Connor should have had 20 total sessions, however he only had 13 total sessions. We do not know if the multiple missed sessions could have limited the increase that was seen in PEAK scores and IQ scores. Having a space and schedule in which participants could have more consistent sessions may show more of an increase in the scores looked at during this study. Although having missed sessions is considered a limitation, it also resembles more closely to the real world, in that clients get sick, miss sessions, and don't always have consistent treatment due to outside factors. Furthermore, the intention of the study was to provide 12-weeks of treatment. Due to a global pandemic (COVID-19), the treatment phase ended at 10-weeks. The pandemic of COVID-19 caused schools to be shut down, normal operations moved to online-only, required social distancing, and to keep away from groups of people. Due to these stipulations that were enforced by state and local officials, there was unfortunately not a way to continue treatment passed 10-weeks. Once again, we are not sure if the limited weeks of treatment could have hindered the increase in scores that the children obtained.

Second, due to the lack of time that was available to complete the study some of the probe data were taken at times it otherwise would not have been taken. As specified in the above methods, IQ and d coefficient probes were to be conducted once the participant had mastered three skills, or three weeks had passed. If the participant were to master out of three skills in less than three weeks, then the probes would be conducted once the three weeks had passed. The third probes were completed without any new skills being mastered by the participant. The final probes were completed with only one skill that had been mastered between the final probe and the previous probe. That being said, although not all of the probes occurred during the intended times, the participant still increased his score on the IQ probes that were completed.

Third, we do not know if the results that were obtained in the present study would be the same if it were done with participants different from the participant chosen. For this study, there were a limited number of responses from potential participants. Even so, the participant selected did meet the criteria that were specified (i.e., autism diagnosis, not currently receiving other ABA services, low score on the CBI), except he could not make consistent symmetrical relations when he began. Although Connor could not make consistent symmetrical relations when he began, his age and gains in IQ line up with some of the participants included in a RCT completed by Dixon et al. (2019). This RCT evaluated IQ gains in children with autism in a comprehensive ABA treatment group, a traditional ABA treatment group, and a waitlist control group (Dixon et al., 2019). Out of the participants who received either comprehensive ABA treatment or traditional ABA treatment, 8 of those participants were the same age, or one year older or younger than Connor. There was also a participant within this study that closely resembled Connor's IQ gains, starting at 46 and ending at 50 following 12-weeks of treatment (Dixon et al., 2019) as compared to Connor's IQ which started at 45 and ended at 51.

Fourth, there was only one participant within the current study. Having additional participants would provide greater assurance that the results of the study did not occur by chance and could apply to other individuals who meet the specified criteria (diagnosis of ASD and a low score on a challenging-behavior assessment) as well as possibly a wide range of individuals. Having more participants would also add to the confidence that intensive ABA therapy (i.e., 30-40 hours per week) is not necessarily needed in order to see great gains in the language and cognition of the individuals we treat. Having more participants could also be used to show that intensive ABA therapy using RFT models may be more effective than other more traditional models. Additionally, although there is currently other research to support this conclusion (Belisle et al., 2018; Dixon et al., 2019), more participants may also increase the assurance that the PEAK relational training system can assist in the rising of IQ scores. In addressing this limitation, the multiple baseline across skills design that was used in this study works well with 1 participant and the design was able to accurately portray the skill acquisition seen through using PEAK. The multiple probe component of this study could be improved by having a control condition and using IQ probes within a multiple baseline across participants (had there been more than 1 participant). The design would have also been improved by conducting a study longer than 10-weeks.

Fifth, although data on treatment integrity was taken and the results were an acceptable percentage (90.6%), taking data on treatment integrity did not begin right away. Having treatment integrity data beginning at the start of the study and applying it through the entire study would allow for more confidence in that all the programs were presented, prompted, and scored the way that they should have been. Ensuring that all programs were presented, prompted, and scored the correct way would also allow for greater confidence in knowing that the participant

learned the skills correctly, actually earned the score they received, and was taught as many skills as possible during the time of treatment.

Sixth, the current study did not include a follow-up after the final probes were completed. We do not know how well the specific skills Connor learned will be maintained, how well he will continue to make derived relations throughout other situations, and how is IQ score may change following the ending of treatment.

Finally, the present study involved using only the discrete trial training (DTT) method of presenting trials. Within this method of training, the individual is taught relations directly and then tested on the emergence of derived relations (Dixon, 2015). Although children who are taught using DTT have been shown to acquire skills more quickly (Miranda-Linné & Medlin, 1992) and this was the preferred method for the current study, adding in another component would add more layers to the research. DTT would still be a necessary strategy to include in order to teach derived relations, however it may be interesting to include data on what other skills the child may be learning within their natural environments or other academic environments that may affect how quickly they are able to show DRR and how it may affect the amount of skills they are able to learn within the specified amount of time.

Future research could not only look at DTT and how presenting targets in a discrete trial format can assist a child in learning derived relations, but also look at incorporating NET components and including peer interactions. The child may learn things in the natural environment and with peers that they would apply to their training during the DTT sessions. Future research should address the other limitations above and continue to explore the potential utility of using PEAK to increase IQ scores, to teach children DRR, and to work towards a less-intensive system of ABA therapy. This would include conducting research that examines the

relationship between PEAK scores and increasing IQ scores in children who may have another developmental disability other than ASD, multiple diagnoses, children who may have behavioral challenges to overcome, and children whom do not have a developmental disability. Future research could also expand the number of treatment weeks provided to the participant, as well as conduct the study in a space that will allow for rescheduling and consistent sessions with the participant. As mentioned above, although the participant missed multiple sessions, it more closely resembled a real-life situation. Therefore, future research could also include this aspect to see if the same results (i.e., the client made significant gains regardless of missed sessions) could be replicated. Additionally, future research should look at modifying the design used in the present study to expand in order to include more participants, such as using a multiple baseline across participants with an imbedded multiple probe. This would allow for the researchers to identify whether the results found in the current study could be applied to different participants and multiple participants. Within the multiple baseline across participants design, the researcher may also include a control participant in order to compare initial and final assessment scores between participants who received an x-week treatment and those who received no treatment during that time. Finally, future research may consider adding a follow-up to the end of the study to examine how the participant(s) maintain the skills that were taught to them during treatment. Other questions that may be answered by doing a follow-up would be (1) what skills have they gained or lost during that time, (2) how has their IQ been affected during that time (i.e., increased, decreased, no movement), and (3) what does DRR look like for the child following the study (i.e., have they been able to continue to derive relations in other contexts not taught or worked on during treatment).

In conclusion, the present study suggests that the PEAK comprehensive assessment and curriculum is able to assess and appropriately teach children with ASD to derive relations, which is a necessary skill in order expand the language and cognition of children beyond simple tacts and mands, as well as potentially increasing IQ. Due to the results of this study, possible decreases in the duration of "intensive ABA treatment" may be warranted as the individual treated was able to improve scores based off a merely 2-hour session twice a week, however more research is needed in order to know for sure. As well, regardless of the intensity of the therapy, future ABA treatment should focus on incorporating RFT models that are more comprehensive.

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Table 1. Initial PEAK assessment scores, including specific frame families from the Equivalence and Transformation module to the right. Final PEAK assessment scores, including specific frame families from the Equivalence and Transformation module to the left.

	PEAK Assessment Scores	
Frame Families	PEAK-E & T Initial	PEAK-E & T Final
Reflexivity	1	2
Symmetry	1	0
Transitivity	1	1
Equivalence	1	0
Coordination	10	10
Comparison	0	3
Opposition	0	0
Distinction	0	0
Hierarchical	0	0
Deictic	2	10

Table 2. IQ scores broken down into each subtest raw score that was obtained for the initial, middle, and final probe.

IQ Subtest Scores			
Subtest	Initial	Middle	Final
Information	2	5	4
Matrix Reasoning	6	9	8
Picture Memory	3	6	8

Table 3. Each PEAK program that was introduced to Connor are listed to the left and the target relations within each program are listed to the right.

Target Relations for PEAK Programs		
Program	Train	Test
SYM: Object to Picture-4B	A=B	B=A
COM: Bigger and Smaller- 3A	A=B	Y=Z
SYM: Superheroes- 4D	A=B	B=A
DIS: Picture Discrimination- 3D	A=B	Y=Z
COM: Faster and Slower- 3B	A=B	Y=Z
SYM: Derived Mands- 4C	A=B	B=A
SYM: Upper/Lower Case Letters- 4F	A=B	B=A
OPP: Picture to Picture- 5C	A=B	Y=Z
SYM: Food Sources- 4E	A=B	B=A
SYM: Textual Number Identification- 5C	A=B	B=A
SYM: Shape Names- 5E	A=B	B=A
DIS: Textual Discrimination- 4A	A=B	Y=Z
DTC: You and I- 4E	A=B	Y=Z

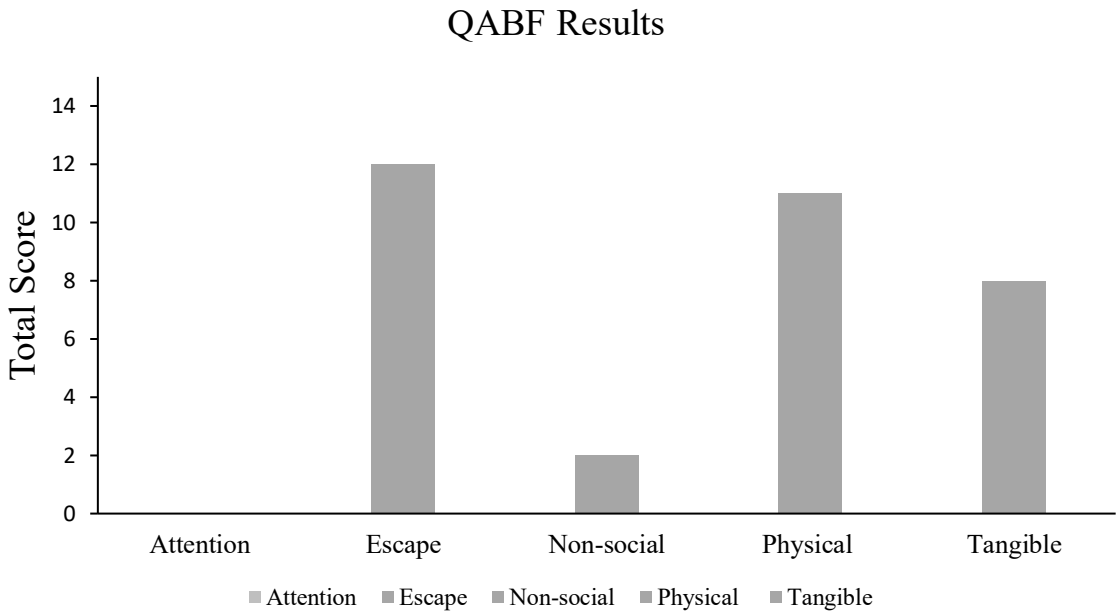

Figure 1. Responses from the participant's guardian regarding the function of the participant's behavior.

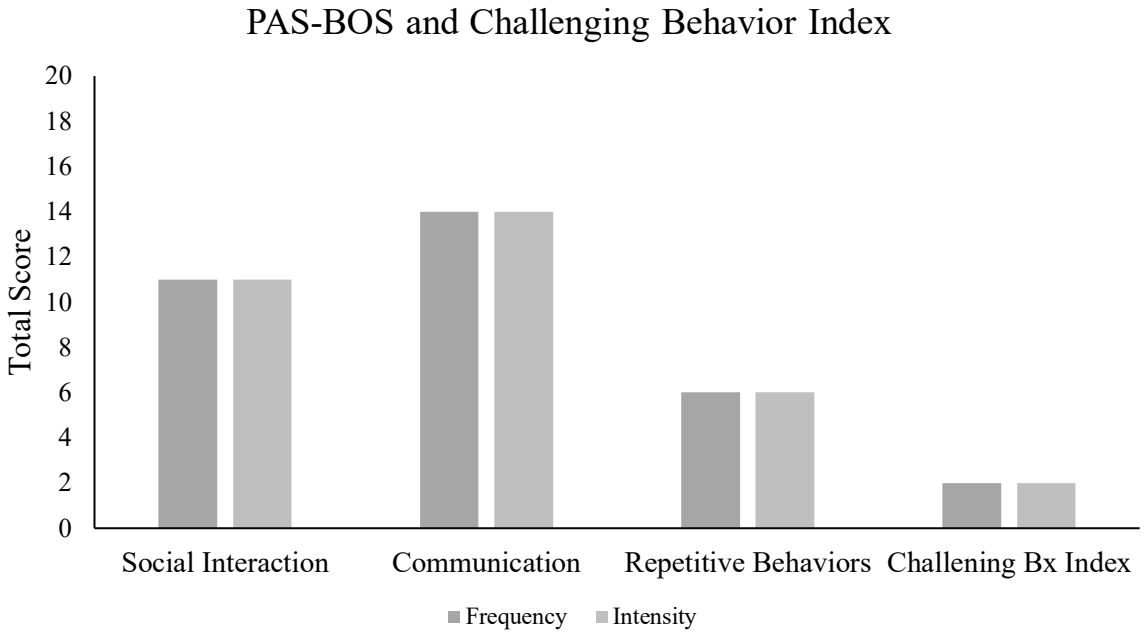

Figure 2. Responses from staff regarding factors that may affect the participant's functioning, as well as results of the challenging behavior index.

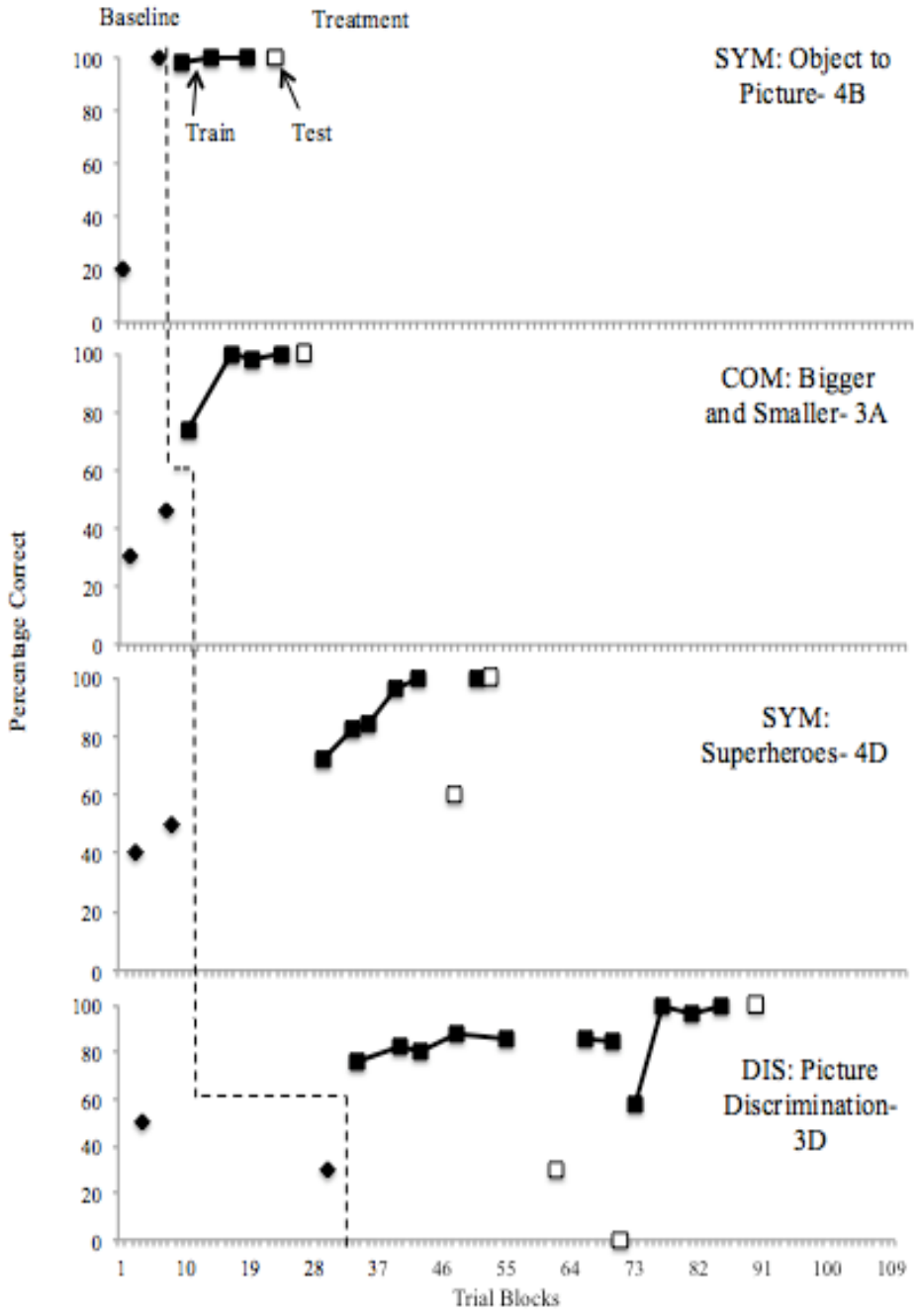

Figure 3. Skills 1-4 taught using the PEAK curriculum. The x-axis represents trial blocks completed while the y-axis represents percentage correct. Includes both PEAK-E and PEAK-T programs.

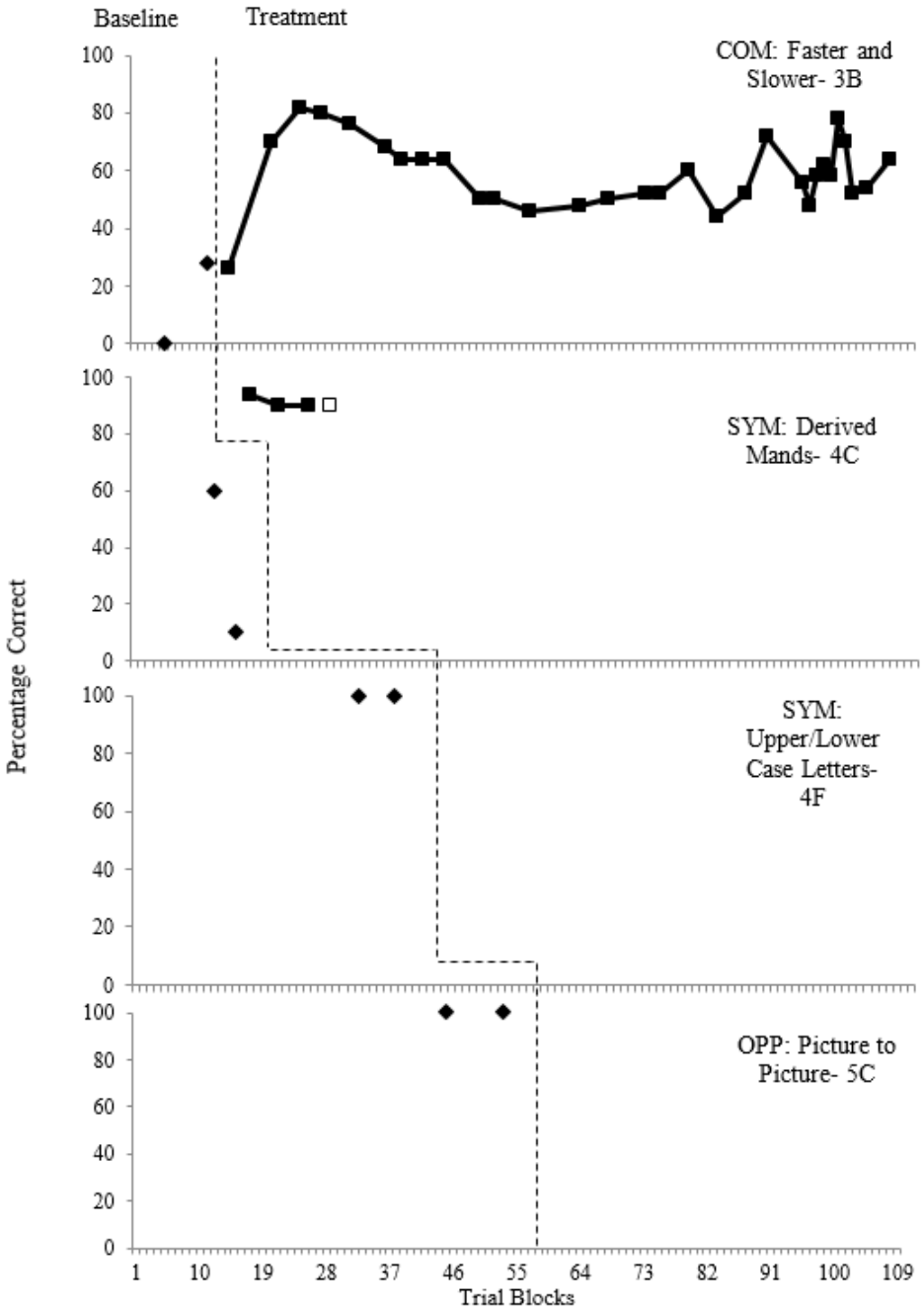

Figure 4. Skills 5-8 taught using the PEAK curriculum. The x-axis represents trial blocks completed while the y-axis represents percentage correct. Includes both PEAK-E and PEAK-T programs.

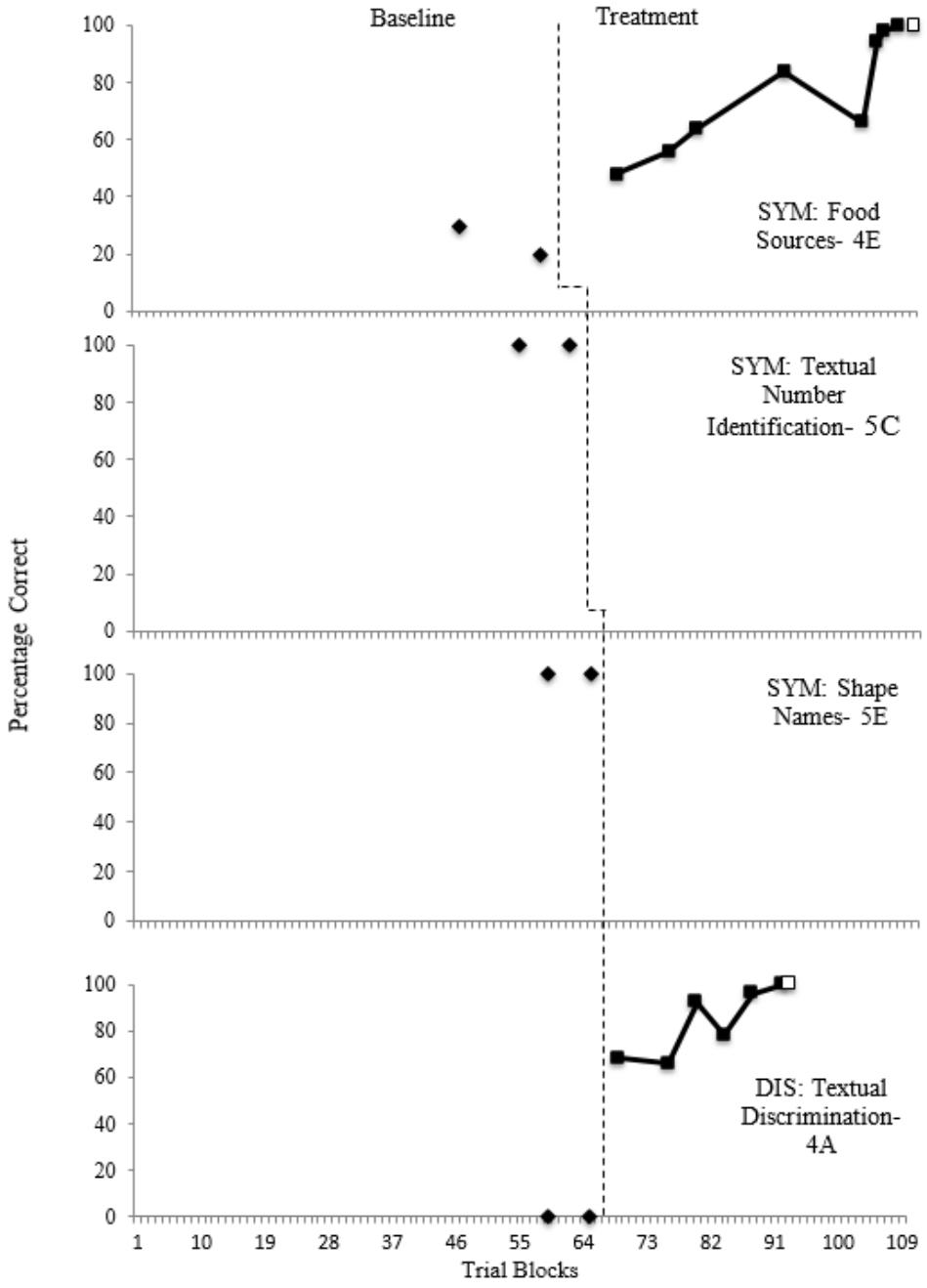

Figure 5. Skills 9-12 taught using the PEAK curriculum. The x-axis represents trial blocks completed while the y-axis represents percentage correct. Includes both PEAK-E and PEAK-T programs.

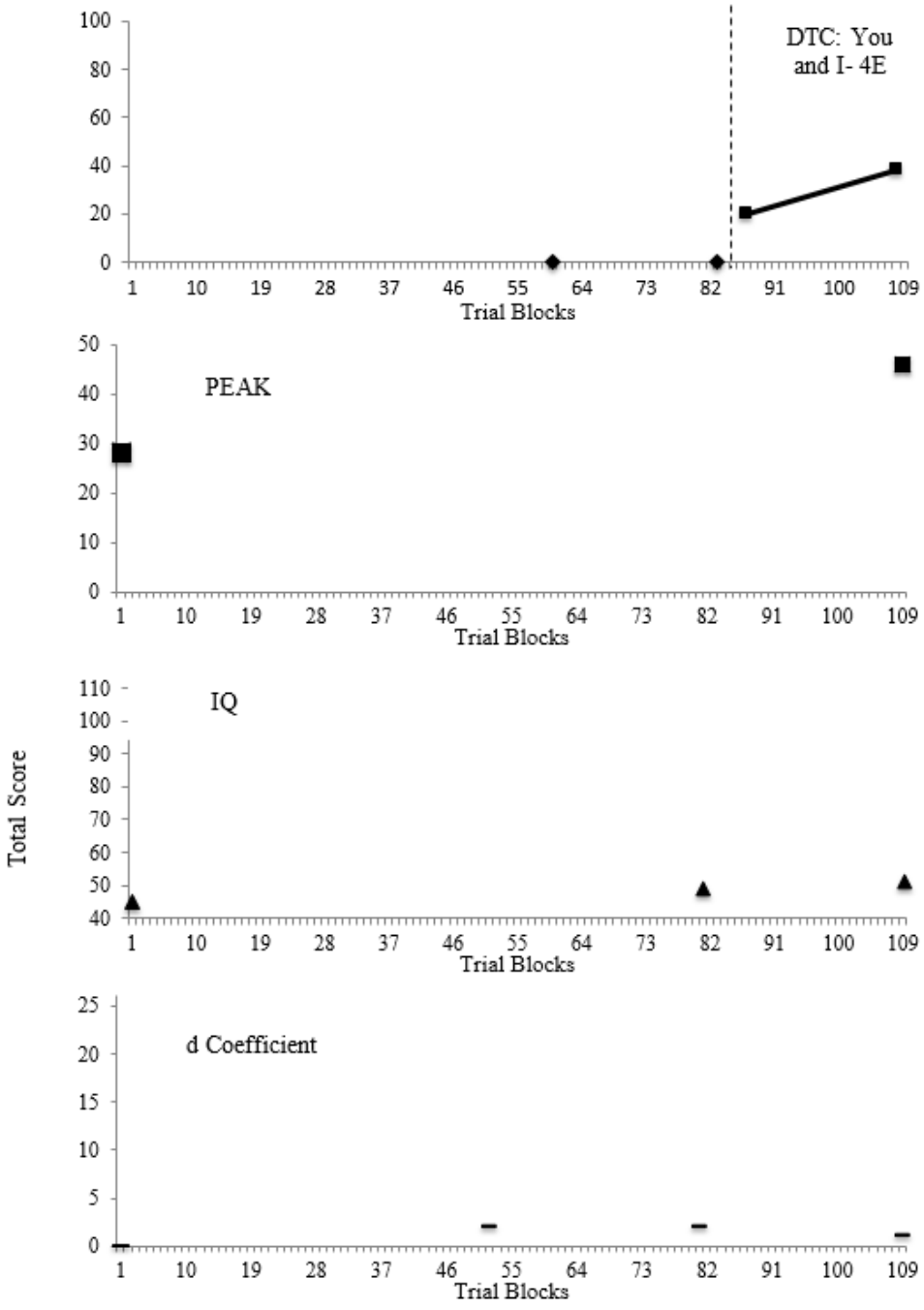

Figure 6. Skill 13 taught using the PEAK curriculum. For the top graph, the x-axis represents trial blocks completed while the y-axis represents percentage correct. Remaining three graphs depict the PEAK, IQ, and d coefficient probes completed in which the x-axis represents trial blocks while the y-axis represents total score.

APPENDICIES

Appendix A. Human Subjects IRB Approval

Date: 4-29-2020

IRB #: IRB-FY2020-33
Title: Teaching Language and Cognition Skills to Children and Adolescents
Creation Date: 7-29-2019
End Date:
Status: Approved
Principal Investigator: Jordan Belisle
Review Board: MSU
Sponsor:

Study History

Submission Type Initial	Review Type Expedited	Decision Approved
Submission Type Modification	Review Type Expedited	Decision Approved
Submission Type Modification	Review Type Expedited	Decision Approved
Submission Type Modification	Review Type Unassigned	Decision

Key Study Contacts

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Member	Crystal Tracy	Role	Investigator	Contact tracy1722@live.missouristate.edu

Initial Submission

Investigative Team

Who is the Principal Investigator?

1 *This individual will be required to certify the protocol for submission and will be responsible for the overall project and **MUST be a faculty or staff** member.*

Name: Jordan Belisle
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Address: 901 S National Ave , Springfield, MO 65897-0027
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Email: jbelisle@missouristate.edu

Who is the Primary Study Contact?

2 *This person, in addition to the Principal Investigator, will be included on all correspondence related to this project. This person may be the Principal Investigator or someone else **(faculty, staff, or student)**.*

Name: Jordan Belisle
Organization: Psychology
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Phone:
Email: jbelisle@missouristate.edu

Will there be any Co-Principal Investigators participating in this study?

3.

Co-Principal Investigators will also be required to certify the protocol for submission and share overall responsibility with the Principal Investigator for the study. Co-Principal Investigators MUST be faculty or staff members.

Yes

✓ No

Will there be any other individuals participating with the investigation?

4

These individuals will be participating as part of the research team, but will not need to certify the protocol submissions, or be included in any correspondence regarding the study. Typically these individuals will be students or individuals from other institutions. Investigators may be faculty, staff, students, or unaffiliated individuals.

✓ Yes

Select the Investigator(s)

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No

General Information

1 What is the full title of the research protocol?

Teaching Language and Cognition Skills to Children and Adolescents

Abstract/Summary

2 *Please provide a brief description of the project.*

The purpose of the study is to evaluate instructional procedures designed to teach language and cognition skills to children and adolescents.
These procedures include the *Promoting the Emergence of Advanced Knowledge (PEAK): Relational Training System*, which is an assessment and curriculum that uses behavioral principles and techniques to teach basic to advanced language skills, and *Acceptance and Commitment Therapy (ACT) for Children with Autism and Emotional Challenges*, which is a language and cognition based therapeutic intervention incorporating mindfulness and behavior change techniques to help individuals learn how to stay in the present moment and identify as well as prioritize their values.

Are you requesting Single IRB Review

3

Single IRB Review is applicable to a study that is being reviewed by another Institution's IRB, in which you wish to rely on the external IRB for review, approval, and oversight.

Yes

✓ No

Does the study require review and oversight of the IRB?

4

Regardless of how these questions are answered, the determination of IRB review and oversight is made by the IRB and this study will still need to be submitted for preliminary review.

4A

Is this study a systematic investigation, following a predetermined plan, for looking at a particular issue, testing a hypothesis or research question, or developing a new theory that includes any of the following:

- Collection or analysis of quantitative or qualitative data
- Collection of data using surveys, testing or evaluation procedures, interviews, or focus groups
- Collection of data using experimental designs such as clinical trials
- Observation of individual or group behavior

✓ Yes

No

4B

Will this study contribute to generalizable knowledge, in that the purpose or intent of the project is to test or to develop scientific theories or hypotheses, or to draw conclusions that are intended to be applicable and/or shared beyond the populations or situations being studied? This may include one or more of the following:

- Presentation of the data at meetings, conferences, seminars, poster presentations, etc.
- The knowledge contributes to an already established body of knowledge
- Other investigators, scholars, and practitioners may benefit from this knowledge
- Publications including journals, papers, dissertations, and theses

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✓ Yes

No

4C

Will this study require obtaining information or biospecimens, through intervention or interaction with an individual that will be used, studied, or analyzed by the investigative team?

✓ Yes

No

Will you be requesting an Exempt Review for this study?

5

In order to qualify for review via exempt procedures, the research must not be greater than minimal risk and must fall into at least one of the exempt categories defined by federal regulations.

Yes

✓ No

6 Is this study receiving internal or external funding?

Yes

✓ No

Does this study contain protected health information (PHI)?

7

PHI is any information in a medical record or designated record set that can be used to identify an individual and that was created, used, or disclosed in the course of providing a health care service, such as a diagnosis or treatment.

Yes

✓ No

8 Has all IRB Human Research training been taken through CITI under Missouri State University?

✓ Yes

No

Research Protocol

Describe the proposed project in a manner that allows the IRB to gain a sense of the project including:

- The research questions and objectives,
- Key background literature (supportive and contradictory) with references, and
- The manner in which the proposed project will improve the understanding of the chosen topic.

1

The purpose of the study is to evaluate instructional procedures designed to teach language and cognition skills to children and adolescents.
These procedures include the *Promoting the Emergence of Advanced Knowledge (PEAK; Dixon, 2016): Relational Training System*, which is an assessment and curriculum that uses behavioral principles and techniques to teach basic to advanced language skills, and *Acceptance and Commitment Therapy (ACT) for Children with Autism and Emotional Challenges (Dixon & Paliliunas, 2018)*, which is a language and cognition based therapeutic intervention incorporating mindfulness and behavior change techniques to help individuals learn how to stay in the present moment and identify as well as prioritize their values. Both approaches seek to understand how language develops, and once developed, how language can influence behavioral flexibility. Research will take place on campus within research space dedicated to the primary investigator. Prior research on PEAK has demonstrated that the assessment tools contain convergent validity with measures of language and intellectual functioning (Dixon et al., 2014; Dixon, Belisle, et al., 2015), and that training guided by PEAK can lead to the acquisition of skills such as perspective taking (Belisle et al., 2016) and categorization (Dixon, Belisle, Stanley, et al., 2015). This research extends upon this work by evaluating PEAK in a better controlled laboratory setting on campus that contains on-going data monitoring and feedback, digital data recording, video monitoring, and physiological measures including heart rate and skin conductance during assessment and training. Research on ACT has also begun to show that this approach can intervene on the relationship between language and present moment awareness and values with children (Coyne et al., 2011). We are seeking to again extend this work by implementing ACT in a more rigorously controlled laboratory setting on campus.

2 Check all research activities that apply:

✓ Audio, video, digital, or image recordings

Biohazards (e.g., rDNA, infectious agents, select agents, toxins)

Biological sampling (other than blood)

Blood drawing

Class Protocol (or Program or Umbrella Protocol)

✓ Data, not publicly available

Data, publicly available

Deception

✓ Devices

Diet, exercise, or sleep modifications

Drugs or biologics

Focus groups

Intenet or email data collection

Materials that may be considered sensitive, offensive, threatening, or degrading

Non-invasive medical procedures

✓ Observation of participants

Oral history

Placebo

Record review

Specimen research

Surgical procedures

✓ Surveys, questionnaires, or interviews (one-on-one)

Surveys, questionnaires, or interviews (group)

Other

Describe the procedures and methods planned for carrying out the study. Make sure to include the following:

- Site selection,
- The procedures used to gain permission to carry out research at the selected sites(s),
- Data collection procedures, and
- An overview of the manner in which data will be analyzed.

Provide all information necessary for the IRB to be clear about all of the contact human participants will have with the project.

3 Subjects will be asked to participate in various language- and cognitive-based training/instructional activities and therapeutic exercises included in their instructional/treatment plans, as well as engage in preferred activities as a reward for doing so. As well, depending upon their age/ability level, they may be asked to complete surveys/questionnaires related to their instruction (attached).

Measurement will consist of standardized language assessments, data related to language and cognition skill acquisition, standardized measures of psychological health/flexibility and mindfulness, and any permanent products produced by participants' during their instruction. Language skill acquisition data typically involves daily or trial based recordings of response accuracy and prompt levels required. Language skills will be assessed both directly, using discrete trial training (presenting the individual with an instruction or question, providing praise/rewards for correct responses, and prompting incorrect responses), and indirectly, by having an adult familiar with the child/adolescent complete a checklist. Other measures will be gathered via questionnaires and surveys. (See attached for measurement instruments).

Direct observation/data collection will be collected during sessions by the behavior therapist/researcher working with the subject, and at some times, by a second researcher observing the session through a one-way mirror built in to the therapy room. Parent(s)/guardian(s) will be able to view the results of assessments by request.

Video/Audio taping will be used for treatment integrity and professional presentation. Separate written consent from subjects' guardians (see Request for Video/Audio Recording and Release of video recordings) will be obtained. The disposition of such recordings will include only the participant and instructor during applications of treatment materials or procedures. This will be done in order to allow for the review of procedural fidelity and reliability of recorded data. In some cases, audio/video recordings may be used in the professional presentations, such as training workshops or research symposiums. Only participants who have provided the additional consents (see audio/video consent and release) will be included in such presentations.

Attach tests, surveys, questionnaires, and other social-behavioral measurement tools, if applicable.

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4 Exemplar Survey Documents.pdf

PARTICIPANT INTAKE SURVEY.docx

5 Attach documentation of site permission, if applicable.

Participants

1 Specify the participant population(s).

Check all that apply.

- Adults
- ✓ Children (<18 years of age)
- Adults with decisional impairment
- Non-English speaking
- Student research pools (e.g. psychology)
- Pregnant women or fetuses
- Prisoners
- Unknown (e.g., secondary use of data/specimens, non-targeted surveys, program/class/umbrella protocols)

2 Specify the age(s) of the individuals who may participate in the research.

1 year through 17 years

3 Describe the characteristics of the proposed participants, and explain how the nature of the research requires/justifies their inclusion.

Children and adolescents (ages 1 through 17) whose parents and/or guardians have determined they would benefit from language and cognition based instructional procedures to develop or enhance their skills will be included in this study.

4 Provide the total number of participants (or number of participant records, specimens, etc.) for whom you are seeking IRB approval.

100

5 Describe what time commitment will be required from each participant, including individual interactions, total time commitment, and long-term follow-up, if any.

Participation in the study will take place for 1-2 hours / day and 2-5 days / week. The total length of intervention will vary across subjects, ranging from 1-week to 12-weeks depending on the intervention package developed to meet the specific needs of the subject.

6 Describe how potential participants will be identified (e.g., advertising, individuals known to investigator, record review, etc.). Explain how investigator(s) will gain access to this population, as applicable.

Subjects will be recruited from schools, ABA therapy providers, and parent referrals to a behavior analysis and therapy clinic operated by the Applied Behavior Analysis program within the Psychology Department at Missouri State University. Sites that work with potential participants will be contacted by the Primary Investigator via email (see Email Script) about the study. If the site responds to the email indicating their interest in providing information about the study to parents, then the site will be provided paper copies of the recruitment flyer (see Flyer) to provide directly to families. The flyer contains the contact information for the research team. Once contacted, the research team will set up an appointment on campus to discuss the research study with parents and complete and obtain informed consent from parents / guardians. Potential participants may be excluded if assessment results suggest participants may not benefit from participation in the study or if challenging behavior during the assessment or reported at intake indicates that the participant may fail to complete training sessions.

7 Describe the recruitment process; including the setting in which recruitment will take place.

Sites are encouraged to physically provide the recruitment flyer to families at the location where the families are receiving ABA services.

Attach recruitment materials (ads, flyers, website postings, recruitment letters, and oral/written scripts), if applicable .

Email Script - Agency.docx

FlyerPEAK.docx

8 Will participants receive compensation or other incentives (e.g., free services, cash payments, gift certificates, parking, classroom credit, travel reimbursement, etc.) to participate in the research study?

✓ Yes

Describe the incentive, including the amount and timing of all payments.

Participants may receive financial compensation for participating in the study. The compensated amount will be $10 per session to cover travel and parking expenses at the university. Therefore, the total compensation amount will be equal to $10 x number of sessions (e.g., 8 sessions = $80.00). We will track the number of sessions throughout the participation in the study. Participants will receive payment either at the end of the final session or after every 10 sessions (i.e., once compensation equals $100.00) if participation exceeds 10 sessions. There is no limit to the total number of sessions, as this will vary across potential participants. All potential participants will also receive a list of community resources that can provide further clinical services to the participants.

No

Risks and Benefits

1 Describe all reasonably expected risks, harms, and/or discomforts that may apply to the research. Discuss severity and likelihood of occurrence.

Consider the range of risks - physical, psychological, social, legal, and economic.

No risks are expected as a result of participation in this study.

Discuss the steps that will be taken to minimize risks and the likelihood of harm.

2 Consent from potential subject will be given before the start of the study. Subjects will be monitored while participating in the study to ensure that potential subjects are not exposed to any unnecessary risks. All procedures will take place in a private location within the therapeutic setting. Personal information will not be shared with anyone outside of the research team.

Describe the potential benefits that participants may expect as a result of this research study. State if there are no direct benefits to individual participants.

3 Participant may benefit from the study in a number of ways. First, all potential participants will be given a list of community resources at the intake session, even if they elect not to participate in the research study. This list may help families to contact services for their children. Second, by participating in the study, participants may acquire new language and cognitive skills or learn to contact the present moment and improve psychological health. Research suggests that improvement in these areas can lead to reductions in challenging behavior and overall gains in life quality.

Discuss any potential indirect benefits to future subjects, science, and society.

4

Indirect benefits include an improved understanding of assessment and treatment for children with- and without-disabilities. Results may guide the development of programming within applied settings (e.g., schools, health providers, ABA clinics).

Describe how risks to participants are reasonable when compared to the anticipated benefits to participants (if any) and teh importance of the knowledge that may
5 reasonably be expected to result.

Because there are no known risks and several potential benefits to the participant and society, risks are considered reasonable.

Informed Consent

1 From the list below, indicate how consent will be obtained for this study.

Check all that apply.

- Written/signed consent by the subject
- ✓ Written/signed consent (permission) for a minor by a Parent or Legal Guardian
- Written/signed consent by a Legally Authorized Representative (for adults incapable of consenting)
- Request for waiver of documentation of consent (verbal consent, anonymous surveys, etc.)
- Waiver of parental permission
- Waiver of consent (consent will not be obtained from subjects)

Describe the consent process including where and by whom the subjects will be approached, the plans to ensure the privacy of the subjects and the measures to ensure that subjects understand the nature of the study, its procedures, risks and benefits and that they freely grant their consent.

2 Once a potential subject has been identified, a solicitation letter will be given to the parent(s)/guardian(s) (see Research Information Letter) along with the Intake survey and other documents. If the guardian signs the letter with an indication that they would like to participate in the study, the researcher will then seek informed consent from the parent or guardian of the potential participant.

At that time, the consent form and aspects of the study will be reviewed with parent(s)/guardian(s).

Assent will also be obtained from any participant above the age of 5. Assent will be gained by approaching the participant with their instructor, therapist, or guardian, and explaining to them what the purpose of the study is. Expectations of participation (see assent form) will be explained and the participant will be told that they will be allowed to quit if they so choose.

Attach all consent and assent documents here:

Consent for Video Release.docx

Consent Video Recordings.docx

Research Letter.docx

Release of Liability Form.docx

Service Agreement Form.docx

Parent Guardian Consent Form.docx

Assent to Participate.docx

Data Collection

Missouri State University is committed to keeping data and information secure. Please review the Missouri Ste University Information Security Policies. Discuss you project with the MSU Information Security Office or your College's IT support staff if you have questions about how to handle your data appropriately.

1

Statement of Principal Investigator Responsibility for Data

The principal investigator of this study is responsible for the storage, oversight, and disposal of all data associated with this study. Data will not be disseminated without the explicit approval of the principal investigator, and identifying information associated with the data will not be shared.

✓ By checking this box, all personnel associated with this study understand and agree to the Statement of Principal Investigator Responsibility for Data.

2

How will the data for this study be collected/stored?

Check all that apply.

✓ Electronic storage format

On paper

Describe where the data will be stored (e.g., paper forms, flash drives or removable media, desktop or laptop computer, server, research storage area network, external

source) and describe the plan to ensure the security and confidentiality of the records (e.g., locked office, locked file cabinet, password-protected computer or files, encrypted data files, database limited to coded data, master list stored in separate location).

3

At minimum, physical data should always be secured by lock and key when stored. Electronic data should be stored on University secure servers whenever possible (Office 365 or other secure campus server). If data has to be stored off campus, the file should be encrypted and the device password protected. Additionally, any data to be shared outside the University network will require a SUDERS request be filed and approved. See https://mis.missouristate.edu/Central/suders/create

All data collected during the study will be stored on University secured servers (Office 365; Microsoft SharePoint). Paper documents will be scanned and secured on the secured server within 48 hours and will subsequently be destroyed. Only researchers affiliated with this project will have access to the server.

Describe how data will be disposed of and when disposal will occur.

4

At minimum, Federal regulations require research records to be retained for at least 3 years after the completion of the research (45 CFR 46). Research that involves identifiable health information is subject to HIPAA regulations, which require records to be retained for at least 6 years after a participant has signed an authorization. Finally, funded research projects may require longer retention periods, you may need to follow the sponsoring agency guidelines.

Paper documents will be shredded within 48 hours. All data contained on the server will be kept for 7 years, after which point it will be deleted from the server.

Additional Information

1 Please include any additional information about the study below.

N/A

2 Please include any additional documents that aren't covered within the application.

Appendix B. PEAK Transformation Data Sheet

Transformation Data Sheet

Participant: ________________

Init: ________ Date: ________
Step(s): ________ Train: ☐
Relation(s): ______ Test: ☐

Trial	Class	Score				
1		0	2	4	8	10
2		0	2	4	8	10
3		0	2	4	8	10
4		0	2	4	8	10
5		0	2	4	8	10
6		0	2	4	8	10
7		0	2	4	8	10
8		0	2	4	8	10
9		0	2	4	8	10
10		0	2	4	8	10
			Total:			

Init: ________ Date: ________
Step(s): ________ Train: ☐
Relation(s): ______ Test: ☐

Trial	Class	Score				
1		0	2	4	8	10
2		0	2	4	8	10
3		0	2	4	8	10
4		0	2	4	8	10
5		0	2	4	8	10
6		0	2	4	8	10
7		0	2	4	8	10
8		0	2	4	8	10
9		0	2	4	8	10
10		0	2	4	8	10
			Total:			

Init: ________ Date: ________
Step(s): ________ Train: ☐
Relation(s): ______ Test: ☐

Trial	Class	Score				
1		0	2	4	8	10
2		0	2	4	8	10
3		0	2	4	8	10
4		0	2	4	8	10
5		0	2	4	8	10
6		0	2	4	8	10
7		0	2	4	8	10
8		0	2	4	8	10
9		0	2	4	8	10
10		0	2	4	8	10
			Total:			

Init: ________ Date: ________
Step(s): ________ Train: ☐
Relation(s): ______ Test: ☐

Trial	Class	Score				
1		0	2	4	8	10
2		0	2	4	8	10
3		0	2	4	8	10
4		0	2	4	8	10
5		0	2	4	8	10
6		0	2	4	8	10
7		0	2	4	8	10
8		0	2	4	8	10
9		0	2	4	8	10
10		0	2	4	8	10
			Total:			

Init: ________ Date: ________
Step(s): ________ Train: ☐
Relation(s): ______ Test: ☐

Trial	Class	Score				
1		0	2	4	8	10
2		0	2	4	8	10
3		0	2	4	8	10
4		0	2	4	8	10
5		0	2	4	8	10
6		0	2	4	8	10
7		0	2	4	8	10
8		0	2	4	8	10
9		0	2	4	8	10
10		0	2	4	8	10
			Total:			

Init: ________ Date: ________
Step(s): ________ Train: ☐
Relation(s): ______ Test: ☐

Trial	Class	Score				
1		0	2	4	8	10
2		0	2	4	8	10
3		0	2	4	8	10
4		0	2	4	8	10
5		0	2	4	8	10
6		0	2	4	8	10
7		0	2	4	8	10
8		0	2	4	8	10
9		0	2	4	8	10
10		0	2	4	8	10
			Total:			

PEAK:	Notes:
0 = no response after multiple attempts at prompts 2 = multiple prompts or reduced stimulus array eventually produced a response 4 = 2 prompts at most produced the response with full stimulus array 8 = 1 single prompt of either verbal or visual nature 10 = independent accuracy on response with no prompt	

PEAK Relational Training System Fidelity Checklist

Therapist:	Rater 1:	Rater 2:	Date:

Preparation Checklist

Instructions: For each item, evaluate if the therapist has met expectations as outlined in the item description. A score of 0 suggests that the therapist has not met expectations and is reserved for when the therapist fails to complete the step entirely. A score of 1 suggests that the therapist has completed the item, however, greater performance is expected. A score of 2 suggests that the therapist has met expectations for the given item.

Item	Score
1. Has determined appropriate stimuli to use as reinforcers using a preference assessment method.	0 1 2
2. Has program sheets with appropriate stimuli indicated on the program sheets.	0 1 2
3. Has written the date and randomized the stimulus presentation order on the data sheets	0 1 2
4. Has arranged the environment in a way that minimizes distractions to conduct training.	0 1 2
5. Has all necessary stimuli, as specified in the participant's program, to conduct training.	0 1 2
Total Score:	/10
Percentage Score:	/100%

Implementation Checklist

Instructions: The implementation checklist is designed to evaluate implementation fidelity for any number of consecutive trials. We recommend that at least 5 trials be evaluated. For each trial, provide a tally indicating whether the step was completed correctly or incorrectly. Note that, for each trial, a step can only be performed either correctly or incorrectly, and the total number of tally marks for each step (i.e., correct + incorrect) should equal the number of trials that have been assessed. Also, only a single tally mark may appear in steps 3 and 4 for each trial as these items are incompatible with one another (i.e., the participant either demonstrates the correct response or an incorrect response).

Train Trials			Test Trials		
Step	Correct?	Incorrect?	Step	Correct?	Incorrect?
1. Clearly presents the discriminative stimulus.			1. Clearly presents the discriminative stimulus.		
2. Allows appropriate time for participant response			2. Allows appropriate time for participant response		
3. If participant response is correct, provides reinforcement.			3. Does not provide reinforcement when participant response is correct.		
4. If participant is incorrect, provides appropriate prompt.			4. Does not provide prompt when participant response is incorrect.		
5. Quickly progresses to the next trial			5. Quickly progresses to the next trial		
Total:			Total:		
Percentage Correct (Train+ Test):		Notes:			
Preparation Fidelity: (Percentage score preparation checklist)					
Implementation Fidelity: (Percentage correct implementation checklist)					

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