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Effects of Peak Equivalence and Transformation Treatment on Derived Relational Responding as a Generalized Operant and IQ

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EFFECTS OF PEAK EQUIVALENCE AND TRANSFORMATION TREATMENT ON DERIVED RELATIONAL RESPONDING AS A GENERALIZED OPERANT AND IQ

A Master's Thesis

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In Partial Fulfillment

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Master of Science, Applied Behavior Analysis

By

Lindsey Marie Schneider

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ABSTRACT

The present study examined P*romoting the Emergence of Advanced Knowledge Relational Training System;* Equivalence (PEAK-E) and Transformation's (PEAK-T) effect on a participant with ASD's derived relational responding, intelligence scores (WPPSI-IV; Weschler 2012), and the deceleration coefficient. One participant with ASD was given 10 weeks of PEAK-E and PEAK-T treatment for four hours a week, along with probes throughout the study for IQ scores and deceleration coefficient scores. The data indicated a significant relationship between PEAK-E and PEAK-T treatment and IQ scores, as well as a relationship between PEAK scores and a participant's deceleration coefficient. This indicated that PEAK-E and PEAK-T treatment is a reliable and valid treatment for individuals with ASD.

KEYWORDS: autism, derived relational responding, generalized operant, peak, stimulus equivalence

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INTRODUCTION

Behavior Analytic Language Intervention for Children with Autism

Autism spectrum disorder (ASD) is a neurodevelopmental disorder that is characterized by deficits in language, social skills, and the display of stereotyped and repetitive behaviors (Dawson, Rogers, Munson, Smith, Winter, Greenson, Donaldson, & Varley, 2010; American Psychiatric Association, 2013). Individuals with ASD generally have impairments in motor skills, adaptive play, perspective-taking, executive functioning, and academic skills (Dixon, Tarbox, Najdowski, Wilke, & Granpeesheh, 2011). Behavior analytic treatments are often embedded within early intensive intervention (EIBI; MacDonald, Parry-Cruwys, Dupere, & Ahearn, 2014). Treatment programs that are considered early intensive behavioral interventions are considered intensive if therapy involves participation of 30 or more hours per week, starts early, use behavioral strategies, and make decisions based on behavioral data (Dixon et al., 2011). Early intervention for individuals with ASD has shown significant improvements in IQ (e.g., ESDM; Dawson et al., 2010), less restrictive school placements (Lovaas, 1987), an increase in spoken and receptive language, motor skills, self-help, imitation, and play skills (Hampton & Kaiser, 2016). An intervention must be comprehensive in nature to allow for a clear and detailed evaluation of an individual's repertoire across all areas of development (Gould, Dixon, Najdowski, Smith, & Tarbox, 2011). There are two classifications of interventions: focused intervention practice and comprehensive treatment models (Odom, Boyd, Hall, & Hume, 2009). Focused interventions are used with individuals with ASD for a limited time with the goal of targeting a specific behavior or single skill, examples include video

modeling, prompting, and pivotal response training (Wong, Odom, Hume, Cox, Fettig, & Kucharczyk, 2015). Comprehensive treatment models are designed around a framework that focuses on broader learning skills and developmental areas, take place over an extended period, and are considered intensive (Rogers & Vismara, 2008).

The need for empirically validated interventions for individuals with ASD is high as the number of individuals with ASD has increased in recent years (Ackley, Subramanian, Moore, Litten, Lundy, & Bishop, 2019). Research suggests that there is considerable variability in the different interventions that are offered to individuals with ASD across therapists and agencies (Bibby, Eikeseth,, Martin, Mudford, & Reeves, 2001). Differences between the different programs available include variability in treatment format, how programs are supervised, and overall differences in curriculum being taught (Love, Carr, Almason, & Petursdottir, 2009). In 2009, 48% of therapist were using more than one curriculum, suggesting that they were not able to adequately teach in all areas the individual with ASD was lacking with one program, increasing the need for a curriculum to be comprehensive (Lovaas 1981; Maurice, Green, & Luce, 1996). Priority should be given to skills that will remain functional across settings and time allowing the individual more learning opportunities, not placing a large amount of attention on unnecessary or inappropriate skills (Rosales-Ruiz & Baer, 1997). Assessments should provide a clear starting point for curricular instruction individualized to meet the idiosyncratic needs of children with ASD, by displaying both necessary skills that are absent and prerequisite skills needed to master later. Research would suggest that Applied Behavioral Analysis used in treatment for individuals with ASD can have major impacts on intelligence, daily living skills, language, and social skills (Virués-Ortega, 2010).

In the book *Verbal Behavior*, B.F. Skinner (1957) took steps towards explaining the complexity of human language. According to Skinner, to be considered verbal behavior another person provided reinforcement and that person has learned in the past to reinforce that behavior specifically (Meindl, Miller, & Ivy, 2018). Dymond, O'Hora, Whelan, & O'Donovan conducted a citation analysis in 2006 on Skinners verbal behavior, which revealed an increase in citations, with most of those citations from non-empirical articles. Dixon, Small, & Rosales extended the analysis in 2007 on empirical citations of Skinners verbal behavior where majority of empirical research had been conducted with young atypical population, mostly participants with ASD or mental retardation. Results of verbal operants measured in empirical research suggest that most studies focus on mands and tacts, ignoring other operants (e.g. echoics, autoclitic) (Sautter & Leblanc, 2006). Petursdottir and Devine (2017), found an increase in *Verbal Behavior* citations, 44% of the articles found were cited in empirical articles. 74% of the articles found focused solely on single verbal operant, the mand being the most common operant studied and then the tact being the next operant most likely to appear in a empirical study (Petursdottir & Devine, 2017). There is a need to expand research beyond the basic verbal operants in Skinners *Verbal Behavior*, to more complex forms of language (Dixon et al., 2007).

Several ABA based assessments and curriculum for teaching language skills to children with ASD have emerged in recent years (Ackley et al., 2019). Behavior analysis is rooted in data to drive the analysis and treatment (Cooper, Heron, & Heward, 2008), yet there has not been a review of empirical data to support the current ABA protocols being used with children with ASD (Ackley et al., 2019). ABA Curriculum for the Common Core, there is currently no research on this protocol's effectiveness, validity, or reliability though it is based on ABA principles. The Assessment of Basic Language and Learning Skills- Revised, there has been one

article published for this assessment's reliability (Partington, 2006) and validity (Malkin, Dixon, Speelman, & Luke, 2017) but none for the overall effectiveness of the interventions guided by the assessment ABLLS-R. SKILLS, there is no data to support the effectiveness of this curriculum, but studies have been done that support inter-observer and test-retest reliability (Dixon et al., 2011). The Verbal Behavior Milestones Assessment and Placement Program, there are no studies regarding the reliability of the VB MAPP, but there is one study evaluating validity (Dixon, Belisle, Stanley, Rowsey, Daar, & Szekely, 2014a) comparing scores between PEAK and VB MAPP and suggesting high correlation between the two assessments scores.

Early Start Denver Model (ESDM; Rogers & Dawson, 2010) uses both ABA and developmental psychology to address different domain skills ages one through 48 months through an interactive style to teach skill acquisition focusing on joint attention (Ratner & Bruner, 1978). The focus on ages 12 months through 48 months reflects a theoretical framework that works to improve early ASD signs in children that impact an individual's ability to learn through the environment (Vivanti & Dissanayake, 2016). ESDM provides an assessment and curriculum that is to be implemented by trained professionals. A key component of ESDM is that is it taught in a Naturalistic Behavioral Developmental Approach (Schreibman, Dawson, Stahmer, Landa, Rogers, Mcgee, … Halladay, 2015). There are no published studies to support the reliability or validity of ESDM protocol. ESDM has however produced effectiveness research since being developed (Estes, Munson, Rogers, Greenson, Winter, & Dawson, 2015). ESDM has shown a significant increase in IQ score, adaptive behavior, and ASD diagnosis (Dawson et al., 2010). After having ESDM as a treatment, individuals with ASD increased 17.6 standard points compared to 7.0 points by the comparison group who had not received ESDM (Dawson et al., 2010). Several studies have been replicated and gotten similar results, which saw

increases in IQ scores (Yoder & Lieberman, 2010) and Vineland scores (Estes et al., 2015). ESDM implemented by parents can be as effective as community-based interventions, even when ESDM is applied with fewer hours (Rogers, Estes, Lord, Vismara, Winter, Fitzpatrick, & Dawson, 2012).

Promoting the Emergence of Advanced Knowledge Relational Training System is aimed at promoting complex language. PEAK is founded in ABA principals and has four modules; PEAK-Direct Training, PEAK-Generalization, PEAK- Equivalence, and PEAK-Transformation, with the first two modules based entirely on *Verbal Behavior* (Skinner, 1957) framework and the last two modules focusing on the complexity of human language and cognition. The Direct Training Module (PEAK-DT; Dixon, 2013) module is based on simple and complex verbal relations and is implemented through discrete trial training (Dixon, Belisle, Whiting, & Rowsey, 2014b), similar to procedures used by programs such as VB-MAPP (Sundberg, 2008) and ABBLS-R (Partington, 2006). The Generalization Module (PEAK-G; Dixon, 2014) promotes generalization by putting both training and generalization targets within trial blocks for individuals to establish generalization of skills (Dixon, Peach, Daar, & Penrod, 2017a).

Studies to support reliability and validity have been conducted on the Direct Training module of PEAK (Dixon et al., 2014b; Daar, Negrelli, & Dixon, 2015). Inter-observer reliability is high for the PEAK assessment and scoring sheets (Dixon, Stanley, Belisle, & Rowsey, 2016c). PEAK has high validity to the Peabody Picture Vocabulary Test (Dixon, Carman, Tyler, Whiting, Enoch, & Daar, 2014c), IQ (Dixon, Whiting, Rowsey, & Belisle, 2014d), and One-Word Expressive and Receptive Test (Mckeel, Dixon, Daar, Rowsey, & Szekely, 2015). One article has been published showing the validity of the Generalization Module of PEAK (Dixon et al., 2014a). PEAK compared to VB MAPP suggests a ceiling effect for the VB MAPP when an

individual had a score of 138 for PEAK-DT and PEAK-G (Dixon et al., 2014a). This implies that individuals, who have all the skills of the VB MAPP could still benefit from PEAK.

Skinners account of language is based on formal properties, rather than functional (Skinner, 1957). A limitation of the *Verbal Behavior* framework is that Skinner's definition does not explain the interaction between behavior and the environment and Skinners way of categorizing verbal responses makes it difficult to distinguish between verbal and nonverbal behavior (Meindl et al., 2018). These limitations are lessened by the inclusion of more contemporary models of human language learning apparent in the final two PEAK modules, which are derived from Stimulus Equivalence and Relational Frame Theory. The Equivalence Module (PEAK-E; Dixon, 2015), which focused on training and testing individuals for their derived relational responding. The Transformation Module (PEAK-T; Dixon, 2016), which focuses on training and testing individuals for derived relational responding across relational frames (Rowsey, Belisle, Stanley, Daar, & Dixon, 2017).

Stimulus Equivalence and Relational Frame Theory

Hayes, Barnes-Holmes, & Roche (2001a) critiqued Skinners definition of verbal behavior for being too broad and not functional, verbal behavior being defined by reinforcement mediated from another person, Skinner mainly addressed the contingencies between the speaker and the listener. Skinner's definition of verbal behavior was not functional in the fact that it relied on the history of another person, instead of the history of the person of interest (Hayes, Blackledge, Barnes-Holmes, 2001b). Relational frame theory suggests that verbal behavior is found in the emergence of relational frames. Human language and cognition could be better understood from using RFT combined with Skinners account (Ingvarsson & Morris, 2004). Sidman described

stimulus relations as the foundation for a theoretical model of symbolic behavior humans display (Deacon, 1997). RFT considers derived stimulus relations a verbal phenomenon, derived stimulus relations are the basis for sophisticated outcomes such as contemplating the future (Weil, Hayes, & Capurro, 2011), and RFT takes on a verbal basis for stimulus relations; how relations create and interact with rule-governed behavior (Critchfield, Barnes-Holmes, & Dougher, 2018). Derived stimulus relations have been at the foundation for creating socially significant behavior change, such as academic instruction, implying knowledge is infinite, but time to teach individuals is limited (Critchfield & Twyman, 2014).

Sidman's theory outlined the emergence of equivalence as a result reinforcement contingency where operant principles are applied (Mclay, Sutherland, Church, & Tyler-Merrick, 2013). Sidman's work was viewed as a critical tool for the analysis of basic language and his research gave momentum for the development of educational criteria based on stimulus equivalence (Rehfeldt, 2011). Relational Frame Theory is a modern behavior analytic approach to the study of human language and cognition, it came about as a result of previous work on stimulus equivalence (Cullinan & Vitale, 2008).

Traditionally, stimulus equivalence occurs when a subset of conditional discriminations are established and new discriminations emerge due to a shared relational stimulus. Within a stimulus equivalence account, symmetry occurs when functional reversibility emerges without any direct reinforcement (e.g. subject trained A1 to B1, given B1 the subject picks A1) (Sidman, 1971; Sidman & Tailby, 1982). Transitivity, at least three pairs of equivalent relations are required (e.g. give A1 subject picks B1 and given B1 subject picks C1; given A1, pick C1 will emerge without training) (Cullinan & Vitale, 2008). The relationship between verbal repertoire

and stimulus equivalence has led to a behavioral analytic treatment of human language and cognition known as Relational Frame Theory (Cullinan & Vitale, 2008).

Relational Frame Theory (RFT; Hayes et al., 2001a) extends beyond stimulus equivalence in three main ways. First, not all relations are equivalent. For example, if taught that a stimulus A is *bigger* than a stimulus B and that the stimulus B is *bigger* than a stimulus C, a participant may derive that A is *bigger* than C and C is *smaller* than A. RFT expands on the ideas of stimulus equivalence by including a wide range of arbitrary relations such as comparison, opposition, hierarchy, difference, and perspective taking (Gorham, Barnes-Holmes, Barnes-Holmes, & Berens, 2009). Mutual entailment involves two events (e.g. if A is related to B, then a derived relation between B and A is established) (Cullinan & Vitale, 2008). It also involves non-equivalent, bi-directional relations (e.g. frame of comparison, A is less than B, B is more than A) (Cullinan & Vitale, 2008). Combinatorial entailment involves three or more events, two trained relations (A and B, B and C) can combine to derive two relations (A and C, C and A) and can also involve more than, less than relations (Cullinan & Vitale, 2008). This lexical distinction is necessary to specify that, although the relations are non-equivalent, knowledge of any given relation can be predicted given only subsets of relations (e.g., bigger/smaller, faster/slower).

Second, Sidman's theory did not account for how derived relational responding develops. In the context of autism treatment, this is problematic because technologies must seek to first and foremost improve language learning if language learning is as critical as proponents of these models suggest. Within an RFT account, derived relational responding is treatment as a generalized operant; meaning that an individual responds to one event in terms of another event and the form or the individuals responses can vary (Dixon, Paulilunas, Barron, Schmick, & Stanley, 2019). Improvements in derived relational responding may therefore occur through

multiple exemplar training, whereby the establishment of cognitive skills develops and the development of flexible learning (Barnes-Holmes, Barnes-Holmes, & Mchugh, 2004). RFT has focused on bidirectional responding using multiple exemplar training, which displays a non-topographically defined relational operant class (Hayes et al., 2001b). Multiple exemplar training is critical to the learning history that increases the generalized relational skill (Barnes-Holmes, Kavanagh, & Murphy, 2000).

Third, functions of stimuli may be transformed due to class containment. Transformation of function is the changes that happen to stimulus functions by participation in relational frames (Cullinan & Vitale, 2008). For example if A is greater than B and A is paired with a shock, then B when presented will exhibit calm or reduced arousal compared to A (Dymond, May, Munnelly, & Hoon, 2010).

Once all of these abilities are present, teaching through stimulus equivalence or RFT can expedite learning. Learning can take place when two skills were directly taught to an individual and the individual derived more relations, the functional response unit of RFT is relating (Barnes-Holmes, Barnes-Holmes, Hussey, & Luciano, 2015). Language according to RFT is taught through complex patterns of derived relational responding, known as relational frames, which then increases the child's emergent responses (Moran, Walsh, Stewart, Mcelwee, & Ming, 2015). Patterns of derived relations is what forms human language and cognition, which typically developing children get through exposure to natural environments (Lipkens, Hayes, & Hayes, 1993), while individuals with ASD have difficulty learning these patterns (Rehfeldt, Dillen, Ziomek, & Kowalchuk, 2007). Research is needed in the area of stimulus equivalence with children with ASD and targeted training procedures are critical (Rehfeldt & Barnes-Holmes, 2009).

Focusing just on Skinners verbal operants and using assessments based on Skinners definition of verbal behavior has yet to be empirically validated (Dixon, Stanley, Belisle, Galliford, Alholail, & Schmick, 2017b). Skinner argued that all verbal behavior was learned, derived relational responding suggests that humans can learn language and cognitive skills through untaught relations, under the same context as previously taught skills (Dixon et al., 2019). The inclusion of RFT into the field of behavior analysis can assist clinicians in developing and implementing programs that demonstrate advances in language and cognitive skills (Raaymakers, Garcia, Cunningham, Krank, & Nemer-Kaiser, 2019). Stimulus equivalence and RFT can be used to teach complex skills to learners such as derived categorical responses, derived intraverbals, and derived autoclitics (Dixon, Belisle, Stanley, Speelman, Rowsey, Kime, & Daar, 2016b).

Applications of Stimulus Equivalence and RFT with Children

In 1957 Skinner published a book called *Verbal Behavior*, where he proposed verbal operants (e.g. mands, tacts, intraverbals). Skinner was the first to provide a foundation for behavior-analytic approach to the study of human language and cognition (Barnes-Holmes, Finn, Mcenteggart, & Barnes-Holmes, 2017). Dymond et al., (2006) conducted a citation analysis of Skinner's (1957) *Verbal Behavior,* from the years 1984 and 2004. This citation analysis concluded that *Verbal Behavior* was continuing to make important contributions within the field of psychological literature and that while majority of citations were considered non-empirical, there was an increasing rate of empirical and non-empirical publications. Another important feature of Dymond et al., (2006) findings was the verbal operant of manding had the most appearances within applied empirical literature. Dixon et al., (2007) extended this previous

citation analysis completed on Skinners *Verbal Behavior.* This analysis indicated that majority of research done in the field of verbal behavior has been conducted with developmentally disabled children and focused on early verbal operants (e.g. tact, mand, intraverbal, echoic). This limited population and target skills may suggest that assessments based and developed on Skinner's verbal operants may not fully encompass the complexity of human language (Belisle, Palilunas, Lauer, Giamanco, Lee, Sickman, 2019).

Dymond et al., (2010) completed a citation analysis of applications with derived relational technologies, results showing a rise in both empirical and non-empirical research being conducted. Raaymakers et al., (2019) examined empirical support for models that include advances with RFT. Results indicate there is an increase in RFT within research on the emergence of verbal operants. Research involving mands usually involves directly training an operant (e.g. training a tact) and testing for derived manding, directly training listener response and testing for derived manding, or mand training and testing for derived mands (Raaymakers et al., 2019). Nuzzolo-Gomez & Greer (2004) worked with individuals with ASD or developmental disabilities using a multiple exemplar instruction strategy to test the effects on mands and tacts. The untaught verbal operants of tacting and mandng were exhibited for adjective-object pairs using multiple exemplar instruction. This study shows how the emergence of untaught verbal operants comes to be called "generative" because the individual generates untaught responses as a result of multiple exemplar training (Nuzzolo-Gomez & Greer, 2004). Murphy & Barnes-Holmes (2010) taught adolescent boys diagnosed with ASD to mand for items using arbitrary stimuli by teaching them to match A to B and then B to C. Each participant was able to mand using the arbitrary stimulus C, demonstrating an example of transfer of function.

Majority of research articles involving the verbal operant of tacting, focused on tact training and testing for another verbal operant besides a tact (e.g. intraverbal) and used conditional discrimination training (e.g. match to sample) or listener training (Raaymakers et al., 2019). Byrne, Rehfeldt, & Aguirre (2014) used stimulus pairing observation procedure with children with autism to teach auditory and visual stimuli. Participants were then tested for tacting and listener responding, the stimulus pairing observation procedure paired with multiple exemplar training was shown to be effective.

Intraverbal training either involves direct training of intraverbals and testing for an derived alternative intraverbal, directly training a listener response or another operant and testing for a derived intraverbal, or sometimes using packaged training of both listener responding and operant training and testing for derived intraverbals (Raaymakers et al., 2019). Miguel, Petursdottir, & Carr (2005) studied neurotypical children and their abilities to label pictures using adjectives when responding to the question "how is it?" Once tact training was completed, children were presented with the stimulus "point to the___." The children had to receive listener responding training and were then taught to respond to "same" and "opposite" implemented by match to same training. Intraverbal probes were then conducted once training was complete. Results show that intraverbals emerged due to auditory-visual conditional discrimination training compared to the listener responding or tact training solely. Derived intraverbals can be tested by tact training in combination with intraverbal training or listener response training. Belloso-Díaz & Pérez-González (2015) studied children's emergence of intraverbals by using two procedures; experiment one learned two tacts and experiment two learned a tact and an intraverbal. Both procedures demonstrated the emergence of intraverbal skills in the participants.

Some studies test for other verbal operants (e.g. textual, dictation, autoclitic) by primarily using match to sample procedures to train and test for derived relations. Luke, Greer, Singer-Dudek, & Keohane (2011) used multiple exemplar training to test for spatial realties for novel tacts and mands, results indicate that children were able to derive responding to novel stimuli. Greer, Yaun, & Gautreaux (2005) found that children were able to spell untaught responses vocally or written, demonstrating derived dictation taking.

Belisle et al., (2019) extended this analysis by looking specifically at applications of derived relational responding with children, with and without disabilities and studies that showed generalization of a relational operant or transfer of stimulus function. This citation analysis revealed that research is being completed with children as participants, 55% of research targets socially relevant verbal relations, and generalization and transformation is being tested in 47% of articles identified for this study. Belisle, et al., (2019) reported that 80% of research targeted the relational frame of coordination, which could be because coordinated relations are likely to occur first (Barnes-Holmes et al., 2000) and potentially easier to apply with children in a research setting. Lynch & Cuvo (1995) conducted a study with seven typically developing children ages 11 to 13, where they directly taught and tested for derived relations of fractions (e.g. ratios, pictorially, decimals). All participants in this study demonstrated mutual entailment and combinatorial entailment following the training procedure. Miguel, Yang, Finn, & Ahearn (2009) studied two children with autism who dictated word of preferred item to picture of preferred item and written work to picture of preferred item. Completing activities on a schedule when words were presented instead of pictures tested generalization or transformation. All participants demonstrated mastery of trained relations and emergent combinatorial entailment relations and all were able to complete tasks as presented in words on the schedule. Research

began on other frames of relation beginning with Kisamore, Carr, & Leblanc (2011) where participants displayed intraverbal responses to categorical questions after categorical classes were trained. Grannan & Rehfeldt (2012) also demonstrated children with ASD and their derived intraverbal responding to categorical classes following category tact and match to sample procedures.

Another form of relating that appears in research is deictic responding (perspective taking) where I-You, Here-There, Now-Then are derived. Jackson, Mendoza, & Adams (2014) showed successful relational training with five children with ASD at establishing perspective taking, single reversals, and double reversals. Belisle, Dixon, Stanley, Munoz, & Daar (2016) demonstrated perspective-taking skills in children with ASD by using the PEAK-T curriculum. This study all three children were able to demonstrate basic perspective taking, and two of the three participants showed derived single reversals of I relations following You relation training. Studies conducted on derived relational responding with children demonstrate the need to extend beyond Skinner's basic verbal operants. This research shows the importance of derived relational responding and the advantages it has on children, specifically when it comes to language, cognition and intelligence. Comprehensive assessments and curriculum designed around this research can have a large impact on language repertoires of both children with and without disabilities (Belisle et al., 2019).

PEAK Relational Training System

Promoting the Emergence of Advanced Knowledge was designed to fill the gap of an individual's repertoire, getting a person to know what they are saying and comprehend what others mean (Dixon, 2013). PEAK is grounded in applied behavioral analysis tradition but

differs from typical ABA programs in its application of RFT to promote efficient learning (Reed & Luiselli, 2016). An assessment is completed to identify potential skills to target for further instruction, these can be completed either directly or indirectly (Dixon, 2013). Indirect would be completed by a person close to the learner or a direct assessment would be presented to learner systematically, the direct assessment is found to be a more accurate display of a learner's abilities (Dixon, 2013). A performance matrix is then completed by color coding the skills in which the learner received a yes during assessment. PEAK recommends that you introduce stimuli in levels, allowing the learner the opportunity to practice new skills that vary in complexity but also relate to each other (Dixon, 2013). The PEAK system data sheets and recording allow for a clinician to easily identify when independent responding is increase with the learner by the way response scoring is tracked (Dixon, 2013). The different levels of prompting required during training are assigned specific scores 0-10 (Dixon, 2013). Stimuli mastery is achieved when a stimuli/response is reliable and program mastery is when the individual can learn and maintain new stimuli without prompts or repeated exposure to trainings (Dixon, 2013). Program updates are always based on data, either a continuous assessment, periodic assessment, or analysis of the data (Dixon, 2013). PEAK provides more for clinicians than tradition treatment packages; PEAK provides a list of targeted skills, detailed ways of data collection, and an assessment tool that allows decisions to be based on data (Rowsey, Belisle, & Dixon, 2014).

The equivalence module of PEAK, which differs from generalization because equivalence does not require formal similarity to be in the environment (Dixon, 2015). The equivalence module is designed to form equivalence classes based on stimulus equivalence and RFT (Dixon, Belisle, Stanley, Daar, & Williams, 2016a). Equivalence learning can teach two

relations and the learner would learn four relations, making this an effective and efficient way to implement ABA curriculum, these stimulus relations are known as symmetry and equivalence (Dixon, 2015). PEAK uses distractors when forming an equivalence class to be confident that a discrimination was made by the learner (Dixon, 2015). The goal of the equivalence module is to teach relations, not what to relate (Dixon, 2015). Reflexivity is one of the relations demonstrated by the PEAK-E module, which is relating stimuli to itself, for example A to A (Dixon, 2015). Symmetry, making a derived relation in the opposite direction to the trained relation, for example a picture of a car A is a "CAR" B, the learner will derive the relation B to A (Dixon, 2015). Transitivity is when a derived relation appears across stimuli that were never related to each other during training, for example A-B and B-C are trained and a transitive relation will emerge of A-C (Dixon, 2015). Equivalence happens when A-B and A-C are trained, and a derived relation between B-C and C-B appears (Dixon, 2015). This module has a pre-assessment that test for all relation types using novel and arbitrary stimuli which is then used to do the PEAK-E assessment (Dixon, 2015). The assessment will train relations and then follow with a test of those relations that were just taught to the learner (Dixon, 2015). PEAK-E has four levels to help learners derive relations. Level one is the standard approach which trains derived relations until mastery. Level two is reduced class presentation by lowering the number of stimuli present during training and reintroduce once mastery occurs. Level three is multiple exemplar training was simply more exposure for the learner to direct relations between stimuli. Level four was an isolated class review where all but one class is put on hold, train and test and once mastery appears, reintroduce the other classes (Dixon, 2015). When your learner matches identical visuals, label objects, single word utterances, or follow one step directions the learner is ready to be introduced to the PEAK-E module.

The transformation module is the last module of PEAK and was developed from RFT and focuses on transforming learner's language and cognitive abilities further than possible with just the first three modules of PEAK (Dixon, 2016). The types of relations found in this module are mutual entailment, combinatorial entailment, and transformation (Dixon, 2016). PEAK-T promotes stimuli relationships beyond equivalence, for example opposition, distinction, comparison, hierarchical, and deictic relational frames (Dixon, 2016). The first relational frame in PEAK-T is coordination, where the learner will relate stimuli as same or equal (Dixon, 2016). Distinction follows coordination, where once a learner can make relations based on sameness, then the learner can distinguish which stimuli is different from the others (Dixon, 2016). Opposition is another relational frame where learners are able to distinguish between stimuli, for example a cup being full, and the opposite would be empty. In order to be considered the opposite of another the stimuli must have dimensions of sameness and distinction (Dixon, 2016). Comparison relational frames can compare stimuli to each other for example "which is bigger" when comparing an elephant to a mouse (Dixon, 2016). Hierarchical is taught when coordination, distinction, opposition, and comparison have started to develop (Dixon, 2016). This relational frame works on belongingness between a categorical relation and stimuli (Dixon, 2016). The last relational frame is deictic which focus on the perspective of the learner, for example "what do you see" could be asked to the learner (Dixon, 2016). There is a PEAK-T expressive and receptive sub test that show the clinician what level to begin for each relational frame (Dixon, 2016). This module also provides a Language and Cognitive Comprehensive Assessment Version which gives a summary of all the current skills the learner demonstrates (Dixon, 2016). This assessment is able to quickly identify gaps in the child's language repertoire (Dixon et al., 2014a). The same levels are used as in the PEAK-E module that assist learners in

acquiring skills. This module also provides a report card which presents the progress being made by learner across all areas being taught (Dixon, 2016).

McKeel et al., (2015) studied the efficacy of the direct training module on language repertories for children with autism or developmental disabilities. This study compared a control and experimental group where the results show the group that was exposed to language instruction based on PEAK had significantly more gains in language compared to the group of children that received treatment as usual. Dixon et al., (2016b) evaluated one of the programs from PEAK-E to test the emergence of untrained receptive labeling and intraverbals. Probes for derived relations were done during baseline, followed by training A-B, then taught to select B when A was present, then they underwent B-C training, and then test probes were conducted for all relations. The results of this study demonstrate effective teaching for all the participants to engage in receptive categorical responding and derived categorical responding. Dixon et al., (2016a) used equivalence instruction to teach geometry skills such as shape names, sides, and figures to children with autism, results of this study demonstrated the emergences of untrained listener responding and intraverbal categorical responses, with only a few being taught, and the rest emerged. Stanley, Belisle, & Dixon, (2018) studied three adolescents with autism using the PEAK-E module to teach chemical compounds, customary unit conversion, and historical figures. The results of this study were all participants acquired mastery of targeted skills and demonstrating the emergence of untrained relations (Stanley et al., 2018).

Dixon et al., (2017b) also taught geography skills to children with autism such as country names, locations on the map, flags, and names of continents. This study the participants had high levels of responding correctly which showed generalization to novel stimuli. Daar et al., (2015) studied the emergence of WH question-answers in children with autism. This study used

community associations such as the person, place, and activity to directly train and test derived relations. During baseline the participants were unable to answer WH-questions and two of the three participants were able to acquire mastery of these skills. Belisle et al., (2016) studied perspective-taking tasks to children with autism using the PEAK-T training curriculum. The results demonstrate that all participants were able to demonstrate perspective taking and two of the three participants were able to derive untrained single-reversal I relations, participants also showed a transfer of stimulus function to untrained stimulus (Belisle et al., 2016).

PEAK is a behavioral analytic approach to human language and cognition that uses environmental variables to promote learning and language acquisition. Current ABA programs lack data that demonstrates they are valid and reliable curriculums. PEAK attempts to bridge the gap in language/learning skills left behind from curriculums that lack evidence to prove reliability and validity (Dixon et al., 2014a). Beyond addressing individual skills throughout the curriculum, PEAK research has begun to vet the contributions of derived relational responding to performance during language and executive functioning tasks, such as vocabulary and intelligence.

The Peabody Picture Vocabulary Test and IQ test are often used to assess and monitor individuals with developmental and intellectual disabilities (Sternberg, Grigorenko, & Bundy, 2001). Dixon et al., (2014c) examined the psychometric properties of PEAK-Direct Training Module by using assessment to identify skill deficits, Peabody Picture Vocabulary Test, and the Illinois Early Learning Standard Test. The results show that PEAK-DT correlated with the Peabody Vocabulary Test and the Illinois Early Learning Standard Test. This studied also found that PEAK was reliable when implemented by an unskilled caregiver who knew the participant and a skilled therapist who did not know the participant (Dixon et al., 2014c). Dixon et al.,

(2014d) examined the relationship between the score of the Direct Training Module of PEAK assessment to IQ with children with autism or other disabilities. Results indicate there is a strong correlation between IQ tests and scores of the PEAK-DT assessment, implying PEAK can be an assessment and protocol for training language and cognitive skill. Dixon, Belisle, & Stanley (2018) studied the correlation between Equivalence module of PEAK pre-assessment and IQ, this pre-assessment examines derived reflexive, symmetrical, transitive, and equivalence relations. Results for this study indicate there was a strong correlation between participant's scores on the pre-assessment of PEAK-E and IQ. These results support behavioral analysis of intelligent behavior; suggesting that derived relational responding and intelligence are related (Dixon et al., 2018). This study showed that participants, who were able to exhibit derived relational responding, also had higher performance on standard IQ tests. Belisle, Dixon, & Stanley (2018) extended the research done by Dixon et al., (2018) by examining the results on the Equivalence Module of PEAK pre-assessment (PEAK-E-PA) and Direct Training Module of PEAK assessment (PEAK-DT-A) compared to intelligence scores. PEAK-E-PA was used because it is a direct assessment of derived relational responding and PEAK-DT-A is an assessment based on Skinnerian verbal development (Belisle, Dixon, & Stanley, 2018). Results for this study indicate that a low score on the PEAK-E-PA or PEAK-DT-A were predictive of a low IQ score, and high PEAK-E-PA and PEAK-DT-A scores were predictive of a high IQ score. There was a strong correlation between PEAK-DT-A and IQ; as well as a strong correlation between PEAK-E-A and IQ. This study suggests that relationships between PEAK-DT-A and IQ can be explained by a participant's derived relations, assessed by PEAK-E-PA (Belisle et al., 2018), these findings consistent with RFT's understanding of language development in individuals with ASD. Dixon et al., (2019) conducted a study where skill acquisition and IQ tests

were examined between traditional ABA, comprehensive ABA, and a waitlist control. The traditional ABA consisted of verbal behavior techniques based on Skinners verbal behavior from PEAK-DT and PEAK-G. The comprehensive ABA treatment used post-Skinnerian accounts for language using the comprehensive PEAK intervention from all four modules and the waitlist control did not receive any ABA services. This study was conducted in 12 weeks and increases in skill acquisition was seen equally in traditional and comprehensive ABA groups, but higher IQ increases were seen for the comprehensive ABA group. Increases in IQ scores were seen in a short amount of time using the PEAK comprehensive assessment that consisted of programming from all four modules of PEAK.

Purpose of the Present Study

The purpose of the present study was to evaluate the effects of PEAK-Equivalence and PEAK-Transformation treatment on derived relational responding as a generalized operant for individuals with ASD. The design used in the study was a multiple baseline across skills with an embedded probe. A multiple baseline across several skills uses an initial baseline, a baseline after criterion was reached in another skill, another baseline test before the introduction of the independent variable, and continued testing during the intervention. This design confirms that without the intervention in place, increases in performance would not occur. This design allows for continued examination at the efficacy of PEAK. An advantage of this design would be that skill acquisition could occur due to mastery of earlier skills. This study also sought to evaluate the effects of PEAK-Equivalence and PEAK-Transformation treatment on intelligence scores for individuals with ASD. IQ is an accepted estimate of skills in the educational system and other therapeutic settings, increases in IQ scores following the implementation of PEAK would add to

the external validity of PEAK. This study also determined the obtained relational deceleration coefficient for the participant using a supplemental test to determine what level of complexity the participant can derive relations. The deceleration coefficient assessment was developed to be a supplemental test on the participant's repertoire to derive relations.

METHODS

Participants

The participant for this study was Abby, a four-year-old girl diagnosed with Autism (ASD; American Psychiatric Association, 2013). A flyer had been sent to Abby due to her wait list status at an ABA provider in the southwest region of Missouri, Abby was not receiving any ABA services at the time of the study. The IRB for this study was approved on August 29th, 2019 (IRB-FY2020-33; see Appendix A). During the initial session, which was two hours long, the researcher completed an initial PEAK-E and PEAK-T assessment, IQ assessment (WPPSI-IV; Wechsler 2012), and deceleration coefficient assessment. The parents of the participant filled out a packet during the initial assessment that included a consent form, Questions About Behavior Function (QABF), indirect assessments for the direct training and generalization modules of PEAK. Abby did not exhibit behaviors during the initial assessment, but parents reported challenging behaviors such as compliance issues and overstimulation as barriers that might impede during treatment. The QABF results completed by parents during the initial assessment suggested that attention and tangible may be the function of Abby's behaviors.

Abby's parent completed indirect assessments for the direct training and generalization modules during the initial assessment. These questions are marked yes, no, or unsure of whether the participant has the skill by a caregiver or parent who works closes with the participant. Discontinue criteria for the indirect assessments would be marking ten in a row as either no or unsure. Abby scored a 146 out of 184 for PEAK-DT; suggesting that she mastered all but two of the foundational learning skills, all of the perceptual learning skills, and most of the verbal

comprehension skills. Abby's indirect assessment scores indicate that she scored above age norm for foundational learning, perceptual learning skills, verbal comprehension, and verbal reasoning, memory, and math skills. Abby scored a 123 out of 184 for PEAK-G indirect assessment completed by her parents. Abby has mastered majority of foundational learning targets, basic verbal comprehension, and memory skills according to the indirect assessment. Her scores for the indirect assessment indicate that she scored above age norm for foundational learning and basic social skills, basic verbal comprehension, advanced verbal comprehension, and verbal reasoning.

Abby was selected for this study based on her scores on the PEAK-E and PEAK-T initial assessment (Table 1). Abby demonstrated reflexivity but lacked symmetrical relations during the first assessment and showed emerging skills in the transformation module. Abby's scores for her intake IQ were completed using the subtests from WPPSI-IV; information, matrix reasoning, and picture memory. WPPSI-IV was used due to the participant's age during the study. Abby's raw scores for information were 20, matrix reasoning scores were 12, and picture memory scores were six. The intake assessment was completed for PEAK-E and PEAK-T; her scores were 12 for the equivalence module and 30 for the receptive transformation module (Table 2).

Abby did exhibit frequent challenging behaviors later in the study that interfered with treatment such as elopement from the assessment area, property destruction, aggression towards staff, and non-compliance. Procedure changes had to be implemented during treatment to address these challenging behaviors (phase change lines in graphs). Procedures that were used were differential reinforcement, token economy where Abby got tokens for correct answers, timers were used to keep the session on a schedule, wall divider was used to block elopement, and staff

attention was removed during challenging behaviors. Accept Identify Move (AIM) was also embedded into this study to promote social emotional development in the participant.

Setting and Materials

The entirety of this study was conducted at Missouri State University in Park Central Office Building on the second floor in the research laboratory, two sessions a week: a total of four hours a week. The sessions took place in a therapy room with an observation room located on the outside. The room was ten foot by eight foot and consisted of a video feed via ZOOM, where other members of the research team and guardians of the participant were able to watch during the duration of the treatment. The room included of a child sized table and chairs, a chair for the researcher, various toys located on a shelf or toys (brought by the guardians before the session), a room divider that had a white board on it, therapy materials, PEAK-E stimulus book, PEAK-T stimulus book, therapy stimuli, data sheets, IPAD for data recording (IPAD Pro), IPAD for video feed into observation room (IPAD mini), Microsoft surface to run assessments on, and a timer. An IPAD (IPAD mini) was also available for the participant to play with during reinforcement if they desired. The child sized table and chair was located in the corner of the room, away from the toy shelf to minimize distractions. The room was divided in half and on the other side of the divider wall was a table and chairs. A divider wall was used to minimize distractions and keep the participant in the area of the camera. The IPAD was mounted on the wall above the child sized table and chairs and ran a live feed into the observation room, where other researchers and parents were located. A token board was used during the session, to signal when reinforcement was available to Abby. Abby was often asked what she would like to work for during the session. Reinforces most often used were playing with items she brought from

home which consisted of stuffed animals, play dough. She also enjoyed playing games with the researchers such as hide n seek or writing on the white board.

Assessments and treatment were conducted throughout the ten weeks with one to three therapists per participant, who were trained graduate students in the Applied Behavior Analysis Program at the Missouri State University. At times researchers were assisted by undergraduate students at Missouri State University. The assessment material used for PEAK initial and final assessments were original copies from the stimulus book and instructional book. The stimulus book was a flipbook that the participant would look at while the researcher would read from a script. IQ testing stimuli for the initial and final assessments were original copies provided by the WPPSI-IV kit. Researchers used the manual, flipbooks for the different subtests, and data sheets provided by the test kit. The researchers created IQ probe materials; these materials were equivalent in complexity to the originals used. The method for obtaining the deceleration coefficient was created by a researcher and put on a Microsoft surface for implementation. This test used colors, pictures, and arbitrary words to test relations. Researchers developed PEAK programming by using publisher, these cards were similar to those described in the typical stimuli according to each program.

Dependent Variables and Interobserver Agreement

Assessment scores on the PEAK-E and PEAK-T modules were recorded for the participant. Mastered programs for the PEAK-E and PEAK-T modules were recorded for the participant throughout the duration of the study, which was ten weeks. The relational deceleration coefficient was used to assess the participant's fluency in relational responding. This method consists of three classes of stimuli containing three members in each class. The

participant was assessed by using a SPOP training, match to sample procedure, and a test phase. This procedure was used to test the participant's fluency to relate all possible stimuli.

Participant's skill progress was measured throughout the duration of the study. Researchers calculated the total percent correct per trial block by adding the trial training blocks and recording the total response score for the trial block. IOA and Fidelity measures were taken on this data. IOA was taken for entire trial blocks and fidelity data was take through video recordings of entire sessions.

Intelligence was tested using the Wechsler Preschool and Primary Scale of Intelligence-Fourth Edition short form (WPPSI-IV; Wechsler 2012). Subtest from information, picture memory, and matrix reasoning were probed three times through the duration of the study. The stimuli used for this assessment will be provided through the purchase of an assessment kit.

Total Interobserver agreement (IOA) was calculated for the direct implementation of PEAK programming and pre/post assessments. IOA was calculated by comparing the scores between observers for both train and test trial blocks. The total number of agreements was divided by the total number of agreements and disagreements and multiplied by 100. IOA was assessed for 26% of trials and averaged 92%. IOA was collected through the video feed from the treatment room to the observational room using the IPAD (IPAD mini) or through a researcher taking IOA in the room where PEAK was being implemented.

Fidelity was scored using the PEAK Relational Training System Fidelity Checklist (Appendix B). This checklist was two part: preparation checklist and implementation checklist. Therapist leading the session was scored on determining appropriate stimuli to use as reinforces, program sheets with appropriate stimuli, date and randomized the stimuli, arrange the environment in a way to minimize distractions, and having all necessary stimuli. Therapist were

also scored on clearly presenting the discriminative stimuli, allowing appropriate time to respond, providing reinforcement during correct train blocks, using appropriate prompts when needed, and quickly progressing to the next trial. Videos of sessions were scored for fidelity via Zoom and overall preparation fidelity was 96% and overall implementation fidelity was 94%. Assessment training was implemented before the beginning of the study. This training consisted of researchers being recorded implementing PEAK and fidelity was scored based on the recording. Researchers had to achieve 100% mastery before the start of this study.

Procedure

The current study was conducted over the course of ten weeks, using a multiple baseline across skills design with an embedded multiple probe. The multiple probe design was used to assess IQ scores and assessment scores for PEAK-E and PEAK-T. The initial assessment was conducted at Missouri State University and was two hours long. The participant did not exhibit challenging behaviors during the initial assessment, but parents reported a lack of obedience and getting over stimulated as challenging behaviors. Parents completed a QABF during the initial assessment, results indicate that attention and tangible could have potentially served as a function suggesting these could maintain the challenging behaviors reported (Figure 1). However, since several functions were endorsed, additional assessment strategies should be conducted to increase confidence in these results. A challenging behavior index (CBI) was completed by those students that ran her initial assessment. The participant scored one out of 20 for frequency and one out of 20 for intensity, which was considered low, implying that there were no barriers during her initial assessment. After assessments were completed for the equivalence module of

PEAK and the transformation module of PEAK, treatment started and the participant came for sessions at Missouri State University two times per week for two hour sessions.

IQ probes were implemented every third skill mastered or every three weeks throughout the duration of the study. When implementing IQ probes staff read each item verbatim to the participant and continued to next item until discontinue criterion was met. Discontinue criterion was three consecutive scores of zero for information, picture memory, and matrix reasoning. The subtests that were included in this study were matrix reasoning, picture memory, and information from the WPPSI-IV. Examples from information include "show me your mouth, touch it" and "what goes in a cup." Examples from matrix reasoning include "tell me the name of a vegetable" and picture memory the participant would be shown a stimulus page told, "Look at this," allow a three second delay and then say "point to the picture I just showed you."

The research design used in this study was a multiple baseline design, which is a combination of multiple baseline and probe design that includes a baseline test of performance, baseline tests after a certain criterion is reached within other steps, a baseline test prior to the introduction of the independent variable, and ongoing testing throughout the extent of the intervention. A train/test procedure was implemented with four programs going at once, two from the equivalence module and two from the transformation module. Both modules were trained and tested concurrently to allow for replication across modules. All assessments were administered using the same procedure throughout the duration of this study. The mastery criteria for trial blocks was defined as three train trial blocks over 90%, followed by a test trial block at 90% or above correct responding.

Targets were selected based on the direct assessment probes and direct testing of the target skills. Within the multiple baseline design, the initial probe served as a direct test, once the

participant masters a program, a second baseline probe tests further if the skill mastered earlier promotes mastery of the skill being examined. PEAK-E assessment assessed the learner's skills to demonstrate arbitrary relations across four types of relations and three levels. A standard set of stimuli were provided for testing and foods or scent materials were gathered by the instructor; alternative stimuli can be used but should be noted in the record form and interpretive worksheet. The PEAK-E record form was used to track performance across the types of relations (reflexivity, symmetry, transitivity, equivalence). Assessors trained relations and then tested for derived responding; giving three seconds to respond, no reinforcement or prompting will be given when testing for derived relations. There are two scoring methods that can be used to determine the skills for the learner; single class and multiple class assessment. Single class assessment uses one stimulus class, which provides a quick way to assess the learner. Multiple class assessment involves presenting direct relations and derived relations, so an overall percentage can be calculated.

PEAK-T has different levels of relational complexity within the module; Level one non-arbitrary relational frame, Level two culturally established relational frames, and Level three arbitrary applicable relational frames, and Level four complex transforming relational frames. Procedure for implementing PEAK-T was multiple exemplar training where relations that are used in the examples will vary in complexity levels, until the learner master's transformations. There was a program sheet provided that organizes the stimuli into classes for each of the relational families.

PEAK-T assessment consisted of expressive and receptive subtests, which assessed the spoken language, and selection based relational abilities that are demonstrated by the learner. PEAK-T-PA allowed the assessor to know which level to begin the learner at and shows areas of

strength within the learner's repertoire. Each subtest has 16 items for each six relational families, a total of 96 items. Only the PEAK-T receptive subtest was used during this research. During this subtest the learner had to respond via selection based from an array of stimuli. This assessments material (script, scoring guide, and series of cards) was provided to the assessor. There is a record form and interpretive worksheet that allow the assessor to summarize the learner's performance and determine which level to begin for PEAK-T Assessment. A performance matrix was completed as it was for PEAK-E, allowing for curriculum to be selected for the learner. When arranging stimuli for this module, it is recommended that you use a "rotational zigzag" where stimuli are crisscrossed by classes to ensure relational control.

Preference assessments were conducted at the beginning of each session using free operant, multiple stimulus without replacement (MSWO), or simply asking the participant what they want to work for. When implementing PEAK-E and PEAK-T the results of the assessment were put into a performance matrix, which allowed the assessor to visually analyze the data. Selection of which programs to run was based on results from the assessment and implementing the corresponding program from the PEAK curriculum. Once programs were selected a train procedure was be implemented using prompting and reinforcement; followed by a test procedure that tested for derived relation that were not directly taught. The instruction strategy used in PEAK-E and PEAK-T is discrete trial training to allow for control of stimuli during the training procedure. Prompt hierarchies were used to systematically increase or decrease the amount of prompting a learning needed to be successful. Prompts used in the training procedure could have include vocal cues, hand over hand assistance, or providing a related picture and the discriminative stimulus was restated when prompting.

PEAK-E and PEAK-T are broken into four different levels that help break down the implementation of teaching derived relations to learners. Level one is the standard approach, which includes providing instruction on four train stimuli classes until they master both the train and demonstrate derived relations. If the learner is struggling to derive relations the next level should be implemented. Level two reduces the number of classes being presented to the learner, putting two classes on hold. Once the learner demonstrates derived relations in those two classes, reintroduce the other classes. Level three is multiple exemplar training, which indicates that the learner may need more exposure to direct instructions in order to derive relations. In this level the assessor would put the first four classes on hold and introduce four new classes, if no derived relations are emerging level four will be implemented. Level four is isolated class review where all but one class will be put on hold and the train and test steps will be conducted, reintroduce the initial four classes that were put on hold. If the learner is still struggling to derive relations after all levels have been attempted, the assessor should retest mastered skills to assure the learner has the pre-requisite skills needed for the programs being run.

Data sheets were provided that include tables representing the ten trials for the training or testing blocks. Assessors randomized the classes to each trial within a block, this is important to assure the learner is not strictly memorizing answers. Responses were scored zero, two, four, eight, and ten for both train blocks. Responses were scores zero or ten for test blocks. No response after multiple prompts was scored a zero, multiple prompts or reduced stimuli produced a response was scored a two, two prompts at most produced a response in a full array was scored a four, one single prompt (verbal or visual) was scored a six, and independent response was scored a ten (Appendix C). Mastery was considered when the learner is able to respond to all train and test skill with 90% accuracy and the learner should be able to respond across different

instructors or environmental contexts. Program updates were done by continuous assessment where the person implementing the training procedure updated programs as the learner master's skills. Data analysis was important in all modules of PEAK, allowing for decisions to be made regarding the modification of any program. Spreadsheets were used to monitor data or a program progress grid, these can help identify trends in the data allowing adjustments to be made to increase skill acquisition.

RESULTS

The results of the experiment are shown in Figures 2, 3, and 4. Abby's initial PEAK assessment was conducted directly by an MSU student researcher for both the equivalence and transformation modules. Equivalence evaluated earlier forms of symbolic and referential language, that provide a foundation for more cognitive skills required for executive functioning, problem solving, and reasoning. Abby scored a 12 on the equivalence module, mastering out of the frame family reflexivity for demonstrating skills such as matching identical pictures, matching words, and matching identical objects during the initial assessment. Abby scored a six on reflexivity, two on symmetry, two on transitivity, and two on equivalence (Table 1). This suggested that Abby's targets should begin by focusing on symmetry, making derived relations in the opposite direction of a trained relation, training A to B and testing B to A. The transformation receptive test was completed directly to generate an estimate score for PEAK-T; raw scores from the receptive test were used because the expressive test was not completed. This assessment evaluated relational learning in terms of similarities, differences, comparison, opposition, categorization, and perspective taking. Abby achieved a score of 30 on this assessment, all of which were from level one. Abby scored an eight on coordination, seven on comparison, zero on opposition, zero on distinction, four on hierarchical, and one on deictic (Table 1). These results suggested that Abby's targets should begin with level two of coordination and comparison. Initial results suggest that there were emerging skills in the frame families of symmetry, transitivity, equivalence, hierarchical, and deictic.

During the 10 weeks of treatment Abby mastered nine targets from both equivalence and transformation modules. Abby mastered six skills from the frame family symmetry, two skills from coordination, and one skill from comparison. During the baseline phase, trial block percentages were generally low, not including the skills in which Abby mastered at baseline. Programs mastered at baseline were Symmetry: Textual Number Identification, Symmetry: Tacting Letters, and Symmetry: Shape Names. For the programs that were not mastered at baseline, once training was initiated there was an improvement in Abby's trial block percentages, where least to most prompting was used to prompt the correct answer, match to sample, and DTT was used during instructional time. Abby was able to demonstrate derive relations in the opposite direction of the relations that were directly taught during training. Abby mastered three skills from the transformation module, two from coordination and one from comparison frame families. Within the frame family coordination Abby demonstrated relating stimuli as same or equal to each other. Abby also mastered a skill in the frame family of comparison, where she displayed knowledge of comparison relations between sets of stimuli.

The mastery criterion during the study was three train trial blocks over 90% followed by a test trial block over 90%. Abby took on average four trial blocks to master PEAK-E programming during the 10 weeks and on average six trial blocks to master PEAK-T programming. Programming that was still in progress was currently at an average of 12 trial blocks for PEAK-E programming and an average of nine trial blocks for PEAK-T programming. Abby did not make derivation during the first test for COR: Cultural to Non-Arbitrary (Feature)-7E, researchers went back to training and then followed with testing. Abby was exhibiting challenging behaviors during this target; notice phase change line (Figures 2,3, and 4). Symmetry: Syllable Sounds-6H researchers were testing for derived relations were Abby was

consistently scoring between 60% and 70% correct, researchers would kick training back in before testing for derived relations. Another skill where Abby was unable to make derived relations right away was Symmetry: Math Symbols-5F, baseline tests were at 0%, training blocks were consistently between 54% and 80% correct, once a procedural change was implemented; notice phase change line (Figures 2,3, and 4) scores for percent correct for the entire trial block were increasing. The procedural change that was implemented was tokens for her token board which earned her reinforcement time was only given for independent correct responses.

A final PEAK assessment for both the equivalence and transformation modules was conducted. Abby scored an eight on PEAK-E, where she did not master out of any of the relational frames. Abby scored a five on reflexivity, one on symmetry, one on transitivity, and one on equivalence (Table 1). Substantial improvements were seen in the transformation module, where her score was a 51 for just the receptive subtest, an increase of 22% from the initial assessment. During her final assessment, Abby made improvements in majority of the frame families in the transformation module. Abby scored a nine on coordination, 12 on comparison, six on opposition, five on distinction, nine on hierarchical, and 10 on deictic (Table 1).

The results of Abby's IQ probes are displayed in Figure 5. The WPPSI-IV was also conducted at the initial assessment; one other probe during treatment, and during the final assessment. The subtest of information, matrix reasoning, and picture memory were implemented. Abby's score on the IQ test also showed improvement throughout treatment. During the initial assessment Abby scored a 20 on information, 12 on matrix reasoning, and six on picture memory. During treatment, an IQ probe was conducted using different IQ material than the initial IQ test to eliminate exposure to the participant. Abby's score on information was 23, matrix reasoning was eight, and picture memory was 12. During the final assessment IQ was

assessed using the WPPSI-IV used during the initial assessment. Abby scored a 20 on information, 16 on matrix reasoning, and a 12 on picture memory. Abby's subtest scores were converted to a full-scale score using the conversion table in the WPPSI-IV manual. Abby's standard full-scale scores were 94 on her initial assessment and 108 on her final assessment. Overall, Abby showed improvements in IQ score during ten weeks of PEAK treatment. Improvements were seen in matrix reasoning and picture memory, where Abby went from a 12 to 16 in matrix reasoning and a six to 12 in picture memory (Table 2). Improvements in matrix reason and picture memory could have been due to Abby's improvements in PEAK-T frame families. Abby increased her scores in coordination, comparison, distinction, and hierarchical. Improvements in PEAK scores could have improved Abby's problem-solving skills and complex language needed to increase scores on the IQ assessment.

During the programs Symmetry 4D and 4E, Abby mastered ten relations, but derived ten more relations. The program Symmetry 5A, Abby matched pictures to textual words and derived matching textual words to pictures, which is impressive given that at the beginning of this program Abby was unable to read according to her parents. Coordination 7G, when she heard the name of an action, she would then perform it, then researchers tested performance of two-step direction when named and name actions when shown. The researchers directly taught Abby eight relations using Coordination 7G, and she derived 12 relations. Coordination 7E; Abby would match textual words for an object based on feature, she derived matching identical objects to textual words for objects that share a common feature for an additional eight relations. Another transformation program that was mastered Comparison 7J eight relations of bigger were implemented, Abby then derived relations for bigger and smaller for an additional eight relations (Table 3).

Abby also completed probes for the deceleration coefficient, which tested the participant's accuracy of relational responding. This procedure used a stimulus pairing observation procedure, match to sample, and a test phase to test Abby's repertoire to relate all possible stimuli. During the initial assessment Abby scored a four total correct overall, indicating that she was able to match B1 to A1, but not B2 to A2. During treatment the deceleration coefficient was probed twice, Abby scored a ten total correct on the first probe and 12 total correct on the second probe. During the first probe Abby was able to match B1 to A1 and B2/B3 to A2/A3, but not B1 to C1. During the second probe, Abby scored a 12, demonstrating matching B1 to A1, B2/B3 to A2/A3, and improvements on B1 to C1. During the final assessment, the deceleration coefficient could not be completed due to time restrains, services were discontinued due to COVID-19 that shut down the clinic.

Challenging behaviors were exhibited midway through the ten weeks of treatment that had to be addressed in order to continue implementing PEAK programs with correct fidelity. Behaviors that were seen during the study were elopement, physical aggression towards staff, property destruction, and non-compliance. When behaviors began to prevent sessions from being properly conducted, QABF's were filled out by students working with Abby and a differential reinforcement procedure was implemented. A phase change line indicates when this took place in relation to targets. When Abby was being non- compliant during work tasks, attention was not given. Staff would give positive attention and praise when Abby was compliant with work tasks. Another phase change line indicates when a behavioral plan was written for her, as behaviors began to become more aggressive in nature. A token economy was re-established and directly linked to correct responses during PEAK programs. Abby received 30 seconds for every token earned during a PEAK trial block. The treatment room was blocked off using a divider wall,

where she was not allowed on the other side of the room to escape the work area and allowed staff to gain instructional control of the session. A response plan was developed when challenging behaviors were seen. Items were going to be removed to the side of the room where she was not allowed that were not safe for throwing, every two minutes of challenging behaviors a researcher left the room, and no attention was given during this time. When challenging behaviors were over, she was required to clean up before moving to the next trial block. Every two minutes of compliance a researcher re-entered the room. Accept Identify Move was implemented approximately one hour into the session. This program is a behavioral analytic curriculum for social and emotional development in children. Curriculum was provided for researchers to read a script to Abby, followed by a discussion and an activity. Only day one was implemented during this study due to the study being closed for COVID-19.

DISCUSSION

Summary of Results

This study expanded on the concept that teaching through stimulus equivalence and RFT can expedite learning, implying that individuals will learn skills faster, progress through curriculum at a rapid pace, and expand their repertoire of different forms of complex language. The results of the current study demonstrate a strong relationship between the implementation of PEAK-E and PEAK-T and an increase in IQ scores. Past research related to IQ and PEAK-E pre-assessment (Dixon et al., 2018) suggest that there is relation between scores on the pre-assessment and IQ, suggesting that derived relational responding and intelligence may be related. This study expands on past research by suggesting that individuals with the repertoire to derive relations had a higher standard IQ score (Dixon et al., 2018).

In prior research focusing on skill acquisition and intelligence test scores between traditional ABA, comprehensive ABA, and a waitlist control group found that the most improvements were seen in the comprehensive group (Dixon et al., 2019). According to this study, the comprehensive ABA group had a mean change score of 12.88 points and had a SD of 7.19. The current study extends this previous research, the participants IQ increased 14 points over the duration of ten weeks of treatment. The current study also extended prior research where participants received smaller amounts of PEAK; and were able to see increases in IQ scores (Dixon et al., 2019). The current study also extends prior research (McKeel et al., 2015) where improvements PEAK scores were seen after only one month of intervention. The current study

would demonstrate that skill acquisition is achievable in a short amount of time and that PEAK programming supported the increase of skills.

Derived relational responding interventions focus on promoting forms of complex language for individuals with autism. Using both Skinnerian and RFT accounts of language within an intervention could be the most effective way to improve language repertories for individuals with ASD (Barnes-Holmes et al., 2004). The current study would extend of prior research by (Dixon et al., 2017a) where the relationship between PEAK-E pre-assessment scores and IQ's were it was inferred that when an individuals derived relational responding increases, their intelligence scores will also increase.

PEAK uses discrete trial training and multiple exemplar training when teaching stimuli, using positive reinforcement, prompting procedures, and exposure to more stimuli to promote derived relational responding to learners. Multiple exemplar training is used to promote the emergence of derived relations, learners are then able to establish cognitive skills and flexible learning develops (Barnes-Holmes et al., 2004). PEAK-E, which focuses on training and testing individuals to derive relations and PEAK-T, which focused on individual's repertoire to derive relations across relational frames. The significant increase in PEAK scores from the initial assessment and the final assessment would suggest that individuals with ASD are able to derive relations, including those across relational frames families within a module. This current study also extends prior research that suggested PEAK inter-observer reliability is high for assessments and scoring sheets (Dixon et al., 2016c). The current study found a high percentage of agreement between observers. The results of this study extend prior research suggesting that improvements in derived relational responding can occur through the use of multiple exemplar training (Barnes-Holmes et al., 2004). This study demonstrated the participants were able to establish cognitive

skills, while also developing flexibility within a learner. Stimulus equivalence and RFT used in the field of behavioral analysis can help develop complex skills across relational frame families.

Implications

Behavior analytic treatments are often embedded within early intensive interventions, which involves participation in therapy at a minimum of 30 hours per week. Past research on early interventions for individuals with ASD have shown significant improvements in IQ (ESDM; Dawson et al., 2010). Research would also indicate that less restrictive school placement results after intensive ABA services were provided (Lovaas, 1987). The current study would suggest that four hours a week of implementing PEAK programming suggests individuals with ASD make significant improvements in derived relational responding and improvements in intelligence scores. Four hours of ABA intervention compared to 30 hours per week would allow for other services to be provided such as occupational therapy or speech therapy. The current study would also imply that there is a way to expedite learning by deriving relations in an individual with ASD, make IQ gains and getting individuals closer to age norm scores by doing fewer hours per week.

Past research suggests that there is high variability in the interventions that are offered to individuals with ASD, such as treatment format, how programs are supervised, and differences in curriculum being implemented (Love et al., 2009). Programs that are used with individuals with ASD should provide a clear starting point for therapist and identify skills that are absent and prerequisite skills needed (Virués-Ortega, 2010). PEAK takes into account *Verbal Behavior* (Skinner, 1957) and expanding human language and cognition. PEAK is grounded in traditional ABA but expands on typical ABA by including discrete trial training, while promoting

generalization by including both train and test stimuli. PEAK aligns with stimulus equivalence and RFT to promote efficient learning (Reed & Luiselli, 2016), the current study would suggest that PEAK is a viable intervention for individuals with ASD, providing a comprehensive assessment that has the ability to promote complex human language and cognition for individuals.

This current study would suggest that PEAK-E demonstrates that an equivalence class cam be formed by teaching relations and the learner will derive relations, therefore suggesting that PEAK-E will improve the rate at which a learner will progress through tasks. PEAK-T transforms the individual's ability to learn language and cognitive skills further past the other modules of PEAK. The current study demonstrated significant improvement between the initial assessment and the final assessment in the transformation module, suggesting improvement across multiple frame families without direct training.

Limitations

Despite the results obtained during this study, there are several limitations that should be addressed with future research. First, the current study involved only one participant, including more participants would increase confidence that the results did not occur by chance. More participants would provide data that the results in this current study would generalize to other individuals with Autism. The use of a multiple baseline design across skills was sufficient for one participant because the design was able to demonstrate the skill acquisition using PEAK curriculum. The participant that was chosen for this study did not initially meet the criteria; she was unable to derive symmetrical relations but her initial PEAK scores indicated that she was the best fit out of the initial pool of participants. Although the initial participant criterion was not

met, the results would still indicate that improvements in IQ and derived relational respond could still be attained in individual unable to derive symmetrical relations initially. A third limitation is that the participant was exposed multiple times during the probes for deceleration coefficient, repeated exposure to these probe stimuli could potentially influence their results although the same stimuli was not used for the initial/final assessment compared to the probes in between. Another limitation would be the final deceleration coefficient could not be directly collected due to time restraints. Additionally, the initial method for finding the deceleration coefficient was in the process of being created when the initial assessment was conducted. The method was altered to be more sensitive to floor effect caused by difficulty of the assessment. Therefore, the method to find the initial deceleration coefficient was altered after the assessment was complete.

Another limitation would be due to the global pandemic (COVID-19), the clinic at Missouri State University was closed early, shortening the length of the study from originally 12 weeks to 10 weeks. Shortening the duration of the study impacts the increases the participant could have made on PEAK programming and IQ gains. Another influence on the study was the impact of missing sessions due to illness or holidays were not able to be made up in the same week due to clinic availability. The participant had missed a total of four sessions throughout the duration of the study. Another limitation was the challenging behaviors that were exhibited during treatment sessions at times interfered with the implementation of programming. Behaviors were exhibited that had to be addressed by putting a behavior plan in place, at times resulting in the staff having to leave the room. These behaviors potentially impacted gains made on PEAK programs and had the potential to influence scores, based on non-compliance from the participant. Initial criteria for the study required low challenging behaviors during the initial assessment and low reports from guardians.

Future Research

Future research should address the above limitations and continue to explore the relationship between individuals with autism, derived relational responding, IQ, and PEAK. One avenue for future research would be to include a larger pool of participants to increase validity of the current study's results. Future researchers could expand the participant criteria by including more participants and examine the effects PEAK programming has on derived relational responding and IQ. If more participants were included in the study it would be recommended to use a multiple baseline across participants. Expanding the criteria would be to include children with challenging behaviors, other disabilities, different aged individuals, a control group, or neurotypical individuals would expand on the findings of the current study.

Due to space availability, sessions missed were unable to be made up during that week. Future research could address this limitation by including parents or teachers as PEAK implementers. Parents could implement PEAK programming at home, teachers could include PEAK programming in the school setting, and the clinic could continue to run sessions as usual. Including other implementers would eliminate issues experienced by availability and would promote generalization of skills to other settings and people.

Another avenue for future research would be to include a follow up phase after treatment. This would allow for researchers to test if results of the study generalized to outside the treatment facility, adding to the social validity of this current study. Another direction for future research would be to include an extended follow up phase, where this participant receives PEAK treatment for an extended period of time. This would allow researchers to extend findings from this present study and examine if IQ gains made during this study were still prominent in the

future. The current study was 10 weeks and was ended prematurely; future research could extend the duration of treatment, allowing for more progress to be made and extending the intensity of IQ gains made.

The present study is a move towards the right direction the research that needs to be conducted with individuals with ASD and deriving relations. Effective treatment for individuals with ASD is needed to improve deficits in complex human language and cognition. The role relational responding plays in treatment for individuals with ASD appears critical from the present study. The current study adds to the body of literature aimed at examining PEAK's role in prompting derived relational responding in individuals with ASD and how that impacts IQ.

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Table 1. PEAK assessment scores broken into frame families for both initial and final assessment. Both PEAK-Equivalence and PEAK-Transformation are presented.

PEAK Assessment Scores		
Frame Families	Initial	Final
Reflexivity	6	5
Symmetry	2	1
Transitivity	2	1
Equivalence	2	1
Coordination	8	9
Comparison	7	12
Opposition	0	6
Distinction	0	5
Hierarchical	4	9
Deictic	11	10

Table 2. IQ assessment scores broken into subtests for both initial and final assessment.

IQ Assessment Scores			
Subtests	Initial	Probe	Final
Information	20	23	20
Matrix Reasoning	12	8	16
Picture Memory	6	12	12

Table 3. PEAK program relations broken down into each individual program for both train and test relations.

PEAK Program Relations		
	Train	Test
Symmetry: Mythology-4D	A-B	B-A
Symmetry: Food Sources-4E	A-B	B-A
COR: Tacting and Performing Actions-7G	A-B	B-A; Y-Z; Z-Y
Symmetry: Picture to Textual-5A	A-B	B-A
Symmetry: Textual Number Identification-5C	A-B	B-A
Symmetry: Tacting Letters-5D	A-B	B-A
Symmetry: Shape Names-5E	A-B	B-A
COR: Cultural to Non-Arbitrary (Feature)-7E	A-B	B-A; Y-Z
COM: Cultural to Non-Arbitrary (Bigger)-7I	A-B; B-C	A-C/C-A; Y-Z
Symmetry: Syllable Sound-6H	A-B	B-A
COM: Object Feature Adjective-7K	A-B	B-A; Y-Z
COM: Cultural to Non-Arbitrary (Faster)-7J	A-B, B-C	A-C/C-A; Y-Z
Symmetry: Math Symbols-5F	A-B	B-A

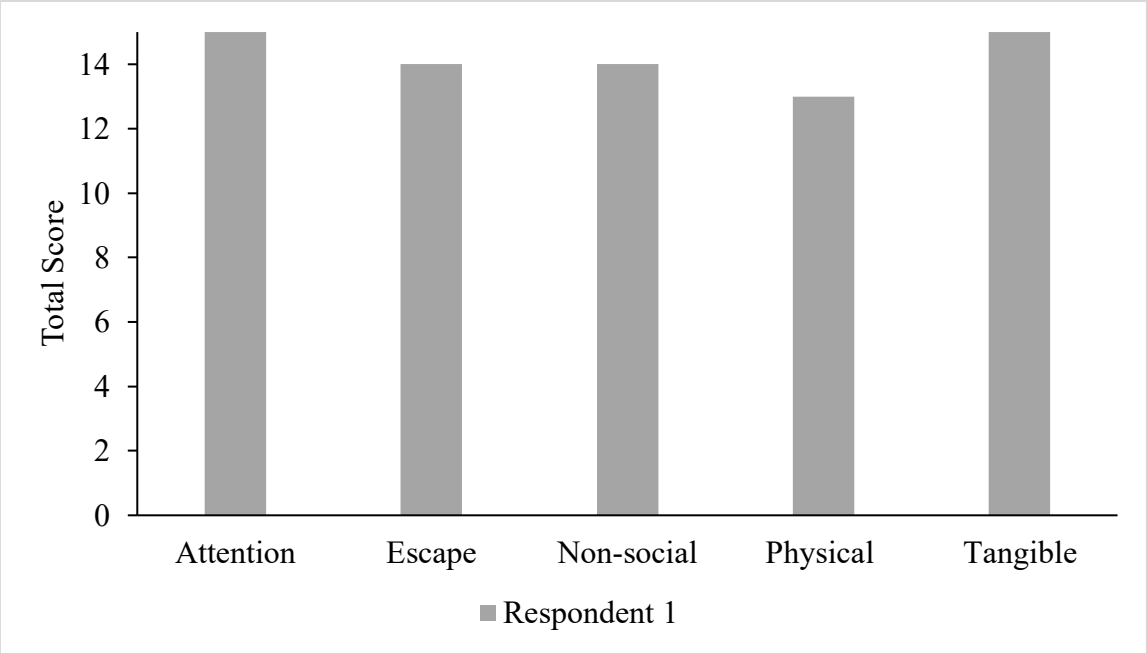

Figure 1. The graph above includes the results from the QABF filled out by the child's caregiver. The vertical axis shows the total score attributed to a specific function. The horizontal axis shows the five different behavior functions.

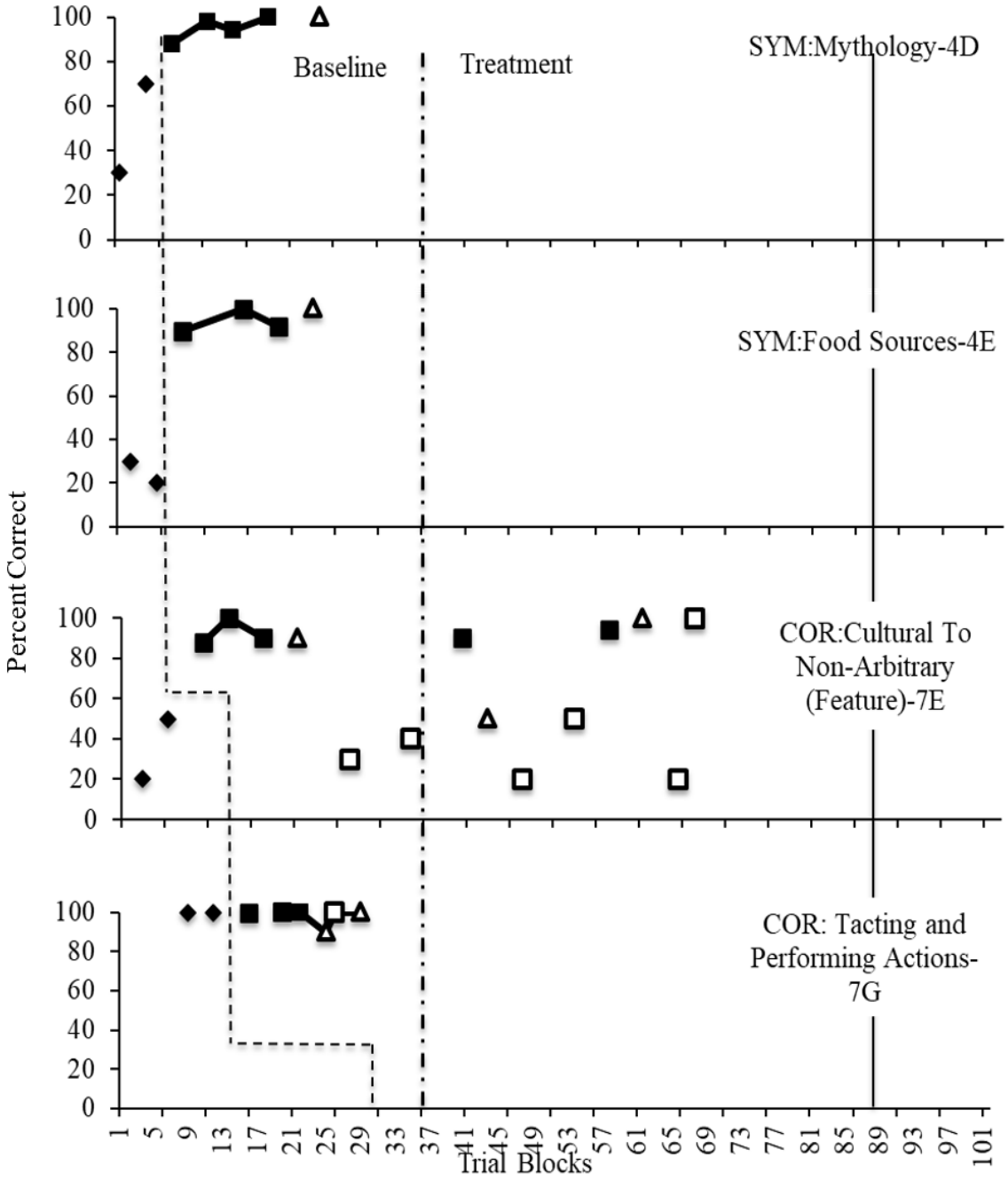

Figure 2. Skills 1-4 taught using PEAK curriculum. The x-axis represents trial blocks; y-axis represents percentage correct.

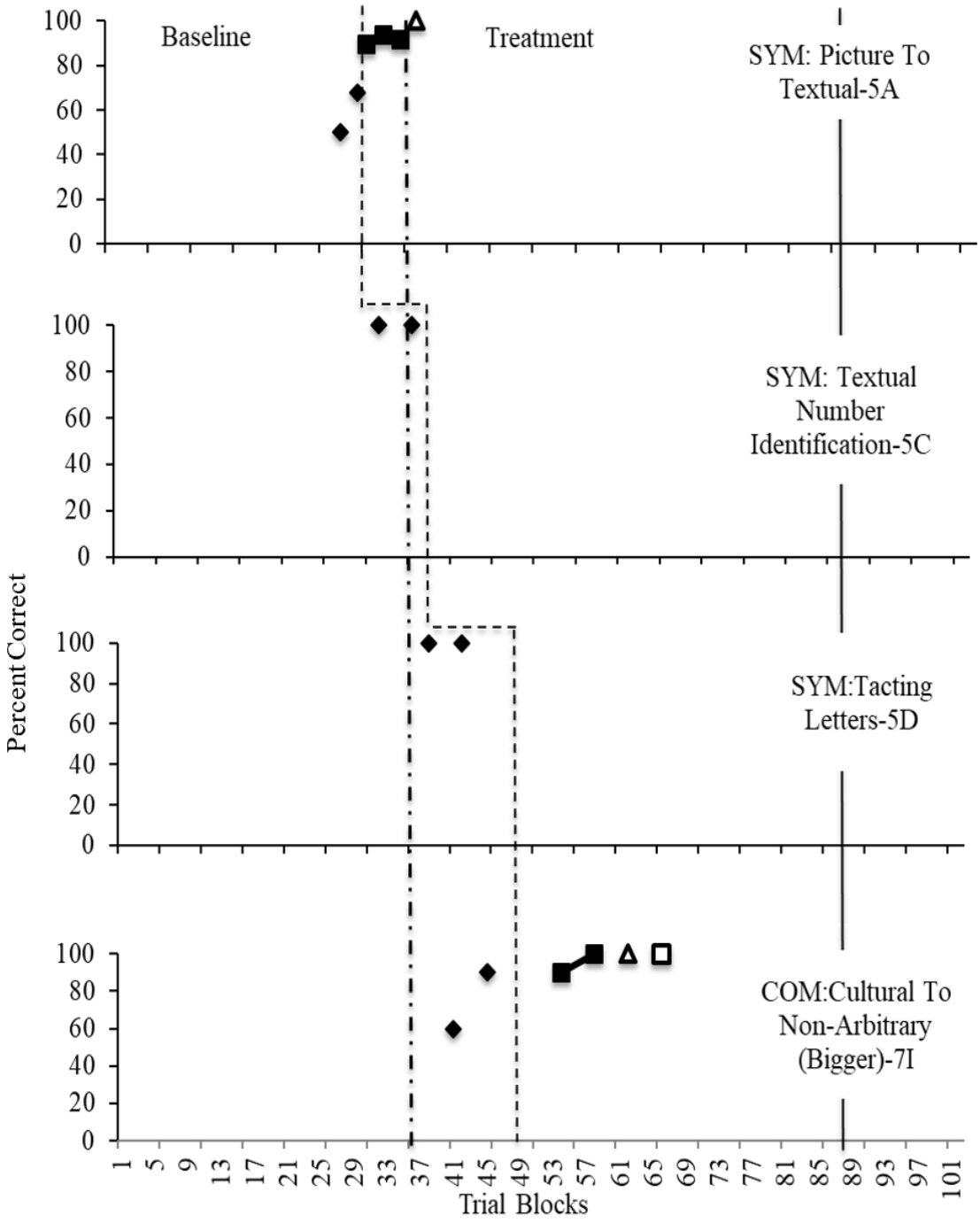

Figure 3. Skills 5-8 taught using PEAK curriculum. The x-axis represents trial blocks; y-axis represents percentage correct.

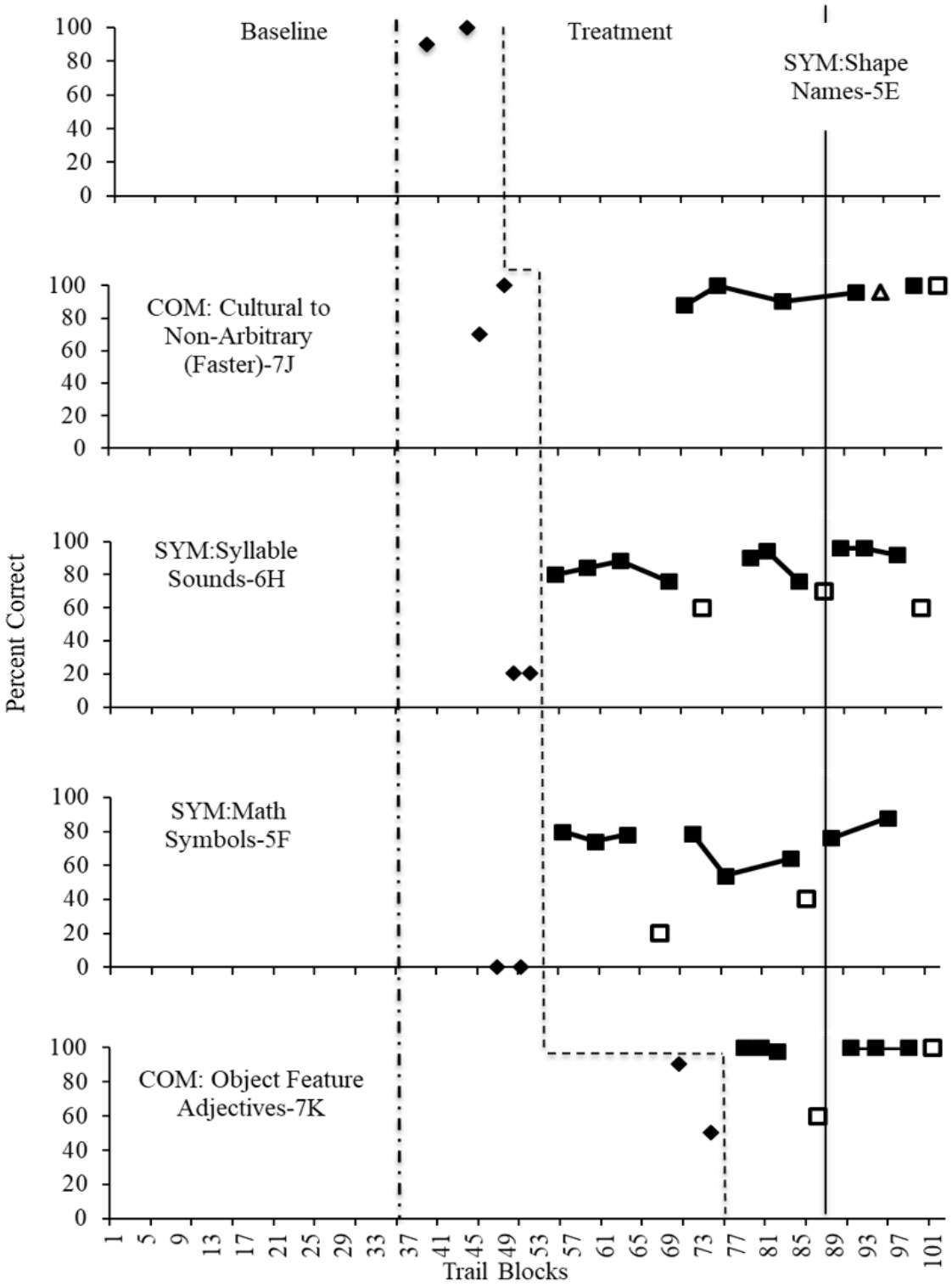

Figure 4. Skills 9-13 taught using PEAK curriculum. The x-axis represents trial blocks; y- axis represents percentage correct.

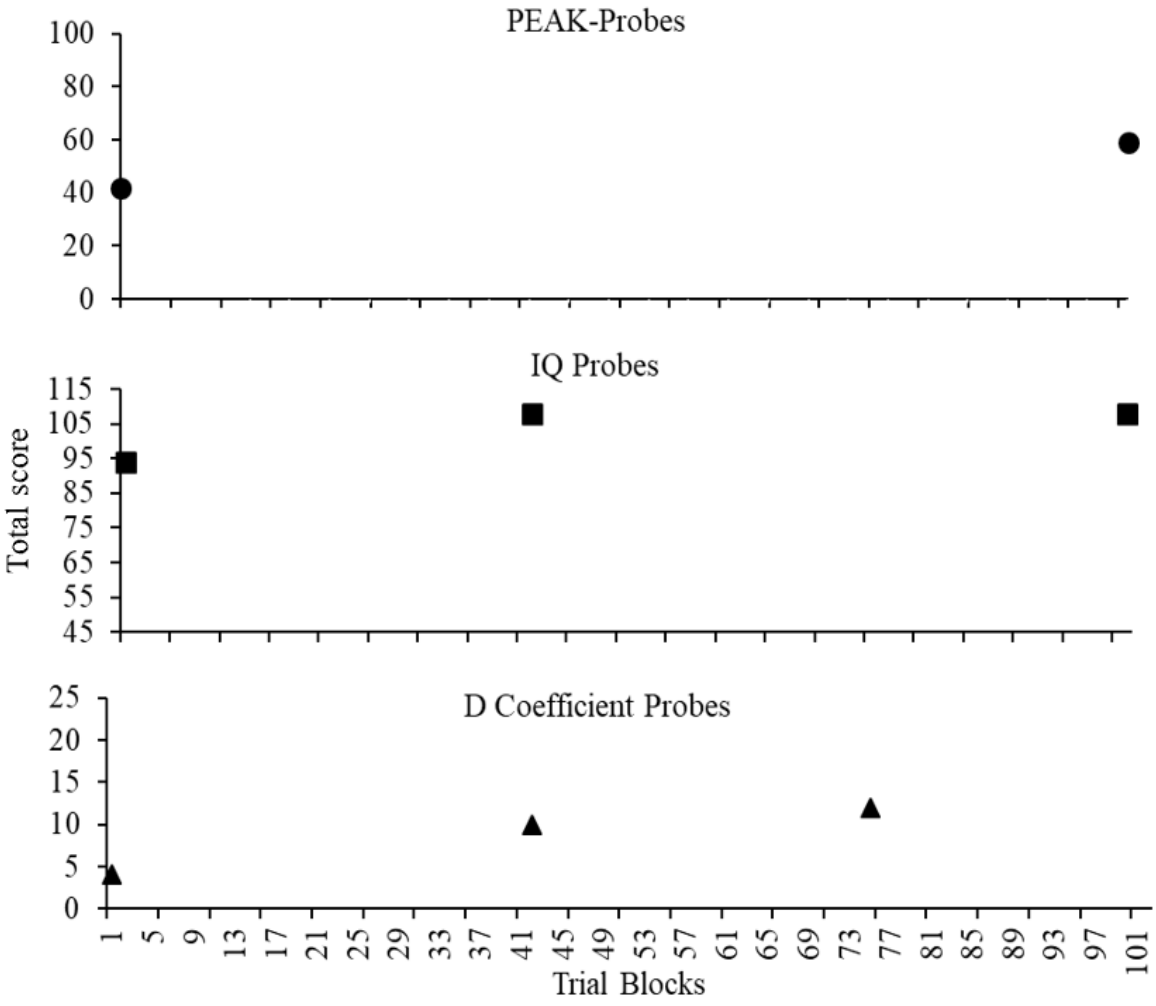

Figure 5. Probes conducted during the study. The x-axis represents trial blocks; y-axis represents percentage correct.

APPENDICES

Appendix A. IRB Approval Form.

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

Member Jordan Belisle	Role Principal Investigator	Contact jbelisle@missouristate.edu
Member Jordan Belisle	Role Primary Contact	Contact jbelisle@missouristate.edu
Member Nicole McDonald	Role Investigator	Contact nc88@live.missouristate.edu
Member Annalise Giamanco	Role Investigator	Contact annalise2015@live.missouristate.edu
Member Taylor Lauer	Role Investigator	Contact tl45911@live.missouristate.edu

				Contact
Member	Celeste Unnerstall	Role	Investigator	unnerstall13@live.missouristate.edu
Member	Megan Kimzey	Role	Investigator	Contact meg19700@live.missouristate.edu
Member	Lindsey Schneider	Role	Investigator	Contact lindsey57@live.missouristate.edu
Member	Hannah Wallace	Role	Investigator	Contact wallace17@live.missouristate.edu
Member	Megan Boyle	Role	Investigator	Contact meganboyle@missouristate.edu
Member	Dana Paliliunas	Role	Investigator	Contact dpaliliunas@missouristate.edu
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
Organization: Psychology
Address: 901 S National Ave , Springfield, MO 65897-0027
Phone:
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
Address: 901 S National Ave , Springfield, MO 65897-0027
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)

Name: Nicole Choate
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Phone:
Email: wallace17@live.missouristate.edu

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.

3 Are you requesting Single IRB Review

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

4 Does the study require review and oversight of the IRB?

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

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.

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).

3 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.

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

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.

3 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.

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.

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

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).

5 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 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.

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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Appendix C. PEAK 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	