The Impact of the PEAK Relational Training System on Language and School Readiness
Outcomes for Typically Developing Preschool Students

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Abstract

Objectives: PEAK Relational Training system is a comprehensive curriculum programme for children with autism that combines traditional Applied Behaviour Analysis (ABA) techniques with innovative research on stimulus equivalence and derived relational responding. The current research investigated the impact of the PEAK Relational Training Systems, specifically the Equivalence (PEAK-E) and Transformation (PEAK-T) Modules, on cognitive and language abilities of typically developing preschool children.

Methods: Thirty-nine typically developing children from a preschool (age 3-4) were recruited for Study 1. Participants were randomised into either PEAK-E intervention (n=13) or PEAK-T intervention (n=13) or treatment as usual (TAU; n=13) groups. Outcome measures included The Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4); The Theory of Mind Inventory (ToMI); and the Bracken School Readiness Assessment, Third Edition (BSRA-3). Results showed a statistically significant increase in pre-post intervention ToMI scores for the PEAK-E and PEAK-T groups, but not for the TAU group. Post-intervention BSRA-3 scores were significantly higher for the PEAK-E group than for PEAK-T and TAU groups. Survey data from n=2 teachers suggest that the PEAK curriculum is socially valid.

Study 2 was designed to determine the intervention-stage at which the PEAK-E module impacted BSRA-3 scores; specifically, would halting the intervention mid-stage suffice to improve school readiness. Thirty-six typically developing children from a preschool (age 3-4) were randomised into either PEAK-E intervention (n=18) or TAU (n=18). Outcomes on the BSRA-3 were measured at baseline, mid-intervention and post-intervention. Generalisation probes were also taken to determine whether intervention effects generalised to novel classroom materials. Results showed a statistically significant difference between PEAK-E and control on BSRA-3 scores. Within group analysis indicated a

statistically significant increase from baseline to mid-stage BSRA-3 scores for the PEAK-E treatment group. Generalisation scores for the PEAK-E group were significantly higher than TAU.

Conclusions: The results suggest that PEAK-E may have utility in affecting school readiness scores; however further research is required.

Keywords: PEAK, relational frame, equivalence, derived relational responding, school readiness, theory of mind, preschool, Montessori.

Chapter 1

The Impact of Teaching PEAK Relational Training System

Within a Preschool

At a time when there is ever-increasing pressure from governments for students to meet educational norms, it is imperative that all children are facilitated to access the national curriculum at an appropriate level (Rehfeldt, 2009). New research in early childhood education has shown that preschool instruction that incorporates academic content including mathematical concepts, pre-literacy skills, and oral language contributes to learning at a higher magnitude than previously estimated, and that these gains persist beyond preschool and into primary school (Duncan, Dowsett, Chantelle, Claessens, Magnuson et al., 2007; Fuller, Bein, Bridges, Kim & Rabe-Hesketh, 2016). This research supports the findings that preschool students exposed to a curriculum that had a strong emphasis on academic instruction showed significantly greater improvements on cognitive tests for reading, writing, math and problem-solving abilities compared to controls (Gormley, Gayer, Phillips & Dawson, 2005). This research contradicts suggestions that gains made in preschool are often small and fade in primary school (Loeb, Bridges, Bassok, Fuller & Rumberger, 2007). Evidence therefore suggests that curriculum-based instruction programmes that incorporate academic content may be best suited to addressing learning deficits and promote long term educational gains.

Currently, early childhood education including preschool and junior infant and senior infant classes in Ireland use the "Aistear" early childhood curriculum framework (National Council for Curriculum and Assessment, 2009). This framework targets four broad areas of learning: well-being; identity and belonging; communicating; and exploring and thinking. The goals within these areas are broadly defined to allow independent development of the curriculum by educational professionals. The demands of the infant classes are markedly different from that of preschool due to increased complexity in academic and social goals, combined with an increase in class size and a decrease in teacher /student ratio (Graziano, Slavec, Hart, Garcia & Pelham, 2004). In an attempt to address the transition between

preschool and junior/senior infant classes, Aistear allows for the possibility of embedding novel learning technologies within the preschool curriculum structure. These technologies may allow for targeted educational interventions to address gaps in skillsets and raise not only basic and remedial skills but also complex language and cognitive skills (Mhic Mhathuna, Ring, Hayes, & McCafferty; 2017; Neylon 2014). One such supplemental aid to education within the preschool curriculum might come from Applied Behaviour Analysis (ABA), with research repeatedly demonstrating that substantial positive impact can be made in schools through its use (Cassidy, Roche, Colbert, Stewart, & Grey, 2016; Cassidy, Roche & Hayes 2011; Rehfeldt, 2011).

The field of ABA originated from the experimental work of behaviourists such as Watson, 1913 and Thorndike, 1898. Skinner (1938, 1953) extended this work in his laboratory-based research on classical and operant conditioning. Skinner's work on operant conditioning was pivotal in examining the impact of the principles of reinforcement and punishment on behaviour, and in informing research on methods of behaviour change including shaping, chaining, discrimination and generalisation. These basic principles were built on, and examined in the context of socially important human behaviour by researchers within the discipline of ABA, which later emerged as a distinct field of scientific study. A seminal article in the 1960s importantly identified the seven dimensions of ABA, which stipulate that ABA should be applied, behavioural, analytic, technological, conceptually systematic, effective and promote generality (Baer, Wolf & Risley, 1968, 1987). This article, published in the *Journal of Applied Behaviour Analysis*, gave direction and guidance to the application of behaviour analysis for behavioural researchers and practitioners.

Modern-day ABA is defined as the scientific discipline that aims to promote socially significant human behaviour through social and environmental modification, via the use of systematic analysis and interventions that identify and utilise variables responsible for

behaviour change (Cooper, Heron & Heward, 2007). The practical applications of ABA principles have been proven effective across a wide variety of settings and populations; including behavioural medicine (Kirby, Kerwin, Carpenedo, Rosenwasser & Gardner, 2008), Organisational Behaviour Management (OBM; Cornwell, Anderson, Abel & Sergio, 1988), health care (Nielsen, Sigurdsson & Austin, 2009), animal training (Howard, DiGennaro & Reed, 2014), hospitality (Austin, Weatherly & Garvina, 2005), and developmental disabilities (Reichow, 2011).

One of the most common applications of ABA is in the area of educational settings and curriculum interventions (Barber & Kagey, 1977; Dunlap, Kern & Worchester, 2001; Larsson, 2013; Yaw, Skinner, Delisle, & Booher, 2014). Researchers have suggested that ABA technologies employed in educational settings may be easy to implement, time efficient and deliver positive results (McEachin, Smith, & Lovaas, 1993; McKeel, Dixon, Daar, Rowsey, & Szekely, 2015a). Well-known research by Lovaas (1987) found that early intensive behavioural intervention, conducted with children with intellectual disabilities, led to normal intellectual and educational functioning with successful first grade performances in 47% of the treatment group compared to 2% of the control group. ABA technologies fit into a well-designed educational curriculum by providing opportunities for feedback, evaluation and mastering one skillset before moving on to the next (Rehfeldt, 2009). One of the most common applications of ABA in the educational setting is targeting the development of communication and language skills, an area of behaviour analysis which has been hugely influenced by Skinner's work on Verbal Behaviour (Paul, 2008; Sundberg & Michael, 2001)

Verbal Behaviour

In Skinner's book on Verbal Behaviour (1957), he builds on his work on respondent and operant conditioning, the three-term contingency (ABC; antecedent, behaviour, consequence), generalization, and discrimination to analyse the conceptual framework and

behavioural taxonomy of language (Sautter & LeBlanc, 2006; Sundberg & Michael, 2001). Skinner hypothesises that verbal behaviour is an operant behaviour that is reinforced through the mediation of the behaviour of another person and is controlled by the functional relations to antecedents and consequences rather than by topography (Sautter & LeBlanc, 2006). Thus verbal behaviour occurs when a speaker's behaviour is reinforced (and hence the future probability of that behaviour increases) through the mediation of the listener (Hayes, Barnes-Holmes & Roche, 2001). The ABA approach is based on Skinner's functional account of verbal behaviour which defined seven verbal operants: echoic, mands, tacts, intraverbals, echoics, transcription and textual responding. These all link together to create complex language skills of the sophisticated speaker. Verbal operants are considered as separate and independent units differing in controlling stimuli and reinforcement contingencies, and are also considered to be functionally independent (Lamarre & Holland, 1985; Sautter & LeBlanc, 2006). For example, the verbal response of "give me water" can yield the reinforcer of a cup of water facilitated through the behaviour of a listener. Thus the verbal response of "give me water" has led to the water (reinforcer) being indirectly obtained by the listener. However, it is the same reinforcer that could be acquired by getting a cup of water for oneself.

A mand is a verbal response controlled by establishing operations and is reinforced by receiving the specific request immediately in the environment, such as requesting a drink, when thirsty, by saying, "drink" and receiving a drink (Sundberg & Michael, 2001). A tact is controlled by a prior nonverbal stimulus or a relationship between objects or events, such as saying "drink" in the presence of a drink, and receiving social praise. In theory, a person might mand for a "drink" when thirsty, or tact (label) "drink" when they see one.

However, that person may not be able to respond with an intraverbal (verbal response which informs social conversations) when asked "what is in the glass". The echoic response

is a type of verbal operant that is often taught by utilising point-to-point correspondence (e.g., hear "water" say "water"). Successive approximations are shaped using positive reinforcement until the response has formally similarity with the verbal discriminative stimulus. Several early studies on mands and tacts such as those of Lammare & Holland (1985) suggested the need to train verbal operants in isolation through direct reinforcement. While this method is effective, it is time-consuming (Hayes, Barnes-Holmes & Roche, 2001).

Although this intensive level of training may be required for some individuals with developmental disabilities, many typically developing (TD) children acquire language skills quickly and demonstrate the ability to generalise these skills to novel contexts (Murphy & Barnes-Holmes; 2009). The generality of language was one of the main reasons why Skinner's account of verbal behaviour was strongly disputed by linguists, most notably Noam Chomsky (1959). Chomsky argued that Skinner failed to account for the inherent ability of children to generalise language. Chomsky also felt that the understanding and production of new language without direct training (i.e. emergent relations) derived from internalized grammar, and not from a history of reinforcement as Skinner theorised (Hall & Chase, 1991; MacCorquodale, 1970; Stemmer 1990). In an attempt to account for the nature of language generality, researchers working in the area of Relational Frame Theory (RFT) built on previous research on verbal behaviour and stimulus equivalence to provide a comprehensive behavioural account of language (Hayes et al., 2011).

Stimulus Equivalence and Derived Relational Responding

Research on Stimulus Equivalence (SE; Sidman 1971) was one of the first attempts to account for the emergence of verbal behaviour that had never been directly reinforced. For example, a child may learn to pair the word "dog" with an actual dog and then may be able to tact a picture of a dog, without ever having received direct reinforcement for doing so. In this way, SE addresses the analytic unit of the "stimulus-response formula" and occurs when

different stimuli both elicit the same response (Barnes-Holmes, Barnes-Holmes, Y., Smeets, Cullinan & Leader; 2004a; Cassidy, Roche & O'Hora, 2010; Dixon, 2015; Hall & Chase, 1991; Hayes, 1989; Sidman 1986; Stemmer, 1990). In research on SE, relationships between stimuli are referred to in terms of reflexivity, symmetry, transitivity and equivalence (Gatch & Osborne 1998).

Reflexivity is demonstrated in matches to sample procedures (Stimulus A = Stimulus A). For example, when an individual is shown stimulus A, and asked to match, the individual can select stimulus A out of an array. Symmetry occurs when the derived relation is made in the opposite direction of the trained relation, such that when taught that A = B, the learner derives that B = A. Transitivity occurs when a learner makes a derivation across stimuli that have never been paired together; for example, if A = B and B = C, the learner derives that A = C, and C=A without this being directly taught or reinforced. Finally, equivalence combines reflexivity, symmetry and transitivity together. Thus an equivalence relation is observed when the learner is taught that A = B and A = C, and they can then derive that B = C and C = B (Barnes-Holmes et al., 2004a; Dixon, 2015; Hall & Chase, 1991). This process is called derived relational responding (DRR; Hayes et al., 2001) and this novel ability has so far only been seen in humans (Gross & Fox, 2009; Hayes, 1989; Steele & Hayes, 1991). Research on equivalence class formation has indicated that foundational abilities in symmetry and transitivity must be in place before equivalence test can be passed, and suggest that fluency in both influence performances in equivalence relations (Fields, Adams, Newman & Verhave, 1992).

The derived relations of stimulus equivalence emerge through a history of reinforcement with multiple exemplars of similar stimuli. The addition of extra stimuli into the equivalence network results in an increase in derived responses (Hall & Chase, 1991; Sidman 1989; Sidman, 2000). Thus learning can be exponentially increased with just a few

increases of extra stimuli into the equivalence networks (Hall & Chase, 1991; Hayes, 1989; Sidman, 1986). This suggests that an efficient instructional strategy that involves minimal training could lead to an exponential increase in novel skills for TD children and even those with developmental disabilities (Barnes Holmes et al., 2004; Dixon et al., 2014c). Experiments done by Sidman in the 1970s (Sidman, 1971; 1986; Sidman & Cresson, 1973) showed that children with learning difficulties while learning to read, were able to relate stimuli to other non-similar stimuli without having been directly trained in the relation. Educational research on classroom applications of SE described methods of establishing equivalence-based networks using matching-to-sample procedures to improve writing and naming performances with auditory – visual equivalent relations. The researchers suggested that SE could be used as a supplemental aid to curriculum based approach if children have difficulty learning equivalence relations from traditional teaching approaches (Stromer, Mackay, Lawrence & Stoddard, 1992). More recent research demonstrated that using multiple exemplar training with an SE protocol increased scores in full-scale IQ measures (Cassidy et al., 2011). In the time since Skinner and Sidman's original work, many research studies have been conducted on VB, SE and on the principals of ABA, and this has formed the basis for many assessment and teaching paradigms for individuals with language delays such as Discrete Trial Training, Pivotal Response Training, Verbal Behaviour, Naturalistic Interventions, Floor Time, The Early Start Denver Model (Rogers & Dawson, 2010), VB Mapp and ABBLS (Dixon et al., 2014a; Dixon, Whiting, Rowsey & Belisle, 2014d; Sautter & LeBlanc, 2006; Sundberg, 2008; .Sundberg & Michael, 2001; Partington, 2008).

Derived Relational Responding and Relational Frame Theory

Derived Relational Responding (DRR) encompasses much more than just bi-directional match to sample stimulus equivalence. Relational Frame Theory (RFT; Hayes et al., 2001) is a behaviour-analytic account of human language and cognition and embraces the

simple idea that deriving stimulus relations is a learned behaviour (Barnes-Holmes, Barnes-Holmes, Y. & Cullinan, 2000; Gross & Fox, 2009; Hayes et al., 2001; Steele & Hayes, 1991). RFT built upon the foundations of SE by extending types of stimulus relations beyond equivalence, and by providing an explanation for the generativity of language (Hayes et al., 2001). RFT considers SE as a frame of co-ordination, and as such equivalence is one of many possible relations between stimuli that may occur. Other relations between stimuli include opposition (opposite relations e.g. hard is opposite to soft), distinction (different relations e.g. not sweet could be bland or spicy), comparison (quantitative/qualitative relations e.g. more or less than), hierarchical (class or kinship relations e.g. watermelons and cherries are fruits), temporal (dimensions along a continuum relations e.g. now, then), spatial (relativity of space e.g. in /out over / under), deictic (perspective taking e.g. I / you, hear / there) (Hayse et al., 2001; Stewart, Tarbot, Roche, & O'Hora, 2013).

When a relational response is made on the basis of a contextually controlled cue and not on the basis of the physical property of stimuli, we call this arbitrarily applicable relational responding (AARR) and, within this, the specific contextual cues are called relational frames (Barnes & Hayes, 2007; Hayes et al., 2001; Steele & Hayes, 1991; Torneke, 2010). RFT is distinguishable from behavioural accounts of SE precisely because the two cognitive skills of AARR and multiple stimulus relations underlie DRR, which is at the core of complex human verbal behaviour (O'Hora, Pelaez, & Barnes-Holmes, 2005; Dunne, Foody, Barnes-Holmes, Barnes-Holmes & Murphy, 2014). The terminology involved in SE – reflexivity, symmetry and transitivity – did not lend itself to the broad nature of the RFT account of AARR (Steele & Hayes, 1991). RFT theorists provided a new nomenclature that addressed this issue and adopted terminology that was more generic and covered all possible derived stimulus relations in any direction (Cassidy et al., 2010). They proposed the terms

mutual entailment, combinatorial entailment and transformation of stimulus functions (Hayes et al., 2001; Hayes et al., 2001).

Mutual entailment describes the relations between two stimuli or events: If A is related to B through certain characteristics (e.g. similarity or distinction), then B is related to A in the same context. This is similar to symmetry and describes the directionality of relational responding (Hayes et al., 2001; Ruiz, 2010). For example if we are told that Conor (A) is faster than Alan (B), we would derive that Alan (B) is slower than Conor (A) (A-B B-A = mutual entailment). Combinatorial entailment describes the relation where two or more stimulus relations can be mutually combined which facilitate the derivation of their relation to a third stimulus: If A is related to B (mutual entailment) and B is related to C (mutual entailment) then the third relation A is related to C can be entailed (combinatorial entailment) (Hayes et al., 2001; Ruiz, 2010). This is considered similar to transitivity and equivalence. For example, if we add to the network the information that Alan (B) is faster than Ruth (C) we then derive that Ruth (C) is slower than Alan (B) (B-C C-B = mutual entailment) we then derive without having been directly taught that Conor (A) is faster than Ruth (C) and Ruth (C) is slower than Conor (A) (A-B B-C = A-C = combinatorial entailment). Transformation of stimulus functions use contextual cues, considered a defining psychological feature of relations frames, to specify the way in which the functions of stimuli are altered in an established relational network. Having been taught the relations of A-B and B-C, if A then acquires a reinforcing function, the functions of B and C will be affected. If we return to our example of Conor, Alan, and Ruth, and say the "fastest" person (contextual cue) must be picked to win a relay race, then Conor would be chosen as we have entailed that Conor (A) is faster than Alan (B) who is faster than Ruth (C). However, if we were to say the "slowest" person is to be chosen, then Ruth would be picked as we have entailed that Ruth is slower than Alan, who is slower than Conor. Thus, the contextual cue has defined the direction and

relation of the response (Barnes-Holmes, McHugh, & Barnes-Holmes, 2004; Cassidy et al., 2010; Hayes et al., 2001; Ruiz, 2010).

An area of research that has proved important in teaching RFT skills is the use of Multiple Exemplar Training (MET; Rosales, Rehfeldt, & Lovett, 2011). MET is the use of multiple exemplars of a stimulus while training (e.g. a letter can be written in different fashions, but still represent the same thing such as A, 𝔄, **𝐀**, *A*, 𝒜, 𝔸). Once relational skills are established, generalised responses can be made across other similar relational tasks (Cassidy et al., 2010). Research on RFT and MET could help behaviour analysis to originate practical interventions that would increase intellectual ability in both normative and developmentally delayed populations (Murphy & Barnes-Holmes, 2010). One study that examined acquisition of a second language in preschoolers found that participants showed noticeable increases in derived tact relations following MET training (Rosales et al., 2011). In another study on establishing derived mands with a population of children with autism, researchers implemented additional MET training to one participant who did not show derived manding responses (Murphy & Barnes-Holmes, 2009). After MET training, appropriate derived responses to a novel stimulus set emerged. This study helped demonstrate that MET facilitates the emergence of generalised contextually-controlled derived relational responding.

Generalised responding is considered one of the most important characteristics of RFT based interventions (Stewart, McElwee, & Ming, 2013). Generalisation is expected to occur without reinforcement, with untrained stimuli. Researchers stress the importance of using MET when programming for the generalization of the learned skill, and reiterate the significance of generalizable skills for service users in the applied setting (Rehfeldt, 2011). This suggests that RFT based interventions which incorporate MET and promote generalisation, may be particularly important in an educational setting. By using RFT

technologies in the development of newly devised curriculums educators can capitalize on these unique aspects of learning to the advantage of students (Dixon, Peach, Daar & Penrod, 2017c; McKeel, Rowsey, Belisle, Dixon & Szelely 2015b).

The call for a comprehensive teaching curriculum linked to DRR has been suggested in ABA research for some time now. One influential textbook on the application of DRR for individuals with developmental disabilities (Rehfeldt & Barnes-Holmes, 2009) describes ways to increase independent communication and academic skills by teaching DRR. The authors suggest that a curriculum could be implemented to programme for the emergence of derived skills. This is supported by research that suggests that RFT-based interventions have been linked to academic performance (Cassidy et al., 2016), cognitive abilities (Kilroe, Murphy, Barnes-Holmes- Barnes-Holmes, 2014), and even intelligence (Gore, Barnes-Holmes & Murphy, 2010).

Research on the relationship between Relational Frame Theory, Stimulus Equivalence, and cognitive abilities

In many educational achievement studies, higher IQ scores have correlated with higher academic achievement. Even though IQ scores have been though to remain stable throughout life, recent research has criticised this notion (Cassidy et al., 2011; Dixon et al., 2014d). In one study with TD children, researchers found that training in SE led to a significant improvement in full-scale IQ (as measured by the WISC), with additional gains noted after training the relational frames of more than/ less than and same/opposite (Cassidy et al., 2011). This result was then replicated in a follow-up study with children with educational difficulties who showed significant within group increases in IQ after MET on the relational frames of more than/ less than and same/opposite. These results suggested that fluency in DRR may be associated with IQ and that scaffolding relational responding may lead to further gains in cognitive ability (Cassidy et al., 2011). This study was backed by

recent research suggesting that students exposed to several months of intensive training on derived relations of more than/ less than and same/opposite, showed significant increases in full scale IQ scores (Cassidy et al., 2016).

Further RFT research on the deictic (perspective-taking) relational frame has also shown promising results with the use of MET on increased IQ and cognitive ability (Davlin, Rehfeldt & Lovett, 2001; Rehfeldt et al., 2009; Rehfeldt, Eillen, Zinmek & Kowalchuk, 2007). Research indicated that accuracy in perspective-taking increased as a function of age in a study on perspective-taking relations under the contextual cues of I-You, Here-There and Now-Then (McHugh, Barnes-Holmes, Barnes-Holmes, 2009). Results demonstrated that young children mastered spatial relations before temporal relations and that overall results support the theory that deictic relations are necessary for perspective-taking ability (McHugh et al., 2009). Research has also found that perspective-taking correlates not only with verbal ability and full-scale IQ (Gore et al., 2010; Stewart et al., 2013) but also with performance on Theory of Mind (ToMi) measures (Hendriks, Barnes-Holmes, McEnteggart, DeMey, Witteman, Janssen & Egger, 2016). This suggests that increases in perspective taking skills could be assessed by Theory of Mind measurements (Theory of Mind Battery; Hutchins, Prelok, & Bonazinga, 2008, 2011, 2014). Therefore, creating training programmes that capitalize upon deictic relations may have important implications, as described above, for the field of ABA and the field of education in general.

Other relational abilities, such as analogical relations are generally used as a metric of cognitive behaviour and are considered important in applied education (Stewart et al., 2013). Analogies are complex relational responses in which one derives a relation of sameness between stimuli; and are considered to be equivalence-equivalence relations. This may indicate how information can be transferred, and thus explains the generativity of language (Barnes, Hegarty & Smeets; 1997; Lipkens & Hayse, 2009; Rehfeldt et al., 2009; Stewart et

al., 2013). Research has indicated that TD children are sophisticated in derived relational abilities of stimulus equivalence by the age of five but need extensive additional training to understand equivalence-equivalence relations (Carpentier, Smeets & Barnes-Holmes, 2002). This may lead credence to the theory that equivalence-equivalence responding is a more complex skill than SE alone. Thus, one should expect that training in early SE such as symmetry and transitivity along with training in RFT based equivalence–equivalence responding should show improvements in traditional analogy tasks (Fields et al., 1992).

In a comprehensive review of the impact of RFT-based applications on education and intellectual development, researchers concluded that relational framing correlates with cognitive and educational skills such as reading, maths and vocabulary (Stewart et al., 2013). These finding suggest that benefits are to be gained with RFT procedures in the applied education setting (for a complete review, see Stewart et al., 2013). The types of educational skills that these RFT-based interventions target are skills that are associated with important educational outcomes such as school readiness (Duncan et al., 2007). For example, one meta-analysis examining research on school readiness found that test scores for reading and maths, e.g., concepts such as comprehension of numbers and ordinality, were the most powerful indicators of later learning. While not as powerful, but still consistent, early language and reading skills such as vocabulary and letters also predicted later learning ability (Duncan et al., 2007).

The above review of the literature above speaks to the fact that DRR can lead to an exponential increase in cognitive and language skills through application of RFT. Early learning pre-requisites (joint attention, mand and tact repertoires), initial relational frames (co-ordination, distinction, opposition) and more advanced relational responding for example causal and diectic can all be trained using RFT technologies (Rehfeldt et al., 2009). The educational and psychological literature repeatedly demonstrates that substantial positive

impact can be made in schools through the use of these behaviour analytic and RFT

technologies (McKeele, Rowsey, Dixon & Darr, 2014). By incorporating DRR, MET and

generalisation into teaching methods, educational practitioners can implement programmes

that are not only easy to use, but time and cost effective and provide data justified results for

maximum effects and exponential learning. Fienup, Wright and Fields (2015) further this

discussion by suggesting that such a curriculum would consist of parameters such as

sequenced training/testing, training structures, response topographies, mastery criterion and

feedback. One team of researchers in Southern Illinois University have recently adopted this

approach and sought to expound on the emergence of DRR skills through the use of a

functional technology (Dixon 2014). Professor Dixon and his team developed the PEAK

(Promoting the Emergence of Advanced Knowledge) Relational Training System: Evidence

Based Autism Assessment and Treatment Manual; a series of four curriculum manuals that

are a combination of traditional ABA, VB and new SE, and RFT protocols for use in

educational settings (Dixon et al., 2014a; Dixon 2013; Dixon, 2014; Dixon, 2015; Dixon et al

2014c; Dixon, Belisle, Stanley, Daar & Williams, 2016a).

PEAK Relational Training System

PEAK Relational Training System is a comprehensive curriculum that aims to

enhance learning ability and intellect for children with autism (Dixon, 2015). The four PEAK

modules are as follows; Direct Training (DT), Generalisation (G), Equivalence (E), and

Transformation of Functions (T). The modules are made for parents and teachers to easily

adapt into any educational setting and environment (Dixon 2014; Dixon 2015; McKeel et al.,

2015a). The four modules increase in complexity and technical requirements and while they

can be used individually they are designed to be run simultaneously.   Each of the four

modules are made up of 184 curriculum programmes complete with programme information

such as goals, required stimuli, and instructions on how to present stimuli. Each module

includes an assessment tool (a specific assessment for each modules programmes) which identify gaps in the child's repertoire of both language and skills. The modules also provide instructions for data collection that is used to inform decisions on when to implement new programmes. All four modules use MET and discrete trial training (DTT) along with reinforcement and prompting procedures as the instruction method The last three modules specifically embed features for generalization, SE, and DRR into the programmes curriculum framework.

PEAK-DT promotes new repertoires of verbal and academic skills. These include concepts of Skinner's account of VB, such as tacts and mands as well as interverbal sequences which increase in complexity to include advanced forms of verbal operants. The DT module teaches skills such as prerequisites for learning (attending, listening and eye contact), imitation skills (vocal and gross motor), cognitive skills (writing, maths), and conversational skills (jokes, metaphors and questions) through a contingency-based protocol similar to traditional ABA methods (Dixon, Belisle, Whiting & Rowsey, 2014b).

PEAK-G systematically trains stimulus and response generalization skills. The trials are run training (using reinforcement for correct response) and testing (using no reinforcement for correct response) within the same trial block. Thus, the novel untrained stimuli are presented with directly trained stimuli that is similar in nature to encourage an untrained correct response which increases generalisation of skills. (Dixon 2014; Dixon et al., 2016a; Dixon et al., 2014a).

The last two modules PEAK-E and PEAK-T utilise behavioural technologies derived from SE and RFT. Like the previous two modules PEAK-E and PEAK-T base, programme protocols on DRR are based on empirically supported procedures that are well established in behaviour analytic literature (Dixon, 2017a). Once pre-requisite learning skills established by previsions modules have been taught, programs can move to advanced relational targets.

PEAK-E includes four primary types of SE relations (symmetry, reflexivity, transitivity and equivalence); the goal of this module is not to teach the learner *what* to relate but to teach the learner *how* to relate (Dixon, 2015). This overarching goal enables PEAK to use the different training methodologies to encourage generalization skills. This flexibility in behaviour response increases the repertoire of the student, giving them the ability to expand their learning without the necessity of directly training every response (Belisle, Speelman, Rowsey, 2016; Dixon et al. 2017a; Dixon et al., 2014c).

Finally, PEAK-T provides a means for evaluation and treatment of deficits in relational responding with targets such as relational arrangements of co-ordination, opposite, difference, comparison, hierarchy and deictics. PEAK-T scaffolds its curriculum from basic non-arbitrary tasks to simple arbitrary relational skills and finally to complex transformations involving arbitrary stimuli relation (Belisle, Dixon, Stanley, Munoz & Daar, 2016a). (see Footnote 2).

Dixon and colleagues justify the operationalization and manualized nature of PEAK by indicating that a systematic validated approach should direct teaching decisions, rather than differing and sometimes inconsistent clinician recommendations (Dixon et al., 2014d; Rowsey, Belisle, & Dixon, 2014). The PEAK researchers attest that manualized protocols allow for standardization of implementation and of assessment of procedural fidelity (Dixon, et al. 2017a). Citing the BACB 2014, they point out that the reason that we must provide treatments for clients that are highly valid and reliable is to ensure that data informed decisions are made both at the assessment and the treatment stage of intervention. PEAK aligns itself to the seven dimensions of ABA as the manuals are designed for use in the applied setting, utilise effective ABA technology, are behavioural and systematic in nature, and have been shown to promote generalization in outcomes (Baer, 1968; Dixon 2015; Dixon et al., 2014a; Rowsey et al., 2014).

A Review of PEAK Relational Training Research

The body of literature thus far suggests that PEAK is a successful assessment and curriculum tool which is aligned not only to language and cognitive assessments but also developmental norms (Reed, 2016). Research citing four studies on the validity and reliability of PEAK-DT and PEAK-G show high psychometric evaluations with Inter Observer Reliability (IOR) ranging from 85% to 99.1% and reported a Cohen's Kappa reliability coefficient of .981 (Dixon et al., 2017a). Convergent validity assessments have shown that PEAK correlates strongly (median r = + .908) with other assessments such as: IQ measures, Assessment of Basic Learning and Language Skills-Revised (ABLLS) and the Vineland Adaptive Behaviour Scales (Dixon et al., 2014d, Partington, 2008); Peabody Picture Vocabulary Test (PPVT) and the Illinois Early Learning Standards (Dixon et al. 2014c); and One-Word Picture Vocabulary Test and Expressive and Receptive language assessments (McKeel et al., 2015b; Dixon et al., 2017a). An examination of content validity has shown that PEAK scores for the PEAK-DT and PEAK-G correlate with normative samples and indicates how skill level of children with developmental delays or autism may compare to that of a TD peer (Dixon et al., 2014d). PEAK research has also addressed Inter-observer Agreement (IOA) and integrity data by investigating how PEAK can be run by trained frontline staff with fidelity and reliability (Dixon et al., 2014c; McKeel et al., 2014; Belisle, Rowsey et al., 2016).

The majority of PEAK research to date has incorporated single subject design (SSD) studies using multiple baseline design; and have been employed to investigate SE outcomes such as derived listener responding and gross motor equivalence (Dixon et al., 2017b; Dixon, Speelman, Rowsey, & Belisle, 2016b); and academic targets and verbal targets such as tacts and autoclitics (Dixon et al., 2017a; Dixon et al., 2017c; McKeel et al., 2014). In a critical review of PEAK research, Dixon et al. collated information on PND (percentage of non-

overlapping data) from ten SSD studies and found that PND exceeded 70% in 41 of 44

unique skills, with a median of 100% (Dixon et al., 2017a; Belisle et al., 2016b; Dixon et al.,

2016a). The PND approach is used to show quantitative synthesis (meta-analysis) of single

subject research (Scruggs & Mastropieri, 2013). These findings, therefore, suggest that

PEAK may be a useful assessment and intervention tool. However, it should be noted, that

intervention researchers consider a randomised controlled trial (RCT) design as the gold

standard in assessing intervention efficacy (Ashburner, Rodgers, Ziviani, Hinder, 2014).

Only one PEAK study, to date, has employed a group RCT design. This study

compared PEAK–DT assessment scores, from a treatment group who received PEAK-DT

training sessions, to a control group who received treatment as usual (McKeel et al., 2015a).

Results demonstrated statistically significant differences between pre-test and post-test scores

within the PEAK-DT group and found additional statistically significant differences between

the treatment and control groups, post test scores, on the PEAK-DT assessment. Effect size

(Cohen's d) was calculated for experimental group, with $d=.99$ indicating a large effect size,

and calculated for the control group, at $d=0.26$, indicating a small effect size. Overall, PEAK

DT was more effective than treatment as usual (Mckeel et al., 2015a).

In the recent critical review of PEAK, mentioned above, researchers have discussed

the limitations of studies, to date (Dixon et al., 2017a), including questions that arise

regarding the psychometric properties of PEAK; specifically, that no psychometric properties

for PEAK-E and PEAK-T have been reported. While initial research show that trained

qualified assessors familiar with ABA can implement PEAK with fidelity, this may not be

true for staff with no experience of ABA (McKeel et al., 2015a). An additional area the

researchers are critical of is the lack of RCTs, citing the natural tendency for behavioural

analysts to shy away from group-comparisons research, mainly because behavioural analysts

work to the basis that, to be most beneficial, treatment must be understood at the individual

rather than a group level (Horner, Carr, Halle, McGee, Odom & Woler, 2005). The review authors concluded that there is a need to continue to design appropriate studies to disseminate information on PEAK to relevant stakeholders, including those who are not behaviour analysts, to increase the range and type of studies undertaken (Dixon et al., 2017a). Specifically, the authors suggest that research should explore the efficacy of the manualized curriculum format and examine whether front-line staff can deliver the manual with fidelity (Belisle et al., 2016b; McKeel et al., 2014). PEAK researchers also suggest that future studies should examine the efficacy of PEAK as a remediation programme for TD individuals, as PEAK could be used to address gaps in language and cognitive skills for TD children (Dixon et al., 2014d; Dixon et al., 2017a). Additional PEAK researchers suggest that future studies that warrant further exploration are those that explore the changes in additional language and learning assessments (not PEAK PDA), following training per PEAK protocols (McKeel et al., 2014).

As previously mentioned, the first two modules (while building in complexity) teach foundation programs specific for children with additional needs such as language skills (i.e. eye contact and early verbal operant) and generalisations skills. While it is acknowledged that both of these modules aim to teach skills relevant to the typical developing 8 and 11 year old, it should be noted that the four modules are designed to scaffold from simple (VB) to more complex skills (DRR) and are meant to be run simultaneously together. Thus, it is assumed that early alpha-numeric programmes of the advanced PEAK-E and PEAK-T programs are also developmentally appropriate to the typical developing 8 and 11 year old (though no PEAK research, to date, has been done to support this). This would be more in line with the developmental levels of typical developing preschool students, as opposed to programs from PEAK-DT and PEAK-G. In light of the fact that the majority of PEAK research has been done on PEAK-DT and PEAK-G modules with children in autism

populations, the current research aimed to address the above mentioned recommendations by utilising the PEAK-E and PEAK-T modules with a typical developing population (Dixon et al., 2017a).

An Argument for PEAK as a Curriculum Intervention

PEAK researchers link the first Direct Training models to traditional ABA assessment and intervention programmes such as the VB-MAPP and ABLLS-R. However, they qualify that it differs from alternative approaches, as PEAK provides more complex topographies of verbal operant targets, correlating with intelligence, with a higher inter-rater reliability and validity (Dixon et al., 2017a; Rowsey et al., 2014). Presently, VB-MAPP and ABBLES-R serve as a curriculum and assessment guide for individuals with autism and developmental disorders. Both have been based upon Skinner's analysis of verbal behaviour and developmental milestones, using research from the field of behaviour analysis to guide the instruction of language and critical-skill acquisition. ABBLS-R was designed to assess and increase a variety of language and general learning skills such as motivation, complex stimuli, generalisation, spontaneity, fluency, joint attention, social skills development, imitation, and learner readiness (ABLLS-R: Partington, 2010). Although VB-MAPP is similar, it consists of 170 measureable learning and language milestones targets that are organized developmentally across three developmental levels from birth to 4 years of age. Furthermore, the protocol also includes a barrier assessment, which allows for specific intervention strategies to be developed to help overcome these problems and lead to effective learning (VB-MAPP; Sundberg, 2008). Despite their popularity in the applied setting, research has indicated that these protocols lack psychometric evaluation and that neither protocols have empirically proven validity and reliability (Dixon et al., 2017a; Gould, Dixon, Najdowski, Smith & Tarbox, 2011; Rowsey et al., 2014). It should be noted; the above references are led by PEAK practitioners, and should be regarded cautiously. PEAK

researchers report that PEAK DT, highlights skill targets expected of a TD eight year old. Alternative treatments such as VB-MAPP only cover skill-sets up to a TD four year old, while PEAK G builds on this and provides targets up to age 11. They further indicate that the last two modules, PEAK-E and T, go beyond the VB-MAPP and ABBLS by utilizing empirically established techniques of training stimulus equivalence and the advanced cognitive learning skills of RFT. This is backed up by conclusions from research on training DRR to children (e.g. Barnes-Holmes, McHugh, Barnes-Holmes, 2004b; Rehfeldt et al., 2009a, 2009b), which suggests that appropriate training in RFT relational skills should lead to improvements, not only in cognitive performances and theory of mind, but also in the methods used to teach relational skills in educational settings (Hendrix et al., 2016).

If we accept that: (i) the PEAK Relational Training System is a modern assessment and curriculum programme that merges traditional Skinnerian verbal operant training with post-Skinnerian procedures to produce DRR; and (ii) the empirical evidence of numerous research studies on the efficacy and validity of ABA technologies in increasing behavioural skills and intelligence, then we surmise that PEAK should have a similar effect on increasing skill acquisition and cognitive ability for a TD population, as has been shown with students with developmental disabilities. This suggests that PEAK may be a beneficial intervention and/or supplement tool for increasing skills in TD populations of preschool and school-age children. The current research aims to further the investigation of the utility of PEAK in affecting educational outcomes for TD learners by utilising assessment measures other than PEAK assessments (McKeel et al., 2014). The outcome measures include the Peabody Picture Vocabulary Test - Fourth Edition (PPVT-4; Dunn & Dunn, 2007), the Theory of Mind Battery Inventory (ToMI; Hutchins et al., 2008), and the Bracken School Readiness Assessment, Third Edition (BSRA-3, 2007).

Justification for Outcome Measures Used in this Research

While PEAK employs its own assessment measures within the manual, it would be expected that measures sensitive to scholastic outcomes, perspective-taking, and language ability would also be able to measure increases in skill sets directly related to training in PEAK. One measure that may prove suitable for testing for scholastic achievement in TD children is BSRA-3, which was developed to assess the U.S. standards of knowledge expected of children aged approximately 5 years. The BSRA-3 tests knowledge in colours, numbers, letters size/comparisons, and shapes, and may be useful in assessing similar skills targeted by the PEAK modules. The BSRA-3 draws content from the American common curriculum standards, has strong psychometric properties, and has been reported as a robust measure of school readiness and expected scholastic achievement (Panter & Bracken, 2009).

Another measure that may be relevant when assessing outcomes related to a PEAK intervention is the ToMi assessment. Research has previously shown that training in deictic relational frames may affect outcomes on theory of mind measures (Hendriks et al., 2016). As the PEAK-T intervention includes two programmes on perspective taking training, it would be of interest to determine whether theory of mind outcomes are affected. The ToMI Task Battery was designed to be used with verbal and nonverbal children and is comprised of 15 static visual stimuli questions, ranging in complexity with nine tasks that tap into a range of ToMI skills. Research has found that the ToMI had excellent test retest reliability and internal consistency (Hutchinson et al., 2011).

As PEAK is considered an intervention tool to target language outcomes, assessments of language ability would be important to include when examining the impact of PEAK on various cognitive skills. Prior research has examined the relationship between outcomes on PEAK-DT and on PPVT-4 assessments (Dixon et al., 2014c), with results showing strong correlations between the two. These results may suggest that children who have access to a larger lexicon, as a result of PEAK training, could conceivably increase their scores on the

PPVT-4. The PPVT-4 tests language ability and allows for comparisons to be made between

receptive and expressive vocabulary performances that represent twenty content areas and

parts of speech. PPVT-4 reports high internal consistency (By Age: Form A: *M*=.94, Form B:

M=.94) and test/retest reliability (By Age: M = .93) (Dunn & Dunn, 2007).

The Current Research

The current study sets out to investigate whether the PEAK Relational Training

System can be successfully employed to teach fluency in responding through MET in

advanced cognitive learning skills (e.g. SE, mutual and combinatorial entailment and

transformation of function). The research also set out to determine the impact of teaching

these skills on scholastic and language based outcomes for TD children. The study uses

curriculum targets such as awareness of symbol in picture, print, numbers, spatial awareness

(such as closer and further away), temporal awareness (such as before and after), and

identifying one's own and others' experiences through perspective taking. The study

incorporates a group comparison design to compare PEAK interventions to a TAU group. It

should be noted that the study took place in a preschool that utilises the Montessori Method

of instruction, thus the intervention group were exposed to Montessori preschool *and* PEAK

during the preschool day (3 hours), while the TAU group were exposed to Montessori

preschool teaching only during the preschool day (3 hours). This means that both groups

received the same number of hours of teaching time per day, therefore the intervention group

did not receive any additional tuition time. It is not the intent of this study to compare PEAK

instruction to the Montessori Method. However, it should be noted that many of the skills

taught in Montessori preschool may overlap with PEAK targets in the current study (Please

see, below, a discussion on what Montessori preschool may entail).

The Montessori Method of education was developed by Dr Maria Montessori in 1907

(Montessori, 1988; Standing, 1998). The method is a child-centred educational approach

based on scientific observations of children. It emphasises that the child will actively engage in a prepared learning environment that scaffolds learning experiences so that each step is within the child's repertoires. Scholastic skills such as matching to sample, ordering, sorting, numbers, letters, culture, and science are taught as part of the curriculum and the child is instructed though what is termed "The Three Period Lesson". The classroom of a Montessori school has defined areas of interest, with material that is scaffolded from simple to complex and connects across the curriculum. Thus, Montessori may encourages the development of generalization skills by extending these lessons to other areas of the room and other novel material. A crucial aspect of this research will be ascertaining if a limited number of targeted PEAK programmes administered to the treatment group can make a positive impact on students' cognitive (i.e. school readiness) and language abilities, above that of the TAU group.

The study will involve a quasi-RCT with students from a preschool in Ireland. The research for this thesis was conducted over two large studies. The aim was to investigate the efficacy of the PEAK Relational Training System programme and examine whether the programmes have a measurable impact on standardised cognitive and language assessment scores. This is the first quasi-randomized control study, to date, to present PEAK-E and PEAK-T targets to typically developing preschool children to evaluate the impact of teaching PEAK on language and cognitive (i.e. school readiness) measures. The research aimed to explore pre-post intervention results of alternative assessments (other than the PEAK assessments). Additional reasons for not using the PEAK assessment measures are twofold. While PEAK-E did have an assessment measure, PEAK-T, which had not been published at the time of the study, did not have an assessment measure available. Secondly, as each of these measures were specific for the module, it would have been impossible to divide the groups based on a standard measure. As mentioned above, previous research has examined

the relationship between outcomes on PPVT-4 and PEAK-DT and reported results that showed a strong correlation between the two (Dixon et al., 2014c). Hence, the PPVT-4 was considered an appropriate measure to quasi randomise the treatment and control groups.

The study also explores reliability and fidelity of front line staff's implementation of PEAK programmes and the staff's perceptions of the PEAK programmes, in terms of ease of use and application. Finally, the study investigated whether skills acquired through PEAK training/testing could be generalized to novel settings and stimuli in the preschool environment.

Study 1 explored the effect that teaching PEAK Relational Training System modules had on preschoolers' school readiness (BSRA-3), perspective-taking (ToMI), and language skills (PPVT-4). Intervention groups received additional training in PEAK-E or PEAK-T during the preschool class hours, while the TAU group received only preschool education. The experimental design uses both within and between group comparisons to evaluate the impact of the independent variables i.e., method of instruction, PEAK-E, PEAK-T (intervention groups), and TAU (preschool) on the dependent variables (i.e., PPVT-4, BSRA-3 and ToMI). Thirty-nine TD preschoolers between the ages of 3-4 participated in the study. This study also explored the fidelity and social validity of PEAK-E and T. Two teachers were recruited (and trained using BST) to participate in the implementation and delivery of assessments and PEAK programmes. IOA data was taken to determine fidelity, with a Likert survey given to explore the opinions of the two teachers on the efficacy of PEAK as a curriculum and teaching method.

Study 2 further explored the nuances of PEAK-E implementation, investigating at which intervention-stage PEAK-E would affect the BSRA-3 scores. Outcomes on the BSRA-3 were measured at baseline, mid-intervention, and post-intervention; these intervention stages corresponded to reflexivity/symmetry (taught between pre/mid-intervention) and

transitivity/equivalence (taught between mid/post-interventions). Thirty-six TD preschoolers between the ages of 3-4 took part in the study. Phase two of this study examined PEAK-E skills that were taught to fluency levels though MET, and explored if the skills would generalize into the natural environment with novel classroom materials.

Research Questions and Hypotheses

Study one has three main questions:

1. Does training in PEAK SE and DRR targets lead to increases in cognitive (specifically school readiness) and language outcome assessment scores? We hypothise that training in DRR and SE will produce gains in language and cognitive outcome assessment scores, in comparison to the TAU group.

2. Can non-ABA trained staff, with minimal training in PEAK protocol, implement PEAK with fidelity? We hypothise that non-BA trained staff can be trained using behavioural skills training (BST) to implement PEAK with high fidelity.

3. Do staff find PEAK social valid? We hypothise that staff will deem PEAK interventions as social valid.

Study two has three main questions:

1. Does training in PEAK SE targets lead to increases in preschool readiness outcome assessment scores? We hypothise that training in SE will produce gains in school readiness outcome assessment scores, in comparison to the TAU group.

2. Does training in PEAK-E targets lead to increases in preschool readiness outcome assessment scores at three different time points; i.e. Time 1(baseline, prior to the intervention), Time 2 (midpoint-intervention, after reflexivity and symmetry), and Time 3 (post-intervention, after transitivity/equivalence). Although it is hypothesised that school readiness may be affected at the midpoint, significant gains will not be observed until post-intervention.

3. Does training in PEAK-E targets lead to generalisation of those targets into the natural preschool environment at a higher level than the TAU group. We hypothesised that the treatment PEAK-E would have higher scores on tests of generalisation, in comparison to the TAU group.

Chapter 2

The Impact of Teaching PEAK Equivalence Module and PEAK Transformation

Module to Preschool Children

Introduction

Relational Frame Theory (RFT) research has proposed that DRR accounts for the generative nature of human language and cognition (Moran, Walsh, Stewart, McElwee & Ming, 2015) and that this is achieved through a history of multiple exemplar training (Corbett, Hayes, Stewart & McElwee, 2017). Promoting language generativity for young children is targeted first by training non-arbitrary relations (based on responding to physical properties such as matching and comparisons), followed by training arbitrary relational responding (ARR). As previously explained, ARR refers to relating stimuli that are not based on physical properties but, rather, based on contextual cues (Ming & Stewart, 2017). Within RFT research, responding to relations that come under the frame of co-ordination (stimulus equivalence) is considered to be the most fundamental type of relational responding, and is considered a pre-requisite for more complex relational framing involving AARR and DRR (Ming & Stewart, 2017; Rehfeldt et al., 2009).

Research on RFT has shown a relationship between training on relational responding and gains in both educational attainment and intellectual ability for children both typically developing and with educational difficulties (Cassidy et al., 2011; Cassidy et al., 2010; Steele & Hayes, 1991; Stewart et al., 2013). As a result of these research findings, which suggest that relational training can positively impact educational outcomes, there has been a demand for operationalised manuals to disseminate new RFT-based intervention technologies to front line staff (Fienup et al., 2015). In response to this demand, researchers at Southern Illinois University have developed the PEAK manuals, with a view to advancing the knowledge-base of staff in applied settings, on delivering evidence-based relational training interventions. These manuals are novel, in that they embed SE and DRR with effective behavioural technologies (such as discreet trial training) to increase academic and verbal skills (Dixon et al., 2017a, Reed & Luiselli, 2016).

PEAK-E includes four primary types of SE relations (symmetry, reflexivity, transitivity, and equivalence). Programmes are scaffolded, from simple non-arbitrary symmetrical relations, to more complex arbitrary relations. The goal of this module is to teach the learner how to relate through training in different methodologies that encourage generalization skills, which lead to increases in the learner's repertoire, without the necessity of directly training every response (Dixon, 2015). PEAK-T modules train relational responding by arranging programmes, from basic non-arbitrary task, to simple arbitrary relational skills, and, finally, to complex transformation involving arbitrary stimuli relations using targeted relational arrangements of (but not limited too) co-ordination, opposite, difference, and comparison (Belisle, et al., 2016a).

Studies have shown that PEAK correlates with IQ and language measures, including the Illinois Early Learning Standards Test, PPVT-4, and the VB-MAPP (Dixon, Belisle, Stanley et al., 2014, Reed & Luiselli, 2016). To date, research has studied multiple facets of the PEAK curriculum programme, including but not limited to: (i) single-subject experiments that documented the effectiveness of PEAK in establishing advanced verbal operant, (ii) the efficacy of PEAK with different clinical populations, and (iii) establishment of age-appropriate norms to identify specific skill deficits for PEAK assessments (Dixon et al., 2017a). Research has yet to examine the impact of PEAK training on the outcomes of school readiness or theory of mind. In addition, no studies have compared the PEAK modules to one another or to a TAU control group, in terms of efficacy.

Study 1, therefore, had three main aims: firstly, the study sought to compare the intervention effects of PEAK-E and PEAK-T (which incorporate SE and DRR targets) to a TAU group, on the outcomes of language skills (measured by the PPVT-4), school readiness (measured by the BSRA-3), and deictic relations (measured by the ToMI battery). Secondly, this study sought to ascertain if non-ABA trained staff (with minimal BST training) could

implement PEAK with fidelity. Finally, this study aimed to assess the social validity of the intervention, as rated by teaching staff.

       This study utilised a three-armed quasi-randomized intervention study with 39 typically developing preschool students. This is the first quasi-randomized control study, to date, to present PEAK-E and PEAK-T targets to typically developing preschool children, to evaluate the impact of teaching PEAK on language and cognitive measures. The independent variables were PEAK-E and PEAK-T, and the dependent variables were scores on the assessment measures PPVT-4, BSRA-3, and ToMI. It was hypothesised that training in SE and DRR would produce gains in cognitive and language outcome assessment scores, in comparison to a TAU group. This study investigated the social validity of PEAK as a teaching curriculum, as rated by teachers who implemented the programme; it also investigated treatment fidelity and IOA for scoring assessments. It was hypothesised that non-ABA trained staff could be trained, using a behavioural skills training (BST) approach, to implement PEAK with high fidelity.

Methods

Participants

Typically developing children, $n = 40$, 22 boys and 18 girls, aged between 3.5 and 5 years ($M = 4.25$, $SD = 1.06$) were recruited to participate in the current study from a Preschool that utilises the Montessori Method instruction. Participants were required to be fluent in English and currently enrolled in the preschool setting. As discussed above, participants were randomised into intervention (PEAK-E $n = 14$, PEAK-T $n = 13$) and control (treatment as usual $n = 13$) groups, based on pre-intervention PPVT-4 scores. An equal number of high, medium, low scores on the PPVT-4 were assigned to each group. One male participant elected not to continue participation and was removed from the study. This resulted in 21 boys and 18 girls completing the study (39 children in total) and resulted in the PEAK-E group number reducing to $n = 13$. As part of this study, two teaching staff ($n = 2$; aged 36 with 5 years' experience and aged 20 with 2 years' experience) participated in BST training, delivered assessments and interventions, and recorded intervention fidelity data, IOA data for scoring, and social validity data.

Ethics

Ethical Approval was sought and granted by the Department of Psychology, Maynooth University Research Ethics Committee in October 2015. The ethical guidelines described earlier pertain to studies 1 and 2. Information and consent /assent forms discussed relevant details of the study, participant requirements, time commitments, procedures for confidentially, data collection, data protection, the right to withdraw, and video consent. Parents were given documentation at the start of the study, which were placed and spread via the students' school bags. The documentation included an information sheet and a consent form. Parents who agreed to their children taking part in the study signed and returned the forms.

Parents were reminded of their right to withdraw their child from participating at the midpoint and were asked to sign a deceleration form if they wished to do so (See Appendix A for information on forms.) Verbal assent was sought from each child before commencing each session. The researchers would ask the child "Would you like to work with learning 'Task' (name what programme was about) or would you like to continue working here with your 'Montessori work'?" Participants were free to respond by opting to continue their work or to work with the researcher. If the participants said "No", they were re-presented with the request at a later stage during the day. It was decided that if a child said "No" more than three times, they would be removed from the study. The researchers looked for signs such as demeanour and facial and verbal expressions of distress. The sessions were terminated when these signs became evident or the participants showed any signs of distress. Participants' responses were reinforced during trial blocks, for correct responding and for staying on task (effort), in the form of social praise, short frequent breaks, access to toys, and small portions of edibles. Participants were given a small edible after testing blocks.

Settings

Participants ($n = 39$ students and $n = 2$ teachers) were recruited from the morning session of a preschool that utilises the Montessori Method of instruction, in Ireland. The preschool consists of three teaching classrooms, two hallways, and a small sensory room. Staff training, assessments, and PEAK programmes were conducted in a quiet space, removed from the environment of the classrooms. Research stations were set up in the hallway of Preschool Room 1 and in a separate room next to Preschool Room 2. The hallway next to Preschool Room 1 is not accessible to children during class hours. It is a quiet place away from activity and was considered appropriate for training PEAK. Participants from each room were taken to the station allocated to their class. All participants interacted with the researcher and the teachers on an individual basis.

Materials

Student participants ($n = 39$) received a total of three pre- and post-intervention assessments. These included the PPVT-4, the BSRA-3, and the ToMI. Intervention material consisted of target programmes taken from PEAK-E and PEAK-T manuals. Staff participants ($n = 2$) received one session of BST on how to deliver PEAK, were trained in recording intervention fidelity data, IOA data, and were given a bespoke seven item Likert scale evaluation questionnaire to assess the social validity of PEAK. See below for further details of these materials.

The Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4; Dunn & Dunn, 2007). The Peabody Picture Vocabulary Test measures the receptive vocabulary of children and adults. The multiple-choice trials consist of four pictures on a page. The participant points at the requested picture. As picture stimuli are provided, no verbal or reading skills are needed. The test can be administered to ages 2.6 to 90 years old. The PPVT-4 is available in two parallel forms: Form A and Form B. The PPVT-4 has a split half reliability coefficient of .94 and .93 for test retest reliability. The PPVT-4 also demonstrates an alternate form reliability of .84. Form A was used for the pre-intervention tests, while Form B was designated for post-intervention tests. The use of both forms was to control for test/retest reliability. The PPVT-4 has been shown to correlate with the Comprehensive Assessment of Spoken Lanugage (CASL; Carrow-Woolfolk, 1999).

The Bracken School Readiness Assessment, Third Edition (BSRA-3, 2007). The Bracken School Readiness Assessment assesses the knowledge that is expected of children in a US setting for pre-kindergarten (pre-school age). It draws its content from the American common curriculum standards written up by each individual state. The assessment trials consist of multiple-choice pictures on a page. The participant may point to the answer and, as such, is suitable for children with limited expressive verbal skills. The BSRA-3 looks at 85

concepts that are broken down into 5 subtests of colours, letters, numbers/counting, sizes/comparisons, and shapes, providing an synopsis of a child's overall aptitudes. The school readiness composite score (SRC) of .76 - .92 indicates good test retest reliability with a split half reliability coefficient of r=.95. Additionally the BSRA-3 correlates (between test .61 -.66) to the Preschool Language Scales - Fourth Edition (PLS-4; Zimmerman, Steiner & Pond, 2002).

   The Theory of Mind Task Battery (ToMI): (Hutchins, Prelok, Bonazinga, 2008). This is a direct assessment of an individual's Theory of Mind. It consists of 15 test questions within 9 tasks or vignettes, arranged in ascending difficulty. The Theory of Mind Task Battery was examined using Cronbach's alpha and it revealed an internal consistency of .91 and .94, representing excellent inter task agreement (Hutchins, Perlock & Chace., 2008)

   PEAK Equivalence Module. The PEAK Equivalence Module is based on the concepts of stimulus equivalence. This module proposes to teach equivalence skills, of reflexivity, symmetry, transitivity, and equivalence, as previously discussed. Eight programmes were selected, two from each area. See Table 1 for programme targets, goals, and materials.

   PEAK Transformation Module.[1] PEAK Transformation Module is based on the concepts of Relational Frame Theory. This module proposes to teach derived relational responding skills. Eight programmes were selected, two from each relational frame selected. See Table 1 for programme targets, goals, and materials.

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[1]**Caveat about PEAK Transformation Manual.** An important caveat is that, at the time of testing, the PEAK Transformation manual has not yet been officially published. Therefore, eight sample programmes were made available by Dr Mark Dixon (creator of PEAK) for use in the current study. As the result of the manual still being under development at the time of testing, the instruction on how to deliver the programmes and record data was relatively ambiguous. Therefore, the research team, in collaboration with Dr Dixon and his colleagues, decided to employ the instructions outlined in the PEAK Equivalence.

Staff Behavioural Skills Training (BST) materials. Staff were asked to read the PEAK-E and PEAK-T instructional manuals. They watched the researcher demonstrate how to run PEAK-E and PEAK-T trials (which utilised the same ABA instructional technique), with stimuli from PEAK-E.

Staff intervention fidelity measure. Implementation fidelity for PEAK-E and PEAK-T trials was measured by means of a bespoke version of the PEAK Implementation Checklist (Belisle, et al., 2016). PEAK-IC was created from the PEAK-D training manual's instruction for running training/test trials with accuracy; however, they are germane to all the manuals (Appendix E).

Staff Inter-Observer Agreement (IOA) data recording. Material used for IOA consisted of additional copies of PPVT-4 BSRA-3 and ToMI assessments sheets and PEAK-E and PEAK-T train/test data recording sheets.

Social Validity (Likert-Scale) questionnaire. A five-point Likert Scale questionnaire (Appendix G) assessed seven Likert items pertaining to teacher evaluation of skills, effective results, ease of incorporation, accuracy of implementation, time, and ease and desire to use PEAK, ranging from Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree, with a quantitative range from a minimum of 7 to a maximum of 35. There was one questionnaire for each programme in the Equivalence and Transformation modules (16 programmes, in total).

Table 1

Module areas, programme targets, and material needed.

EQ Area	PEAK Targets	Goal	Stimulus A	Stimulus B	Stimulus C	Stimulus D
Reflexivity	1A Picture to Picture	Match the sample identical picture to the original picture	10 picture cards	10 identical cards to A		
	1B Textual Match	Match the sample identical written word with the original written word	10 written word cards	10 identical cards to A		
Symmetry	5C Textual Number Identification	Match a picture of a number of items with the written number	10 number cards 1 - 10	10 quantity cards to match A		
	5E Shape Names	Identify shape names when presented with the shape picture	10 shape cards	10 "words" of shapes to match A		
Transitivity	9P Actions and Outcomes	Match an action to a second non-trained action	10 action picture cards	10 outcome pictures to correspond with A	10 outcome picture to correspond with B	
	10A Addition	Match addition problem with the total number	10 textual addition problems	10 picture addition problems to match A	10 number cards to match B	
Equivalence	10L Features Rule	Match a picture of a number of items with the written number	10 "word" of a feature	10 object feature cards to match A	10 object feature cards to match A	
	11F Letter and Case Sounds	Match upper case and lower case	10 letter sounds	10 capital letters to match A	10 lower case letters to match A	

RFT Area	PEAK Targets	Goal	Stimulus A	Stimulus B	Stimulus C	Stimulus D
Spatial	2A The Cue of Closer	When given the cue "closer", select the closest item	10 objects	10 identical objects to A		
	2B The Cue of Further	When given the cue "further", select the farthest item	10 objects	10 identical objects to A		
Temporal	4C The Cue of Before	When shown an object sequence, identify the object that was shown first	10 objects	10 different objects to A		
	4D The Cue of After	When shown an object sequence, identify the object that was shown last	10 objects	10 different objects to A		
Comparison	7E The Cue of More	When given the cue "more than", select the greater of the stimuli	10 picture cards/ 3 items	10 picture cards/ 5 items	10 picture cards/ 2 items	10 picture cards/ 7 items
	7F The Cue of Less	When given the cue "less than", select the lesser of the stimuli	10 picture cards/ 3 items	10 picture cards/ 5 items	10 picture cards/ 2 items	10 picture cards/ 7 items
Deictic	12A The Cue of You/I	State who sees different images on each side of a picture, "You or I"	10 picture cards	10 picture cards different A		
	12B The Cue of You/I Reversal	When told to reverse perspectives, state who sees what image	10 picture cards	10 picture cards different A		

Experimental Design

This experimental design is quasi-randomized between within group comparison.

Students were randomised into PEAK-E ($n = 13$), PEAK-T ($n =1 3$), or control ($n = 13$),

based on their screening PPVT-4 scores (hence quasi-random). The independent variables

(IV) were the treatments, i.e., PEAK-E, PEAK-T, and control, while the dependent variables (DV) were the outcome measures of PPVT-4, BSRA-3, and ToMI Battery assessment. The *within participant* DV was the difference between pre- versus post-intervention scores on each of the three outcomes measures (PPVT-4, BSRA-3, ToMI). The *between participant* DV was the difference between the three groups on post-intervention scores on the PPVT-4, the BSRA-3, and ToMI. A Likert scale questionnaire was given to staff upon completion of the study to assess the social validly of PEAL procedures.

Procedures

In this study, $N = 39$ pre-school children were exposed to baseline assessments (PPVT-4, BSRA-3, ToMI), intervention (PEAK-E, PEAK-T, control), and follow-up assessments (PPVT-4, BSRA-3, ToMI). Staff were trained to deliver PEAK, assessments, using BST. Data were also recorded to measure procedural fidelity, IOA, and social validity. Instructors were also trained in fidelity and IOA procedures. See Figure 1 for visual representation of the full procedure.

Staff Training	

• Staff training using Behavioural Skills Training
     o Assessment
     o PEAK procedures	

Pre-Intervention assessment • The Peabody Picture Vocabulary test - Fourth Edition (PPVT4; Dunn & Dunn. 2007) • The Bracken School Readiness Assessment - Third Edition (BSRA-3) • The Theory of Mind Task Battery (ToMI; Hutchins, Prelok, Bonazinga, 2008)	IOA and Fidelity taken on assessments and interventions
Intervention PEAK-E • Phase 1 Probe • Phase 2 Training Trials of the 8 PEAK-E targets • Phase 3 Testing Trials of the 8 PEAK-E targets	

Intervention PEAK-T	
• Phase 1 Probe • Phase 2 Training Trials of the 8 PEAK-T targets • Phase 3 Testing Trials of the 8 PEAK-T targets	
Post-Intervention assessments	
• The Peabody Picture Vocabulary test - Fourth Edition (PPVT4; Dunn & Dunn. 2007) • The Bracken School Readiness Assessment - Third Edition (BSRA-3) • The Theory of Mind Task Battery (ToMI; Hutchins, Prelok, Bonazinga, 2008)	
Social Validity	
• Staff complete Likert scales for validity	

Figure 1. Visual representation of procedures

Staff training

Two teachers were recruited to implement PEAK programmes for Study 1. The teachers received one BST session on how to deliver PEAK programmes, assessments, and IOA measures. The teachers were asked to read the PEAK programme manual and the training procedures' description on DTT presentation and prompt levels and stimulus levels. The teachers, then, observed the experimenter implement all the PEAK programmes and they participated in a roleplay where the teachers took on the role of the instructor and demonstrated the implementation of PEAK procedures. Teachers practiced roleplay with one programme from PEAK-E. Feedback was provided by the experimenter during training and in-situ. Staff delivered PEAK-E and PEAK-T programmes to the specification of the research procedure for no more than twenty minutes per child over a period of three months. Staff were trained on the implementation of the three assessment measures by reading the assessment manual's instructions and then observing the experimenter implement the assessments. The staff then participated in roleplay, giving assessment, followed by feedback. Staff were instructed in IOA and fidelity procedures by observing the

experimenter implement an IOA and a fidelity procedure and, then, by participating in roleplay, followed by feedback.

Treatment fidelity. To ensure that the treatment was delivered in the way it was planned, the researcher included a fidelity rating scale to be performed on 25% of all programmes delivered. On 25% of trials, the researcher and or a trained instructor sat and observed teachers implementing the PEAK procedure; the researcher also recorded the child's attendance (i.e. attention to task), the teachers' correct use of the ABC format, the teachers' correct use of, and recording of, prompt levels, and whether the teachers presented the material in line with the PEAK Implementation Checklist. Scores were recorded over one trial block of 10 trials (See Appendix E). The number of correctly performed steps were divided by the total number of steps and multiplied by 100 in order to calculate the percentage.

Inter-observer agreement. Inter-observer Agreement (IOA) data was collected for PPVT-4, BSRA-3, ToMI at pre- and post-intervention assessment sessions. In addition, IOA data was also collected for PEAK-E and PEAK-T train/test intervention trials. In all instances, IOA data was collected on 25% of trials. In both assessment and intervention sessions, a second person, such as the researcher or a trained assessor, sat behind the participant and collected data from the participant. The second person was out of line of sight of the instructor's data sheet and recorded the responses of the participant independently. Trial-by-trial IOA was calculated by dividing the number of all trial agreements by the total number of trials and then multiplying by 100 to determine a percentage.

Baseline assessments. Participants (n = 39 children) were administered the pre-intervention PPVT-4 assessment and were quazi-randomised, according to high, medium, and low scores, into three equal groups (one control and two treatment conditions). Once the treatment groups were established, participants were administered baseline assessments of

BSRA-3 followed by the ToMI. As soon as a participant completed one assessment, they moved straight to the next assessment within the same research session. Cooperation was rewarded with noncommittal praise such as "good pointing", "good looking", etc. A small edible was given upon completion of the task; participants were not differentially rewarded for correct versus incorrect responses on measures, however.

Intervention: PEAK-E and PEAK-T instruction strategies. The PEAK instruction manuals utilise MET and present a structured ABA procedural format for presentation of stimulus and format for trials. The manual provides a DTT flow chart for both train/test blocks. This, along with instructions for prompting levels and the level strategies flow chart (Figure 3), make up the teaching and data recording process

PEAK-E and PEAK-T training commenced with each group simultaneously. Participants were exposed to eight target programmes (See Table 1 for list of PEAK-E target programmes and PEAK-T target programmes). Participant were given a probe trial at the start of each programme in order to record if the skill set was within the students' repertoire. Training and test trails continued until participants reached mastery criteria. Mastery criteria was set at 90% train, and 90% x 2 or 100% for test. Training for each PEAK goal began with the presentation of the Sd, and the participant was given three seconds to respond. A reinforcing consequence was presented for correct response (social praise on an F1 schedule and a jelly sweet on an F10 schedule at the end of the trial block). If an incorrect response or no response was emitted, the instructor used a series of least to most prompting to evoke a correct response. The prompt level was then recorded as the PEAK score for the trial. Training and testing blocks consisted of 10 trials each.[2] When scoring PEAK data (Figure 2),

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[2] *Discrepancies and adjustments to the Level Strategies and Exemplar Classes.* At the outset, a discrepancy was found in the PEAK Equivalence manual between the trial stimuli on the programme sheets and the trial stimuli on the data sheet. The programme sheet required eight exemplar trials; however, the data sheet required 10. To rectify this, 10 stimuli were presented to match the data sheets. This decision took into account that the participants in the study were from a normalized population.

staff recorded prompt level data ranging from scores of 10 to 0. Prompt scores during training

sessions included 10 (indicating independent response), 8 (representing a single prompt and a

full array), 4 (representing two prompts or a reduced array), 2 (representing multiple prompt

attempts or a single stimulus in the array), and 0 (indicating no response with multiple

prompts). Data recorded for testing sessions were either 0 or 10, indicating correct/incorrect

responding. Sample raw data scores for participants can be seen in Appendix B. When one

programme was mastered, students continued on to the next highest alphanumerical

programme, until all programmes had been mastered.

Relation: _____

Train
Test

Trial	Sample	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:				

Figure 2: Showing PEAK-E data recording block, numbers representing prompt levels.

In addition to prompt levels, four PEAK levels strategies were utilised, including standard approach, reduced class presentations, multiple exemplar training, and isolated class review. See Figure 3 for a description of each level used during the study.

Level 1 Standard Approach	Train steps until they become mastered
Level 2 Reduced Class Presentation	Reduce the class amount by limiting the number of stimuli presented in train/test blocks until the student shows increased derived relations
Level 3 Multiple Exemplar Training	Introduce new untrained or tested stimuli until derived relations are present when original stimulus is reintroduced
Level 4 Isolated Class Review	Runs train and test trials side by side with one stimulus

Figure 3. Shows the order of implementation of level strategies.

Level strategies were increased to ten stimuli for level one, five stimuli in level two, and two stimuli in level three. If the students were unable to master criteria at level three, the programme was terminated. The decision to terminate the programme after level 3 was made by the researcher due to time constraints involved with directly training every response. Figure 4 shows an example of how the levels and the mastery criteria were combined together in the study.
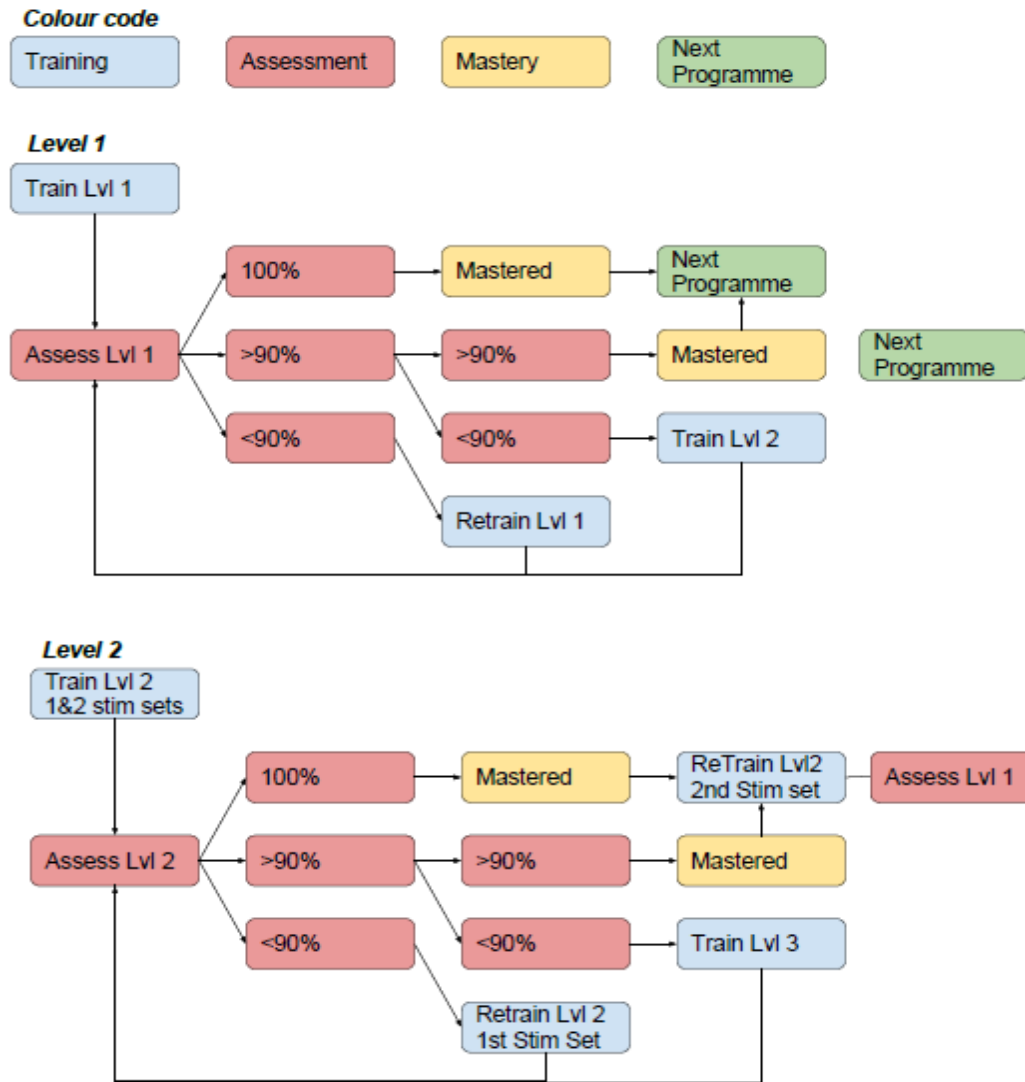
Figure 4: Flow chart shows mastery criteria of train test trials, and subsequent movement, either to next alphanumerical programme, or, if not mastered, movement to next level (reduced stimulus array) of the same programme. This flow chart was made for the study and is not a part of the PEAK Relational Training System programme.

Intervention: PEAK-E procedures. The PEAK-E programmes focuses on the four areas of stimulus equivalence: reflexivity, symmetry, transitivity, and equivalence. Each child ($n = 13$) was exposed to exactly the same eight programmes, two programmes from each of the four areas of reflexivity (programme *1A Picture to Picture,* and programme *1B Textual Matching*), symmetry (programme *5C Textual Number Identification,* and programme *5E Shape Names*), transitivity (programme, *9P Actions & Outcomes,* and programme *10A Addition*), and equivalence (programme, *10L Feature Rules,* and programme *11F Letter Case*

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& Sound). Each session took approximately 20 minutes. This could vary depending on how long it took students to move through training and testing trials, as some children needed more opportunities to master derived relations than others. An outline of one complete programme (*Reflexivity: 1A- Picture to Picture*) and all that it entails is provided below (Please see Appendix C for a complete written out description of the other 7 programmes train/test procedures). See Table 1 for a list of all materials used in PEAK-E programmes; Figure 5 shows a sample of stimuli used in *Symmetry: 5C- Textual Number Identification* programme.

     PEAK-E target programme Reflexivity: 1A - Picture to Picture. The goal of the programme was to train children (*n*=13) in how to match a sample picture (stimulus A) with an identical picture (stimulus B) (A-B), by presenting a sample picture (A) and an array of pictures (B); please note, that (A-B) is PEAK-E notation for reflexivity programmes. Then, the child was tested to see if they could match the identical sample picture (stimulus B) to the original picture (stimulus A) (B-A). Ten sets of matching pictures were used as stimuli (e.g. Toy car, elephants, dolls house, dress etc.) During the training phase, for example, a sample picture, "Toy Car", was placed in front of the participant, along with an array of 3 pictures, with one being the same as "Toy Car". The instruction was given "Put with the same". If the participant did not respond[3], the instructor picked up the sample picture "Toy Car" and placed it on the top of the array picture, "Toy Car", while repeating the Sd, "Put with the same". Then, placing the picture of "Toy Car" back in front of the participant, the Sd was repeated again. When the participant correctly matched the picture, "Toy Car", to the array picture of "Toy Car", they were rewarded with verbal praise and a jelly sweet. The instructor rated the response on a 0–10 score card, which measured the prompt level necessary to occasion the matching. Training continued until the participant finished all 10 trials (with 10

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[3] This example of prompt level flow was the same for all programmes. As such, it is not reported henceforth.

different stimuli) and met mastery criteria. Testing involved the same procedure; however, no prompts and no reinforcements were used. The participant matches "Toy Car" to the picture of "Toy Car". The participant received a 0 for no response or a 10 for correct response on first attempt with no prompt. Testing continues until the participant finishes all 10 trials (with 10 different stimuli).
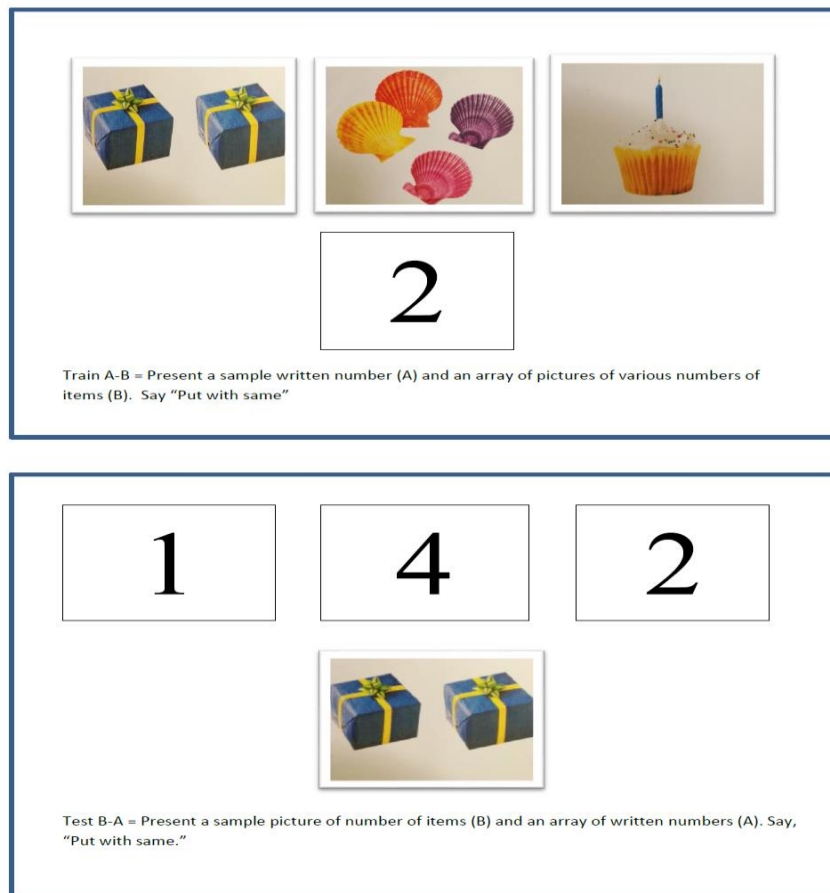
Figure 5. Example of stimuli PEAK-E programme, *Symmetry: 5C - Textual Number Identification*

Intervention: PEAK-T procedure. The PEAK-T programmes focuses on four areas of relational framing: spatial, temporal, comparison, and perspective taking. Each child (*n*=13) was exposed to exactly the same eight programmes, two programmes from each of the four areas. Spatial (programme *2A Cue of Closer*, and programme *2B Cue of Further*), temporal (programme *4C Cue of Before,* and programme *4D Cue of After*), comparison

(programme *7E Cue of More Than,* and programme *7F Cue of Less Than*), and perspective

taking (programme *12A Cue of You and I,* and programme *12B Cue of You and I Reversal*).

Each session lasted approximately 20 minutes and varied depending on how long it took

students to move through training and testing trials, as some children needed more

opportunities to master derived relations than others. An outline of one complete programme

(***Spatial: 2A - The cue of "Closer"***) and all it entails is provided below (Please see Appendix

C for a complete written out description of the other 7 programmes train/test procedures).

See Table 1 for a lists of all materials used in PEAK-T programmes.

     PEAK-T target programme Spatial: 2A - The cue of "Closer". The goal of this

programme is to train the cue of "Closer" to an array of objects (stimulus A) and (stimulus B)

that vary in distance from the participant. The participant will then be able to select the

closest item to them when tested with novel stimuli. A set of ten small toy objects were used

as stimuli (e.g. toy grape, orange, car, football, banana etc.). *Training:* An array of objects

(stimulus A) and (stimulus B) are placed in front of the participant, with (stimulus A) being

closest to the participant. The Sd of "Show me which is closer" is provided. If the

participant does not respond, then the instructor prompts by pointing to the item (stimulus A)

that is closest to the participant and saying "Closer". The Sd is repeated and, if the

participant gets the correct response, verbal praise is delivered, along with a small edible.

The instructor rated the response on a 0–10 scorecard, which measured the prompt level

necessary to occasion the matching. The training continued until the participant finished all

10 trials. *Testing*: The participant is presented with an array of novel objects (stimulus A)

and (stimulus B), where (stimulus B) is closest to the participant. The instructor says "Show

me which is closer". The participant receives a 0 for no response or a 10 for correct response

on first attempt with no prompts. Testing continues until the participant finishes all 10 trials.

Control group. The control group (*n* = 13) was exposed to treatment as usual, which was attendance in a preschool that utilises the Montessori Method of instruction. The control group attended and participated in the daily preschool class, which lasted for three hours a day. Daily activities in the preschool included maths, language, culture and science, fine and gross motor work, sensorial work, play, music, and art. For a complete review of the Montessori Method, please see Montessori (1988).

Follow-up assessments. Participants (*n* = 39) were administered the post-intervention PPVT-4 assessment and then the BSRA-3 followed by the ToMI. As soon as a participant completed one assessment, they moved straight to the next assessment within the same research session. Cooperation was rewarded the same as pre-intervention assessment, with noncommittal praise such as "good pointing", "good looking", etc. A small edible was given upon completion of the task; participants were not differentially rewarded for correct versus incorrect responses on measures.

Staff Follow-up Social Validity. Two teachers were asked to fill out a 7-point Likert questionnaire on the social validity of PEAK after all the PEAK-E and T train/test trials had been completed. The teachers were given five working days to fill out the forms and return them to the researcher. Each PEAK programme delivered during treatment received its own evaluation form, which consisted of 7 questions that were scored on a sliding scale from 1 (Strongly Disagree) to 5 (Strongly Agree). The Likert scale covered a range of questions, from the importance of the trained skill and time requirements, to the effectiveness of results. For a complete list of questions, see Appendix G.

Results

Overview of Results: PEAK-E and PEAK-T Intervention,

Three stages of statistical analyses were conducted to explore between-group and within group differences. The between participant DV was the difference between the three groups on the PPVT-4, BSRA-3 and ToMI, and the within participant DV was the difference between pre-versus post intervention scores on the assessments as above. First a visual analysis of assessment scores was conducted followed by three analysis of covariance (ANCOVA) tests to compare the differences between the three groups at post-intervention. Finally, following on from a result of significant differences found between groups on the BRSA-3, a one-way between-groups analysis of variance (ANOVA) with planned comparisons was conducted to compare pre- to post-intervention change scores (in order to determine which groups differed). Subsequently a within participant comparison was conducted utilizing a paired samples t-test to compare the pre-intervention and post-intervention scores on the PPVT-4, BRSA-3 and the ToMI for each of the three groups (PEAK-E, PEAK-T and Control).

Between Participant Comparisons

A visual analysis of pre- and post-intervention scores was conducted. Table 2 shows the scores obtained on pre-intervention and post-intervention assessments across three measures: PPVT-4, BSRA-3 and ToMI Battery. Trials to Mastery are also displayed to indicate total trials on all PEAK programmes needed to reach mastery level. All participants reached mastery level on all programmes in PEAK-E and PEAK-T interventions.

Scores on the **PPVT-3** showed PEAK-E scores decreased ($M = 112.1$, $M = 110.3$), while PEAK-T ($M = 109.6$, $M = 116.5$) and control scores increased ($M = 103.7$, $M = 106.7$). Scores on the **BSRA-3** indicated PEAK-E scores increased ($M = 105.7$, $M = 109.1$), while PEAK-T ($M = 112.5$, $M = 106.3$) and control scores decreased ($M = 103.7$, $M = 100.6$).

Scores on the **ToMI** indicated that all groups' scores increased: PEAK-E (M = 7, M=8.4),

PEAK-T (*M* = 7.9, *M* = 9.7), and control (*M* = 7.7, *M* = 9.0). See Figure 6 for a visual

description of changes in means.

Table 2

Individual participant demographics and performance data on pre-intervention and post-intervention testing clustered by control and treatment groups.

Group	Pre-PPVT	Post-PPVT	Pre-Bracken	Post-Bracken	Pre-ToMi	Post-ToMi	
Control							
1	72	73 *	84	80	4	6 *	
2	123	105	131	117	9	7	
3	106	119 *	88	94 *	4	6 *	
4	83	98	88	74	5	10 *	
5	108	109 *	91	91	11	9	
6	120	112	108	109 *	10	11 *	
7	112	116 *	109	107	8	10 *	
8	91	83	90	88	8	6	
9	104	106 *	127	116	8	12 *	
10	104	118 *	90	103 *	6	8 *	
11	117	132 *	121	115	7	7	
12	75	96	88	85	9	9	
13	134	121	134	129	12	14 *	
Mean	103.76	106.76	103.76	100.61	7.76	9.07	
SD	18.8	16.16	18.74	16.6	2.52	2.36	

Group	Pre-PPVT	Post-PPVT	Pre-Bracken	Post-Bracken	Pre-ToMi	Post-ToMi	Trials to Mastery
Equivalence Treatment Group							
1	91	111 *	93	111 *	5	6 *	360
2	117	85 *	112	125 *	9	9	360
3	109	107	93	94 *	4	6 *	340
4	145	133	133	124	7	8 *	240
5	62	71 *	75	77 *	4	5 *	410
6	117	118 *	104	113 *	8	10 *	460
7	100	114 *	97	117 *	5	7 *	410
8	145	128	114	106	8	13 *	340
9	105	114 *	97	104 *	7	8 *	445
10	124	118	122	127 *	10	9	270
11	122	124 *	104	110 *	10	11 *	260
12	113	105	115	104	10	10	250
13	108	106	107	107	4	8 *	220
Mean	112.15	110.3	105.07	109.15	7	8.4	
SD	21.66	16.84	14.78	13.54	2.38	2.22	

Group	Pre-PPVT	Post-PPVT	Pre-Bracken	Post-Bracken	Pre-ToMi	Post-ToMi	Trials to Mastery
Transformation Treatment Group							
1	143	142	132	111	8	13 *	310
2	116	112	109	112 *	7	6	280
3	106	111 *	106	97	9	11 *	230
4	113	121 *	142	120	7	10 *	240
5	84	114 *	97	94	5	10 *	300
6	117	124 *	118	100	8	9 *	220
7	92	130*	122	105	13	12	250
8	120	118	121	118	9	10 *	290
9	121	110	110	114 *	6	10 *	260
10	109	116 *	95	107 *	10	11 *	210
11	76	79 *	83	81	6	6	330
12	124	110	101	98	6	8 *	240
13	104	128 *	127	125	9	11 *	230
Mean	109.61	116.53	112.53	106.3	7.92	9.76	
SD	17.81	14.69	16.49	12.16	2.13	2.08	

* Indicates an increase from pre- to post- assesments scores. Trials to Mastery for the PEAK programs are displayed for treatment group participants. Mean and Standard Deviation are displayed for all assessments. A 15 point increase represents a standard deviation for both PPVT-4 and BSRA-3 measurements.
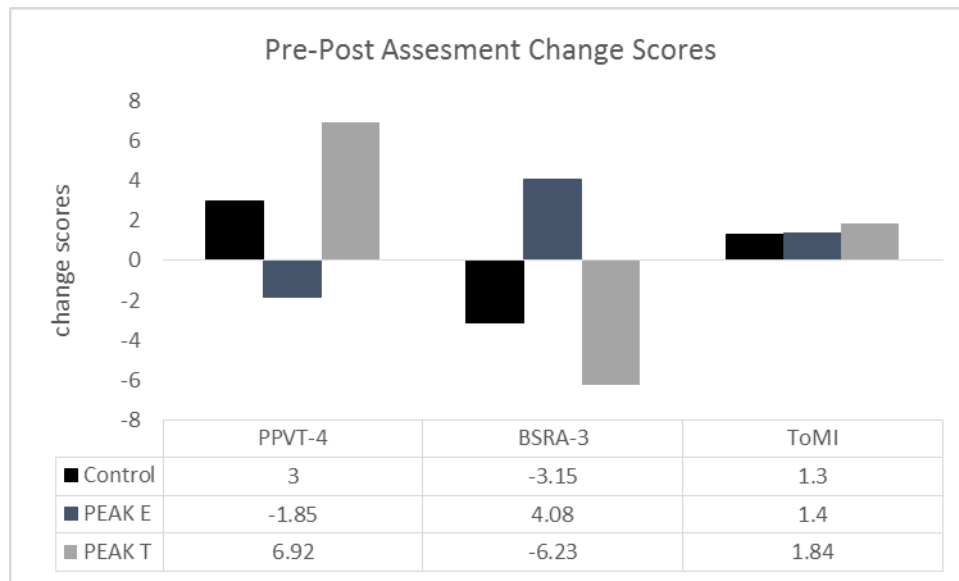
Figure 6: Shows differences in mean scores between treatments clustered by assessment. Increases in pre-intervention/post-intervention change scores can be seen in bars above the axis, and decreases in pre-intervention/post-intervention change scores can be seen below the axis.

Three individual one-way ANCOVAs were conducted to compare the post-intervention scores between the three groups (Table 3). The IV was Group (PEAK-E, PEAK-T and Control group) while the DV was Score (mean post-intervention scores on the assessment measures, PPVT-4, the BSRA-3 and ToMI). Participants' baseline scores were used as the covariance in this analysis to control for variance in effects due to baseline abilities. Preliminary checks were conducted to ensure that there was no violation of the assumptions of normality, linearity, homogeneity of variance, homogeneity of regression slopes, and reliable measurement of the covariate.

After controlling for pre-intervention scores, there was no significant difference between the three groups on post-intervention scores on the **PPVT-4** assessment measure, $F (2, 35) = 1.7$, $p = .19$, partial eta squared = .08.

After controlling for pre-intervention scores, there was a significant difference between the three groups on post-intervention scores on the **BSRA-3** assessment measure, $F (2, 35) = 4.4$, $p = .019$, partial eta squared = .20. Following on from this finding, a follow-up

one-way between-groups ANOVA with planned comparisons was conducted using change scores as the dependent measure (see below).

After controlling for pre-intervention scores, there was no significant difference between the three groups on post-intervention scores on the **ToMI Battery** assessment measure, $F (2, 35) = .84$, $p = .43$, partial eta squared = .04.

Table 3.
Shows three one-way between groups analysis by assessment measures.

Assessment	Source	Sum of Squares	df	Mean Square	F	p	Eta
Dependent Variable: PPVT							
	Contrast	440	2	220.4	1.7	0.19	0.08
	Error	4501.53	35	128.6			
Dependent Variable: Bracken							
	Contrast	604.3	2	302.1	4.42	0.019	0.202
	Error	2391.3	35	68.3			
Dependent Variable: ToMi							
	Contrast	5.27	2	2.63	0.84	0.43	0.04
	Error	109.6	35	3.13			

Significant difference in scores across time reported in the Bracken School Readiness Assessment with p < .05

Following on from the finding that there was a statistically significant difference between the three groups' post-intervention BSRA-3 scores, a one-way between-groups ANOVA with planned comparisons was conducted using change scores as the dependent measure. There was a statistically significant difference in BSRA-3 scores between the three groups: $F (2, 36) = 6.4$, $p = .004$. Results of the planned comparisons showed a significant difference between the Control and PEAK-E groups' BSRA-3 change scores, $F (1, 36) = 5.6$, $p = .023$; and a significant difference between PEAK-E and PEAK-T groups' BSRA-3 change scores, $F (1, 36) = 12.28$, $p < .001$, but no significant difference between the Control and PEAK-T groups' BSRA-3 change scores, $F (1, 36) = 1.26$, $p = .269$ (see Table 4).

Table 4
Shows results of planned comparison of the BRSA-3

Treatment	Sourse	Sum of Squares	df	M	*F*	p
1. Control / Transformation						
	Contrast	-3.8	1	-4.07	1.26	0.269
	Error	3.4	36			
2. Control / Equivalence						
	Contrast	8.1	1	4.07	5.6	0.023
	Error	3.4	36			
3. Equivalence / Transformation						
	Contrast	-12	1	-7.92	12.28	0.001
	Error	3.4	36			

Significant difference reported in Bracken Measure with p < .05 in both contrast 2 and 3

Within Participant Comparisons

Paired samples t-tests were conducted to compare the pre-intervention and post-intervention scores on the PPVT-4, the BSRA-3 and the ToMI across the three different groups: PEAKE, PEAK-T and control group (Table 5).

For the PEAK-E group, results for the **PPVT-4** indicated no significant difference from pre-intervention ($M = 112.15$, $SD = 21.66$) and post-intervention ($M = 110.31$, $SD = 16.84$) scores, $t(12) = .483$, $p = .638$ (two-tailed). The results for the **BSRA-3** indicated no significant difference from pre- intervention ($M = 105.07$, $SD = 14.79$) and post-intervention ($M = 109.15$, $SD = 13.55$) scores, $t(12) = -1.5$, $p = .157$ (two-tailed). For the **ToMI,** there was a statistically significant increase from pre-intervention to post-intervention scores: pre-intervention ($M = 7.0$, $SD = 2.3$) to post-intervention ($M = 8.4$, $SD = 2.2$), $t(12) = -3.26$, $p = .007$ (two-tailed). The paired difference was -1.46 with a 95% confidence interval ranging from -2.43 to $-.486$, the eta squared statistic (.47) indicating a large effect size.

For the PEAK-T group, results for the **PPVT-4** indicated no significant difference from pre-intervention (*M* = 109.62, *SD* = 17.81) to post-intervention scores (*M* = 116.54, *SD* =14.70) scores, *t* (12) = -1.63, *p* = .13 (two-tailed). Results for the **BSRA -3** indicated no significant difference from pre-intervention (*M*= 112.54, *SD* = 16.49) to post-intervention scores (*M* = 106.30, *SD* = 12.17) scores, *t* (12) = 2.14, *p* = .053 (two-tailed). For the **ToMI,** there was a statistically significant increase from pre-intervention (*M* = 7.92, *SD* = 2.1) to post-intervention (*M* = 9.7, *SD* = 2.0), *t* (12) = −3.20, *p* =.008 (two-tailed). The paired difference was −1.84 with a 95% confidence interval ranging from −3.10 to −.591, the eta squared statistic (.46) indicating a large effect size.

For the control group, results for the **PPVT-4** indicated no significant difference from pre-intervention (*M* = 103.8, *SD* = 18.81) to post-intervention scores (*M* = 106.8, *SD* =16.16) scores, *t* (12) = -.88, *p* = .392 (two-tailed). Results for the **BSRA -3** indicated no significant difference from pre-intervention (M = 103.8, *SD* = 18.74) to post-intervention scores (M = 100.6, SD = 16.6) scores, *t* (12) = 1.5, *p* = .158 (two-tailed). For the **ToMI**, there was no significant difference from pre-intervention (*M* = 7.77, *SD* = 2.52) to post-intervention (*M* = 9.07, *SD* = 2.36), *t* (12) = -2.06, *p* = .062 (two-tailed).

Table 5.

Results of paired samples t-test.

Pair	Time	Mean	Paired Difference	N	Std. Deviation	Std. Error Mean	Sig. (2-tailed)
Pair 1	C Pre PPVT	103.76	-3	13	18.8	5.21	0.392
	C Post PPVT	106.76		13	16.16	4.48	
Pair 2	C Pre Bracken	103.76	3.15	13	18.74	5.19	0.158
	C Post Bracken	100.61		13	16.6	4.6	
Pair 3	C Pre ToMi	7.76	-1.3	13	2.52	0.69	0.062
	C Post ToMi	9.07		13	2.36	0.65	
Pair 4	Eq Pre PPVT	112.15	1.84	13	21.66	6	0.638
	Eq Post PPVT	110.3		13	16.84	4.67	
Pair 5	Eq Pre Bracken	105.07	-4.07	13	14.79	4.1	0.157
	Eq Post Bracken	109.15		13	13.54	3.75	
Pair 6	Eq Pre ToMi	7	-1.46	13	2.38	0.66	0.007
	Eq Post ToMi	8.46		13	2.22	0.61	
Pair 7	Tr Pre PPVT	109.61	-6.92	13	17.81	4.94	0.13
	Tr Post PPVT	116.53		13	14.69	4.07	
Pair 8	Tr Pre Bracken	112.53	6.23	13	16.49	4.57	0.053
	Tr Post Bracken	106.3		13	12.16	3.37	
Pair 9	Tr Pre ToMi	7.92	-1.84	13	2.13	0.59	0.008
	Tr Post ToMi	9.76		13	2.08	0.57	

Two significant results were obtained between pre and post Theory of Mind scores for both the Equivalence and Transformation treatment groups. Pair 6 and 9

Overview of Results: Procedural fidelity, Inter-observer Agreement

Procedural fidelity. Fidelity for PEAK-E was obtained for 25% of trials with 97.6% of overall procedural fidelity indicating that programmes were run within the parameters of PEAK instructions. Fidelity for PEAK-T was obtained at 25.51% with 95.5% of overall procedural fidelity indicating that programmes were run within the parameters of PEAK instructions.

Inter-observer agreement. For the PPVT-4, pre-intervention assessment scores IOA were obtained at 35.90% of trials with 99.37% of agreement. Post-intervention assessment

IOA scores were obtained at 33.3% of trials with 99.09% of agreement. IOA meet criteria indicating that the data for the PPVT-4 is reliable. For the BSRA-3, pre-intervention-assessment scores of IOA were obtained at 38.46% of trials with 99.56% of agreement. Post-intervention assessment IOA scores were obtained of 48.72% of trials with 99.3% of agreement. IOA meet criteria indicating that the data for the BSRA-3 is reliable. For the ToMI, pre-intervention assessment scores of IOA were obtained at 35.90% of trials with 98.54 % of agreement. Post-intervention assessment IOA scores were obtained at 46.15 % of trials with 97.54 % of agreement. IOA meet criteria indicating that the data for the ToMI is reliable. For the PEAK-Equivalence Module, train/test IOA data was 26.8 % with a 94.3% agreement, indicating reliability. For PEAK Transformation Module, train/test IOA data was 25% with a 98% agreement, indicating reliability.

Overview of Results: Social Validly

      Social validity results. PEAK-E evaluation scores ranged from a minimum score of 7 to a maximum score of 35 per questionnaire item. Higher scores represented a higher level of satisfaction with PEAK-E. Figure 7 shows teachers' scores clustered by programme. Teacher 1 preferred four programmes across the eight. Mean score across the seven questions was $M = 30.75$, ($SD = 1.28$), while for Teacher 2 mean score across the seven questions was $M = 31.12$, ($SD = 1.45$). This suggests that the teachers who implemented PEAK-E both found it to be an effective treatment that they understood, found easy to use, and would implement in their classrooms. Teacher 1 rated three of the seven programmes (1A Picture to Picture Match; 5C Textual Number Identification; 10 L Feature Identification) higher on the Likert Scale questionnaire than Teacher 2 (5E Shape Name identification; 10A Addition; 11F Letter Case and Sound). They both rated programme 1B Textual Match the same.

PEAK-T scores ranged from a minimum score of 7 to a maximum score of 35 per questionnaire item, with higher scores representative of a higher level of satisfaction with PEAK-T. Figure 8 shows teachers' scores clustered by programme. Teachers 1's mean score across the seven questions was $M = 32.5$, ($SD = 0.92$). Teacher 2's mean score across the 7 questions was $M = 32$, ($SD = 1.41$). This suggests that the teachers who implemented PEAK found it to be an effective treatment that they understood, found easy to use, and would implement in their classrooms. Teacher 1 rated three of the seven programmes (2B Cue of Further; 4D Cue of After; 12ACue of You/I) higher on the Likert Scale questionnaire than Teacher 2. They both rated the other five programmes the same.

Graph indicates PEAK programs Likert Scores. Black represents Teacher 1 scores. Grey bar represents teacher 2 scores. Higher Scores represent higher levels of satisfaction with PEAK. Total scores (M= 30.93, SD = 1.34). Scores ranged from 5 - 35. Teacher 1 score (M=30.75, SD = 1.28). Teacher 2 score (M=31.12, SD=1.45).

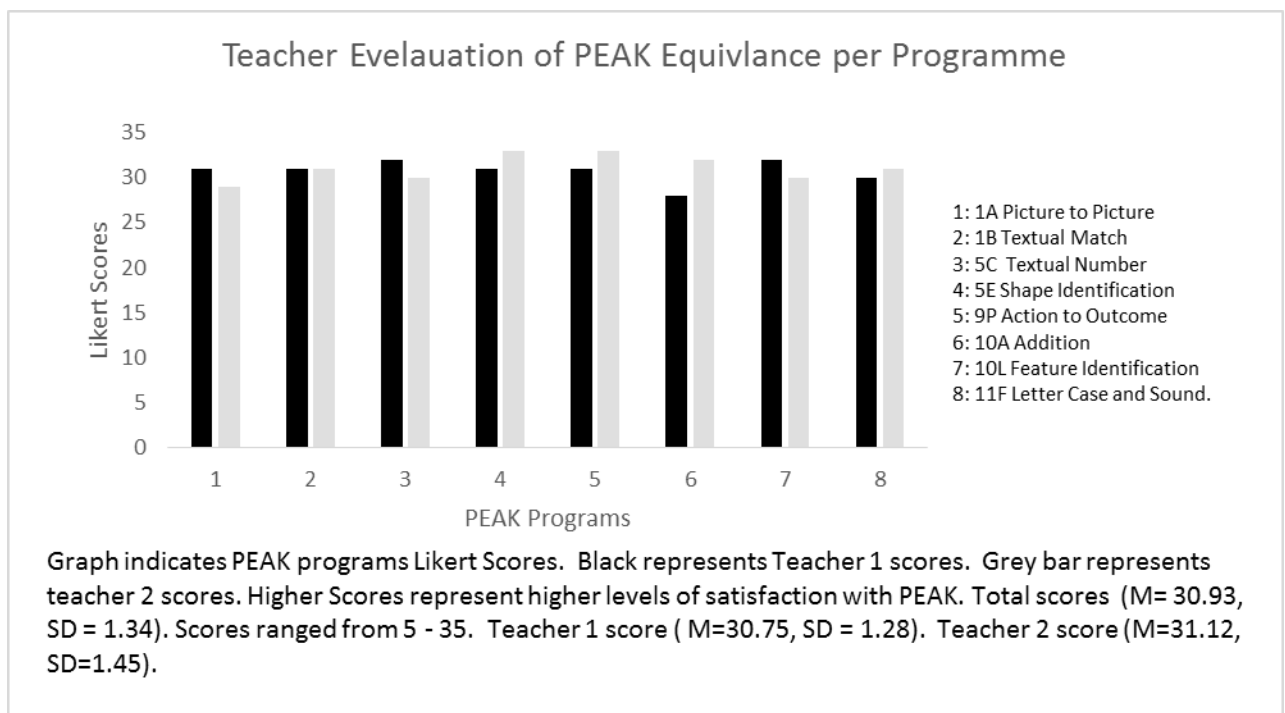*Figure 7.* Shows teachers' scores clustered by programme. Higher scores represent higher satisfaction with PEAK-E programmes.
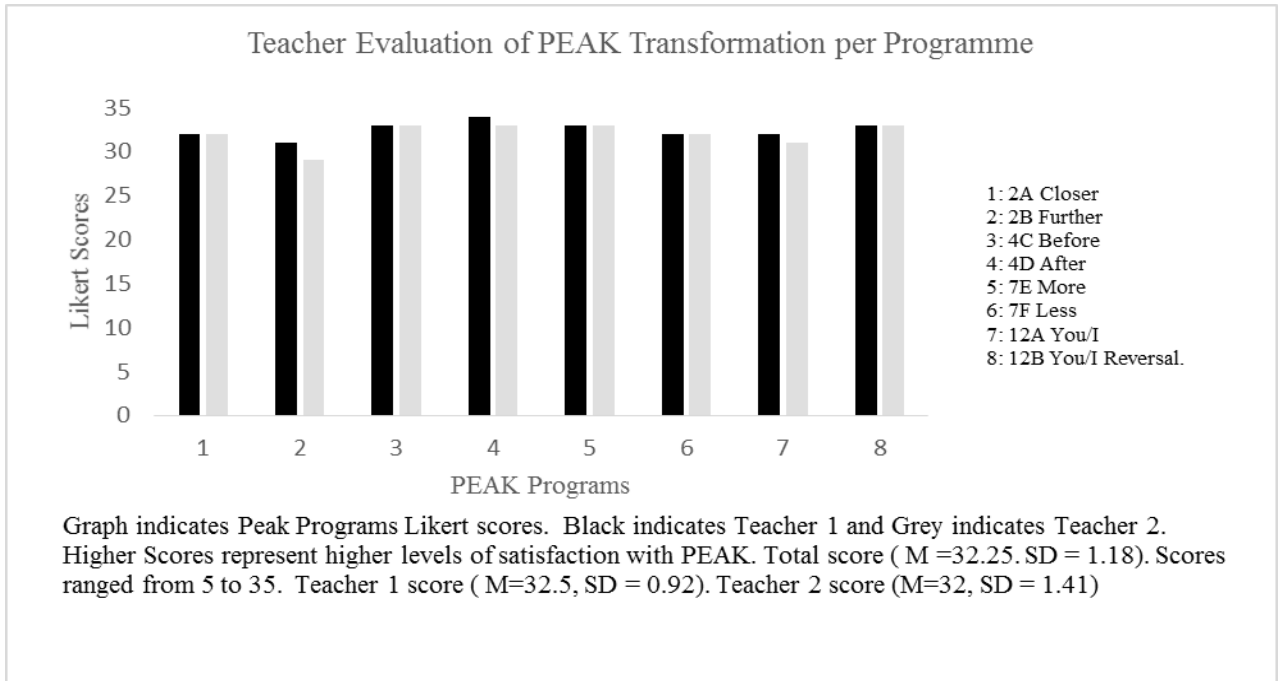
Figure 8. Shows teachers' scores clustered by programme. Higher scores represent higher satisfaction with the PEAK-T programme.
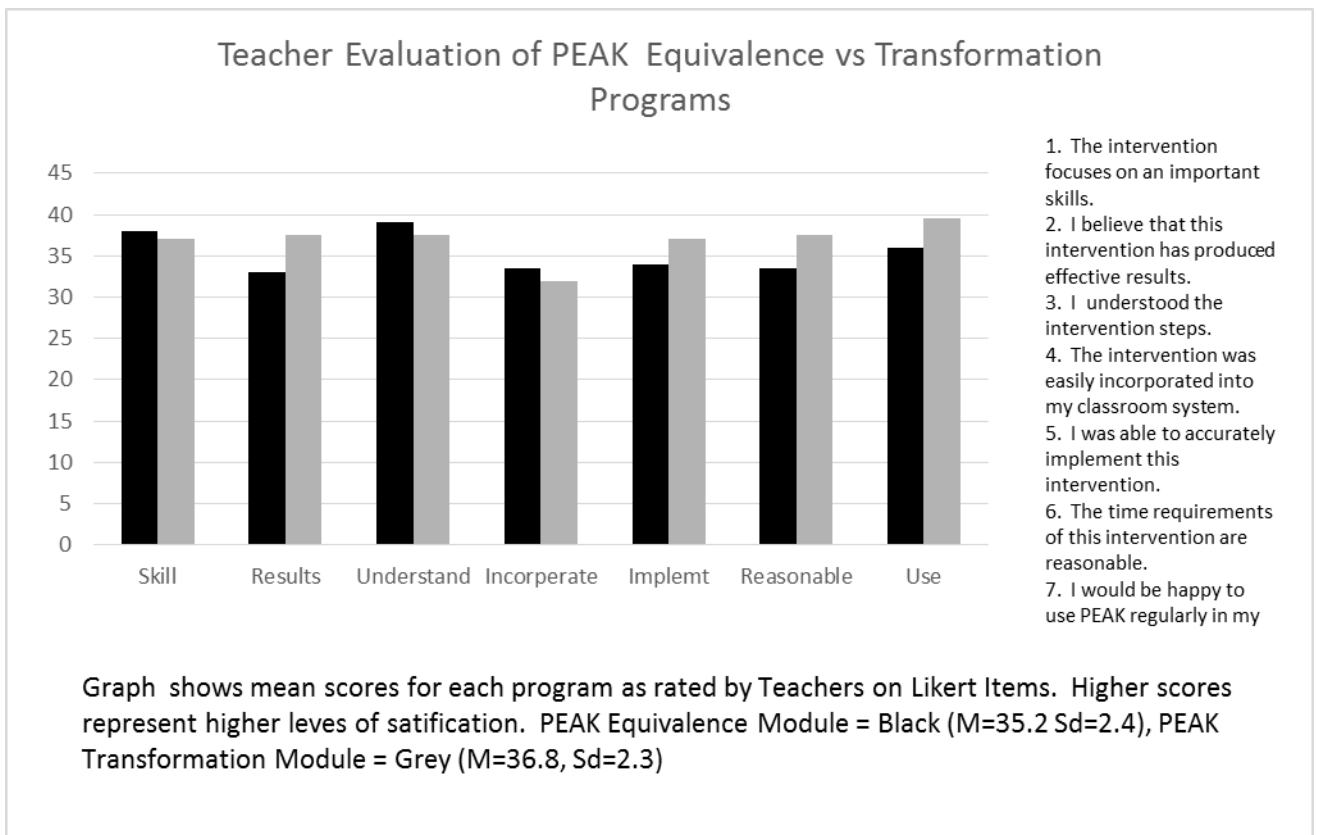

Figure 9. Shows that teachers rated PEAK-E higher in three of the seven questions and they rated PEAK-T higher in four of the seven questions.

Summary of Results

The between groups analysis indicated that there was a statistical difference between groups on the BSRA-3 measure but not on the PPVT-4 or the ToMI. Further analysis of change scores showed that this statistical difference was found between both the PEAK-E and PEAK-T intervention groups, and between PEAK-E and control groups. Visual analysis of means indicated that PEAK-E group scores increased on the BSRA-3, while PEAK-T and control groups' scores decreased on the measure. A within group analysis was then undertaken to explore difference between pre- versus post-intervention scores on the PPVT, BSRA-3, ToMI. The results indicated that while all groups did increase in ToMI scores only PEAK-E and PEAK-T had statistically significant increases. There were no other significant increases between pre-intervention and post-intervention scores reported.

Results indicated high procedural fidelity in implementation of PEAK programmes, indicating that PEAK programmes were run within the parameters of PEAK instructions. IOA Results for assessment measures (PPVT-4, BSRA-3 and ToMI) and for PEAK interventions met IOA criteria and indicate data is reliable. Social validity questionnaires reported by teachers indicated a high level of satisfaction with PEAK interventions.

Discussion

Overview of Results: PEAK-E, PEAK-T, Reliability, Fidelity and Validity of PEAK-Targets

The current study had two main goals, firstly, to compare the intervention effects of PEAK treatments to a TAU control group and, secondly, to evaluate the impact of PEAK-E and PEAK-T on outcomes of language, school readiness, and deictic relations, as measured by the PPVT-4, BSRA-3 and the ToMI assessment measures. Results showed that PEAK-E resulted in significantly greater improvements on the BRSA-3, compared to PEAK-T and control groups. Analysis of the mean change scores suggested that PEAK-E scores increased on the BSRA-3 while PEAK-T and control scores decreased. There were no significant differences between groups on the remaining measures (see discussion below). Further investigation of within group results suggested that significant pre-post differences were only found on ToMI scores for PEAK-E and PEAK-T, but not for controls. No other pre-post differences were reported.

Overall, the results suggest that the PEAK-E intervention resulted in greater gains, in terms of school readiness, compared to PEAK-T and control groups. The results also showed that PEAK-E and PEAK-T might contribute to increases in skills related to deictic relations. It is noted that the between groups finding must be regarded with caution, in light of the findings from the within group's analysis. Specifically, while PEAK-E intervention did result in increased assessment scores on the BSRA-3, when compared to PEAK-T and control, the fact that no significant pre-post differences were found for PEAK-E on the BSRA-3 might indicate that the intervention itself may not have contributed to between groups' differences. However, the ANCOVA accounts for pre-intervention scores in its results, and, as part of the study, groups were also quazi-randomized, by high, medium, and low PPVT-4 scores, at pre-intervention. Taken together, this may suggest that the treatment PEAK-E led to a statistically

significant rise in scores on the BSRA-3. Overall, the findings may help to support the hypothesis that training in skills of derived relational responding through reflexivity, symmetry, transitivity and equivalence, would produce gains in cognitive and language outcome assessment scores, in comparison to a TAU group. Although these results appear to support previous research (that training in relational responding leads to gains in educational attainment), the research was very preliminary in nature and requires replication before any firm conclusions can be drawn (Cassidy et al., 2011; Cassidy et al., 2010; Steele & Hayes, 1991; Stewart et al., 2013).

Results also showed that theory of mind scores improved from pre- to post-intervention for PEAK-E and PEAK-T. The ToMI Battery measures higher order thinking and perspective taking skills, such as understanding our own and others' emotions, and the ability to take others' perspectives into account in order to drive one's actions. This indicates that teaching DRR may increase children's ability in these areas. This supports previous research, indicating that deictic relational framing underlies perspective taking ability and that, additionally, it correlates with verbal ability and IQ scores (Hendrix et al., 2016; Rehfeldt, Dillen, Ziomek, & Kowalchuk, 2007; Stewart et al., 2013). However, some caution must be expressed at this interpretation, as, as previously mentioned, the PEAK-T programmes specifically taught "Deictic Relation Frame – Perspective Taking", using the Cue of You/I and You/I reversal, and this specific training in deictic relations may have contributed to the subsequent rise in PEAK-T ToMI scores.

In light of prior research findings that training in DRR increases language scores (e.g. Hayes et al., 2001), it is somewhat surprising that there were no significant effects reported for the PPVT-4. Although differences were non-significant, scores did increase somewhat for the PEAK-T and control groups, while scores decreased for the PEAK-E group. This may also suggest that training skill sets relevant to school readiness may impede skills relevant to

language assessments Simultaneously, PEAK-T and control test scores fell on the BSRA-3

measurement, while PEAK-E scores increased. It should be noted that programmes chosen

from PEAK-E characterise aspects tested on the BSRA-3 such as shapes, letters, and

numbers. While this could be viewed as teaching for the test, it does back the promising use

of PEAK training to raise scores on pre-post aptitude measures.   The inconsistent nature of

the results may suggest that additional variables might be at play such as time of year,

participant engagement with the material, or parental influence. One additional confound

could be the expectations of parents in regards to preschool, and in the specific case of this

study, a Montessori preschool. As Montessori utilises an academic curriculum, this may have

influenced the choice of school by parents who would find academic skills preferable in a

preschool, resulting in a homogenous participant pool that may not reflect the general

population.   Additionally, this study took place in the spring of the year, and all of the

participants had already been exposed to four months of preschool teaching, which would

have included much academic and language based content, as per the discussion above,

regarding Montessori curriculum. It could be that PEAK training reinforced and solidified

learning by tapping into and enhancing repertoires that had already taken place in the

previous four months. However, as all groups showed increases (albeit in different measures

and not all statically), it may be that all treatments are effective, as many of the relational

operants could have been established as a result of attending preschool. Additionally,

participants (3-4 years of age) may have reached a developmental celling, in regards to

language and academic content, and this may have been reflected in PPVT-4 and BRSA-3

pre-post assessment scores. For example, PPVT-4 scores showed 30 out of 39 participants

(77%), with a standard score of over 100 (average) for pre-assessments, and a standard score

of 32 out of 39 participants (82%) over 100 (average) for post-assessments. The BSRA-3

showed 24 out of 39 participants (62%) with pre-assessment standard scores over 100

(average), and 27 out of 39 participants (69%) with a standard scores over 100 (average) for

post assessments (Table 2). Furthermore, as the data is quite variable in nature, a type one

error in interpretation of the data may have occurred, and, due to the above mentioned

confounds, there may be no effect for treatment. However, these results are very preliminary

in nature and require replication. Thus, future research should consider these issues.

Furthermore, it is important to note that the study of behaviour analysis often use

methods that feature repeated measures of behaviour of the individual in traditional study

design, in order to discover effective interventions for socially significant behaviours at the

individual level. Thus, it is prudent to considering the limitations of group design when

interpreting the research. Three weakness are often identified with group comparison designs.

Mainly that intrasubject replication is absent; group data may not be representative of the

individual subject's performance; and that variability in the data is often masked (Cooper,

2007). It is important when coming to conclusions regarding group data that the general

effectiveness of treatment should not be seen as a reason to adopt a treatment without further

clarification at individual level (Horner et al., 2005). It is essential to remember that while

group scores may have gone up (or down), on an individual level some participants may have

benefited, however, some may not have benefited and in fact may have deteriorated with

treatment. This individual variation, however, cannot be seen in statistical results.   Due to the

variability of group data on the BRSA-3 and the PPVT-4 assessment results, one

recommendations for this study, would be the inclusion of additional individual data from

PEAK programmes that were conducted. While all data points had been recorded

individually for all PEAK trials, (see sample in Appendix B) representation in visual format

has not been included in this study. This may have allowed for a more nuanced discussion on

the contributions of specific programs at an individual level and may have illustrated

extrinsic variables such as maturation. As previously, mentioned, preschool education targets

many relational skills present in PEAK-E and PEAK-T programmes. However due to the design of the study, no data was taken on any related targets in the preschool environment, as such, we cannot conclude with certainty that TUA did or did not have an impact on acquisition of PEAK targets and assessment results. Future research could address this confound by taking data on preschool targets that are similar to PEAK and running a traditional behaviour analytic design such as a multiple baseline across behaviours. Unfortunately, due to the limited time in which this research was conducted, it was not within the scope of the research to do so.

Finally, given the divergence between the results seen for PEAK-E and PEAK-T, this may raise questions about the effectiveness of PEAK modules when used both without utilising the PEAK assessments and, additionally, when using the modules independently, instead of as a combined package. This study did not utilise the PEAK assessment manual to ascertain skill levels in students. At the time of this study, PEAK-T was not published, thus, no assessment manual was available for this purpose. Future studies should consider these issues. Furthermore, when taking all of these limitations into consideration, the results of the study are preliminary and should be interpreted with caution.

The results of Study 1 are important in the applied setting and should be explored further to tease out the relations between equivalence skill sets and scholastic achievement. Research, in the area of early childhood education, indicates that programmes that incorporate academic instructional content such as pre-literacy and math (which are targets that are picked up in the BSRA-3 measure), contribute to learning and that these positive gains have been shown to persist into primary school (Duncan et al., 2007; Fuller et al., 2016). Therefore, it may be more socially valid to target BSRA-3 results, as opposed to ToMI.

This can be accomplished by a partial replication of Study 1, involving breaking the Equivalence Module down into simple (reflexive and symmetrical) and complex equivalence skill sets (transitivity) and providing school readiness assessment measure at the pre, mid, and post-intervention phases.

Overall, analysis of social validity scores show that teachers had a positive experience in implementing both of the module programme into the classroom, as indicated by responses on Likert items by Programme. Scores on the individual programmes within the modules showed that PEAK-E programmes displayed more individual preferences between the two teachers, in comparison to the PEAK-T programme (Figure 7/Figure 8). Combined Scores (Figure 9) show that teachers rated PEAK-E higher in three of the seven questions and they rated PEAK-T higher in four of the seven questions. Only the more experienced teacher, Teacher 1, showed a preference for PEAK-T programme, as all other scores were equal. This difference in rating may be related to the novelty of the Transformation modules. More specifically, the programmes that were chosen for PEAK-T may not be taught formally in the preschool classroom, thus both teachers would have been exposed to new teaching outcomes in the course of the implementation of these programmes. However, the more experienced teacher would have been more sensitive to the difference. This novelty may have been seen as progressive and attractive due to its potential to measure new features of behaviour not formally assessed in the familiar preschool programmes. As only two teachers filled out reports of social validity, the analysis of scores should be treated with caution. It may also be the case that teachers felt under obligation to report higher scores on PEAK programmes and this would have resulted in skewed data.

Results of IOA, on reliability and fidelity of both PEAK train/testing procedures and assessment measures, extend the findings of PEAK researchers and suggest that staff with lower level qualifications (Level 6 on the Quality and Qualifications Ireland, QQI), who

receive a session of BST in PEAK implementation, along with assessors with higher qualifications (Level 8 and above on the QQI), can implement PEAK train/test procedures and assessment measures with fidelity and reliability (Belisle, et al., 2016). The results are preliminary in nature and even though they support the ease of use of the PEAK system to the overall implementation of the programme in a preschool environment (Dixon 2014), they require replication before inferences can be drawn. A limitation of this study would, not only include the limited number of staff employed, but also the fact that the staff were trained in PEAK through the use of BST. It may be advantageous to see, if the PEAK manuals are written in such a way as to disseminate the train/test protocol without the need for additional BST. Future studies may look at reliability/fidelity and social validity from staff who are trained in PEAK via BST and those who only read the instruction manual.

One aspect of all successful programmes that are implemented in school system is staff "Buy-in". If staff feel that the programme is easy to use and implement, and that they have had a say in the programme's efficacy, they are more likely to implement the programme to procedural fidelity. Research on schoolwide curriculum models outline some fundamental aspects of choosing an effective programme. These include selecting programmes that have been reviewed by staff and that are considered to be effective, with results that can be replicated. The authors suggest that the benefit of implementing these 'off the shelf' instructional models are clear, thus school staff need not reinvent the wheel (Fashola & Slavin, 1997). Results of the questionnaire showed that teachers evaluate PEAK highly, suggesting that they would be more willing to invest their time and energies into implementing the programme into the school. This may be even more pertinent to schools that run ABA instruction for children with Autism. As PEAK provides, not only the assessment measure, but also the curriculum, the teachers need not spend valuable time

combining programmes from different sources to write up students' Individual Education

Plans.

Chapter 3

Exploring the impact of PEAK-Equivalence Module on Improvements in School Readiness and Language Assessment in Preschool Children over Three Time Points

Introduction

Results of Study one suggest that teaching targets from the PEAK-E module leads to higher gains in school readiness scores, compared to the PEAK-T and TAU group. These results lend support to prior findings that training in relational responding improves pre-requisite academic skills and provides a basis for more complex relational framing (Cassidy, et al., 2010; Steele & Hayes 1991; Stewart et al., 2013). In preparing children for transitions from preschool to primary school, it has been shown that high quality, academically orientated preschools contribute to learning; these gains have been shown to persist into primary school (Fuller, et al., 2016). Assessments of scholastic achievement are an effective measurement of the efficacy of interventions aimed at school readiness (Graziano et al., 2004).

In the applied setting, time is of the essence, thus, knowing which sequence of PEAK-E programmes contributed to increases in the BSRA-3 school readiness assessment scores could help to streamline interventions for both teachers and students. A more detailed investigation of PEAK-E may therefore allow for information to be provided on the minimum intervention requirements necessary for increased school readiness achievements. This investigation also addresses the call for effective treatments that use scientifically verified teaching practices that elicit reasonable use of resources (Dixon et al., 2017a; Graziano et al., 2004; Rehfeldt, 2011). To further assess the areas within the PEAK-E curriculum, and which sections may be contributing to the increase in school readiness assessments, the current research seeks to investigate if there is a stage in the delivery of the equivalence programmes (after reflexivity/symmetry, or after transitivity/equivalence) at which a measurable (statistically significant) effect occurs on the assessment measures. Previous research has indicated that gains in equivalence class formation occurred after the induction of symmetry, but additional gains in equivalence class formation occurred after a

combined symmetry/transitivity induction (Fields et al., 1992). Therefore, it would be prudent to examine if order of delivery could translate to effects on school readiness. It is proposed to use baseline, mid-intervention, and post-intervention times to help understand which instructional procedures have the potential for success.

It can be argued that the division of the measurements, into three time periods, may not be precise enough to discriminate the nuances of rises in assessment scores if they occur. However, due to test-retest effects (the participants becoming sensitive to the testing material) and the time constraints of the study, it was not possible to test between all eight programmes of the equivalence intervention. An additional justification for assessing outcomes after reflexivity/symmetry, and again after transitivity/equivalence (as opposed to at four time-points after each stage of training), stems from the following: RFT researchers have provided a natural break between symmetry, which, as discussed in the introduction, is called mutual entailment, and transitivity/equivalence, which are called combinatorial entailment (Hayes et al., 2001). In this regard, it was felt that these distinctions were enough justification for the break between reflexivity/symmetry and transitivity/equivalence. (See PEAK-Equivalence programme details in Appendix C)

One of the fundamental aspects of PEAK Relational Training System is to teach how to relate, not what to relate, thus PEAK promotes generalization skills through the use of MET and DTT (Dixon, 2015). Basic generalization skills occur when a response is emitted in the presence of a stimulus that has characteristics similar to stimuli that have been previously trained. Examples include being able to respond in different environments, with different instructions and different teachers. Treatment should incorporate aspects of generalization to be considered effective (Baer et al., 1968, 1987). Generalisation of this type has implications for students in the applied setting, as training through MET may result in exponential learning gains in the natural environment (McKeel et al., 2015a; Rehfeldt, 2011). Therefore,

it is important that studies implementing behavioural training programmes assess whether generalisation has occurred within the natural environment.

Study 2 had three main aims: firstly, the study sought to compare the intervention effects of PEAK-E to a TAU group. The second aim was to evaluate the impact of PEAK-E on outcomes of school readiness (measured by the BSRA-3) at three different time points; i.e. Time 1 (baseline, prior to the intervention), Time 2 (midpoint-intervention, after reflexivity and symmetry), and Time 3 (post-intervention, after transitivity/equivalence). Finally, this study aimed to enquire into the generalisation of PEAK-E targets into the natural preschool environment.

This study utilised a quasi-randomized intervention study, with 36 typically developing preschool students. The study was designed to determine differences at group level in the intervention-stage at which the PEAK-E module impacted BSRA-3 scores; specifically, would halting the intervention mid-stage (i.e. after reflexivity and symmetry) improve school readiness. This is the first study, to date, that has been designed to discern which target area of PEAK-E has the most beneficial effect. The independent variables were PEAK-E versus control and the dependent variable was scores on the assessment measure BSRA-3. It is hypothesised that training in PEAK-E programmes will produce gains in school readiness scores, in comparison to a TAU group. It is also hypothesised that, although school readiness may be affected at the midpoint, significant gains will not be observed until post-intervention.

Follow-up assessments examined generalisation of PEAK-E targets into the preschool environment. Thus, we hypothesis that the PEAK-E treatment group should generalize new skills in the environment at a higher rate than the TAU group.

Methods

Participant

Typically developing children, $n = 36$, 14 boys and 22 girls, aged between 2.11 – 4.7 years ($M = 3.4$, $SD = 1.8$) were recruited to participate in the current study from the same preschool as Study 1. No participants from Study 1 were recruited for Study 2. Participants were randomised into intervention (PEAK-E $n = 18$) and control (treatment as usual $n = 18$) groups based on pre-intervention PPVT-4 scores. An equal number of high, medium, low scores on the PPVT-4 were assigned to each group. The train/test format of the PEAK modules and the assessment measures were carried out in English. Children who did not speak English were excluded from the study. Three teaching staff (2 from study 1) were recruited to take part ($n = 3$; aged 45 with 3 years' experience, aged 37 with 6 years' experience and aged 21 with 3 years' experience). Staff were trained in the methods required to implement PEAK assessments and interventions, and completed measures of intervention fidelity.

Ethical Approval

Ethical Approval was sought and granted by the Department of Psychology, Maynooth University Research Ethics Committee in October 2015. The ethical guidelines that were put in place pertain to the entire study. Information and consent /assent forms discussed relevant details of the study, participant requirements, time commitments, procedures for confidentially, data collection, data protection, and the right to withdraw. All procedures regarding ethics and verbal assent were reproduced from the previous study. See Study 1 for a complete discussion of ethics and verbal assent.

Settings

Participants ($n = 36$ students and $n = 3$ teachers) were recruited from the morning session of a preschool in Ireland. The setting used for Study 2 was the same used for Study 1. Information pertaining to the setting can be found in Study 1.

Materials

Student participants ($n = 36$) received a total of two assessments. One was the Peabody Picture Vocabulary Test - Fourth Edition (PPVT-4), taken only at baseline, while the second was the Bracken School Readiness Assessment - Third Edition (BSRA-3), taken three times - baseline, mid-intervention, and post- intervention. Intervention material consisted of target programmes taken from PEAK-E manuals. Staff participants ($n = 3$) received one session of BST on how to deliver PEAK, assessment measures and how to record IOA data. A bespoke generalisation test was created to ascertain generalisation of PEAK-E targets in the preschool environment on novel (not as of yet introduced into the environment) preschool material. As the preschool utilised the Montessori Method of instruction, novel Montessori material was used.

All material listed were the same as Study 1. The Peabody Picture Vocabulary Test - Fourth Edition (PPVT-4; Dunn & Dunn, 2007), The Bracken School Readiness Assessment - Third Edition (BSRA-3, 2007), PEAK Equivalence Module, Staff Behavioural Skills Training (BST) materials, staff intervention fidelity measure, and staff Inter-Observer Agreement (IOA) data recording sheets.

Generalisation test of PEAK-E Targets. Materials for the generalization tasks were selected from the naturally prepared environment of the preschool room across the following subject areas: Math, Language, Culture, and Biology. The novel material selected for the generalization tasks had not yet been introduced (taught) into the classroom environment as curriculum programmes (and as such could be considered novel). The preschool utilises the Montessori Method of instruction and, as such, novel Montessori materials were selected for

generalization tasks. The goal of the Montessori material chosen corresponded to the PEAK-E target outcome goals (See Table 7).

1. Montessori Material: Cultural People Cards, a set of material that is composed of 10 cards, with picture of people in traditional cultural dress, with a set of 10 matching cards. Programme outcome is matching pictures.

2. Biology Cards: A frieze of 10 picture part cards, with words written underneath. A set of 10 word cards match the frieze. Programme outcome is matching text.

3. Cards and Counters: Number cards 1–10 and counters to equal 10. Programme outcome is matching symbol.

4. Geometric Cabinet: Ten 2-demensional shape cut-outs, used for writing and shape names. Programme outcome is identification of shape names.

5. What Happens When Questions: List of 10 questions that require the child to know what happens after an action. List of 10 outcomes. Programme outcome is answering what happens next.

6. Stern Maths Board Maths Set: Five Blocks, with numbers 1–5 written on them. Six blocks with 1–6 written on them and two blocks with the symbols = and + written on them. Programme outcome is addition.

7. Feature Classification Board: Set of 10 words regarding features of animals. Animals to match to feature words. Programme outcome is matching features.

8. Movable Alphabet: Upper and lower case cut-out letters a–z. Programme outcomes is matching uppercase and lowercase letters by phonetic sound.

Table 6
Module areas, programme targets and material needed.

EQ Area	PEAK Targets	Goal	Stimulus A	Stimulus B	Stimulus C	Stimulus D
Reflexivity	1A Picture to Picture	Match the sample identical picture to the original picture	10 picture cards	10 identical cards to A		
	1B Textual Match	Match the sample identical written word with the original written word	10 written word cards	10 identical cards to A		
Symmetry	5C Textual Number Identification	Match a picture of a number of items with the written number	10 number cards 1 - 10	10 quantity cards to match A		
	5E Shape Names	Identify shape names when presented with the shape picture	10 shape cards	10 "words" of shapes to match A		
Transitivity	9P Actions and Outcomes	Match an action to a second non-trained action	10 action picture cards	10 outcome pictures to correspond with A	10 outcome picture to correspond with B	
	10A Addition	Match addition problem with the total number	10 textual addition problems	10 picture addition problems to match A	10 number cards to match B	
Equivalence	10L Features Rule	Match a picture to a feature	10 "word" of a feature	10 object feature cards to match A	10 object feature cards to match A	
	11F Letter and Case Sounds	Match upper case and lower case	10 letter sounds	10 capital letters to match A	10 lower case letters to match A	

Experimental Design

This experimental design is a quasi-randomized between within group comparison.

Students were randomised into PEAK-E ($n = 18$), or control ($n = 18$) based on their screening

PPVT-4 scores. The independent variable (IV) was the treatment PEAK-E and control, and

the dependent variable (DV) was the outcome measure of the BSRA-3. The *between*

participant DV was the difference between the two groups on pre-mid and mid-post and pre-

post intervention scores the BSRA-3. The *within participant* DV was the difference between pre–mid and mid-post intervention scores on the BRSA-3.

Procedures

The study consisted of baseline assessments (PPVT-4, BSRA-3), intervention (PEAK-E, control), mid-intervention assessment (BSRA-3), and follow up assessment (BSRA-3), followed by generalisation probes, with $n = 36$ children. Staff were trained to deliver PEAK-E and assessments using BST. IOA and procedural fidelity were also collected on all assessments and PEAK-E train/test procedures by trained assessors.

Staff Training	

• Staff training using Behavioural Skills Training
    ○ Assessment
    ○ PEAK procedures	

Pre-Intervention assessment • The Peabody Picture Vocabulary test - Fourth Edition (PPVT4; Dunn & Dunn. 2007) • The Bracken School Readiness Assessment - Third Edition (BSRA-3)	IOA and Fidelity taken on assessments and interventions
Intervention PEAK-E • Phase 1 Probe • Phase 2 Training Trials of the 4 PEAK-E targets from Reflexivity/Symmetry • Phase 3 Testing Trials of the 4 PEAK-E targets from Reflexivity / Symmetry	
Mid- Intervention assessment • The Bracken School Readiness Assessment - Third Edition (BSRA-3)	
Intervention PEAK-E • Phase 1 Probe • Phase 2 Training Trials of the 4 PEAK-E targets from Transitivity Equivalence • Phase 3 Testing Trials of the 4 PEAK-E targets from Transitivity Equivalence	
Post-Intervention assessments • The Bracken School Readiness Assessment - Third Edition 9 BSRA-3)	

> Generalisation of PEAK-E targets
>
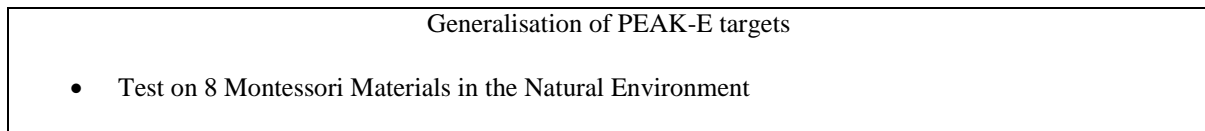> - Test on 8 Montessori Materials in the Natural Environment

Figure 10. Visual representation of procedures

Staff training

Two teachers were recruited to implement PEAK programmes for Study 2. The teachers received one BST session on how to deliver PEAK programmes, assessment, fidelity, and IOA measures. The teachers were asked to read the PEAK programme manual and the training procedures' description on DTT presentation and prompt and stimulus levels. The teachers then observed the experimenter implement the PEAK programmes and they participated in a role play where the teachers took on the role of the instructor and demonstrated the implementation of PEAK procedures. Teachers practiced role play with one programme from PEAK-E. Feedback was provided by the experimenter during training and in-situ. Staff delivered PEAK-E programmes to the specification of the research procedure for no more than twenty minutes per child over a period of three months. Staff were trained on the implementation of the assessment measures by reading the assessment manuals instructions and then observing the experimenter implement the assessments. The staff then participated in roleplay, giving the assessment, followed by feedback. Staff were instructed in IOA procedures by observing the experimenter implement an IOA procedure and, then, by participating in a roleplay, followed by feedback.

Baseline assessments. Participants ($n = 36$ children) were administered the pre-intervention PPVT-4 assessment and were quazi-randomised, according to high, medium, and low scores into two equal groups (one control and one treatment condition). Once the treatment groups were established, participants were administered baseline assessments of BSRA-3. When a participant finished one assessment, they moved onto the next assessment during the same research session. Cooperation was rewarded with noncommittal praise such as "good pointing", "good looking", etc. A small edible was given upon completion of the

task; participants were not differentially rewarded for correct versus incorrect responses on measures.

Intervention: PEAK-E. The intervention for PEAK-E group ($n = 18$) was run at the same parameters as Study 1, with the exception of a mid-intervention assessment (BSRA-3). Please revert back to study 1 for full account of PEAK-E general procedures, instruction strategies, data scoring, prompting levels, level strategies, PEAK-E targets, training/testing procedures, and IOA and fidelity procedures.

Control group. The control group ($n = 18$) was exposed to treatment as usual, which was attendance in a preschool that utilises the Montessori Method of instruction. The control group attended and participated in daily preschool class, which lasted for three hours a day. Daily activities in the preschool included maths, language, culture and science, fine and gross motor work, sensorial work, play, music, and art. For a complete review of the Montessori Method, please see Montessori (1988).

Mid-assessments. Participants ($n = 36$) were administered mid-assessments (BRSA-3) after all Reflexivity and Symmetry training/testing procedures had been completed by the participants. Cooperation was rewarded the same as with pre-intervention assessments; through noncommittal praise such as "good pointing", "good looking", etc. A small edible was given upon completion of the task; participants were not differentially rewarded for correct versus incorrect answers.

Follow-up assessments. Participants ($n = 36$) were administered the post-intervention the BSRA-3. Cooperation was rewarded the same as with previous intervention assessments, with noncommittal praise such as "good pointing", "good looking", etc. A small edible was given upon completion of the task; participants were not differentially rewarded for correct versus incorrect responses on measures.

Treatment fidelity. To ensure that that the treatment was delivered in the way it was planned, the researcher included a fidelity rating scale to be performed on 25% of all programmes delivered. The researcher or a trained instructor sat and observed teachers implementing the PEAK procedure; the researcher also recorded the child's attendance (i.e. attention to task), the teachers' correct use of the ABC format, the teachers' correct use of and recording of prompt levels, and whether the teachers presented the material in line with the PEAK Implementation Checklist. Scores were recorded over one trial block of 10 trials (See Appendix E). The number of correctly performed steps were divided by the total number of steps and multiplied by 100 in order to calculate the percentage.

Inter-observer Agreement. Inter-observer Agreement (IOA) data was collected for PPVT-4, BSRA-3, at pre-, mid- and post-intervention assessment sessions (data was only collected for PPVT-4 at pre-intervention stage for the purpose of quazi-randomising the groups, as was procedure in Study 1. In addition, IOA data was also collected for PEAK-E train/test intervention trials. In all instances, IOA data was collected on 25% of trials. In both assessment and intervention sessions, the instructor, and a second person who sat behind the participant, collected data from the participant. The second person was out of line of sight of the instructor's data sheet and recorded the responses of the participant independently. Trial-by-trial IOA was calculated by dividing the number of all trial agreements by the total number of trials and then multiplying by 100 to determine a percentage.

Generalisation Testing

Participants (*n* = 36) from both groups, the treatment PEAK-E and the control group, were asked to complete eight tests on novel Montessori material (material which had not at this stage been introduced in the environment). The novel Montessori material contained 10

stimuli, equating to 10 test questions, which corresponded to outcome goals from intervention

PEAK-E targets (see Table 7 for an outline of how PEAK-E and novel Montessori material

aligned). Teachers asked the child if they would like to work with new Montessori material

or continue with what they were doing. The material was then presented either on the table

or the floor. The participant was asked to complete the test with the material. The results of

the test were recorded on a PEAK test data sheet, with a 10 for a correct response and a 0 for

an incorrect response. No reinforcement was delivered during testing. When finished, the

child was given access to a preferred toy or small jelly. Three teachers from intervention one

were recruited to participate in the study, to implement the generalization testing. Eight

novel Montessori materials were used, as described in the materials section, each relating to

PEAK-E targets to test for generalisation in the natural environment.

Table 7

PEAK-E targets and aligning novel Montessori materials used for generalisation test.

Table 7 PEAK Equivalence Programs and Corresponding Montessori Material

Equivalence	PEAK E Targets	Target Goals	Novel Montessori Material
Reflexivity	1A Picture to Picture	Picture Matching	Cultural People Cards
	1B Textual Match	Textual Matching	Biology Cards
Symmetry	5C Textual Number Identification	Number Quanity and Symbol	Cards and Counters
	5E Shapes Names	Shape Labeling	Geometric Cabinet
Transitivity	9P Action and Outcomes	First /Then Sequence	What Happnes When?
	10A Addition	Addition	Stern Math Board
Equivalence	10L Features	Feature Sorting	Biology Sorting Board
	11F Letter Case and Sounds	Phonetic Awarness	Movable Alphabet

<center>**Results**</center>

Overview of Results: PEAK –E

A mixed between within subject ANOVA used to investigate two groups at three time periods. This was followed by a post hoc analysis to determine at which intervention stage significant effects occurred, reflexivity/symmetry (pre-intervention /mid-intervention) or transitivity/equivalence (mid-intervention to post-intervention). Additional within participant comparisons used a one-way repeated measures ANOVA with follow-up pairwise comparisons to determine at which treatment stage significant effects occurred within group.

Between Participant Comparisons

A visual analysis of pre-mid-post-intervention scores was conducted. Table 8 shows the scores obtained on pre-intervention, mid-intervention and post-intervention assessments across measures: PPVT-4 (pre-intervention only) and BSRA-3. One standard deviation jump was observed in six of the PEAK-E participants from pre-assessment to post-assessment scores. Trials to Mastery are also displayed to indicate total trials on all PEAK programmes needed to reach mastery level. See Figure 11 for breakdown of trails to mastery per PEAK-E programme.

Table 8

The table depicts pre/mid/post-intervention scores on assessments over the course of the study.

Group	Pre-PPVT	Pre-Bracken	Mid-Bracken	Post-Bracken	T to M
Control					
1	121	95	108 *	107	
2	118	100	102 *	102	
3	116	97	103 *	101	
4	115	91	106 *	98	
5	114	102	110 *	107	
6	113	91	85	95 *	
7	112	102	111 *	112	
8	110	98	105 *	93	
9	108	103	110 *	106	
10	107	83	100 *	87	
11	106	86	94 *	94	
12	103	132	127	130 *	
13	103	101	83	90 *	
14	96	96	105 *	114 *	
15	95	109	116 *	109	
16	91	84	85 *	79	
17	83	100	105 *	94	
18	79	78	73	71	
Mean	105	97.11	101.55	99.38	
SD	11.94	11.91	13.18	13.62	

Group	Pre-PPVT	Pre-Bracken	Mid-Bracken	Post-Bracken	T to M
Equivalence Treatment Group					
1	121	86	98 *	99 *	280
2	121	103	118 *	111	270
3	117	108	114 *	114	490
4	116	81	94 *	102***	620
5	115	99	114 *	110	530
6	114	119	124 *	130 *	340
7	113	114	125 *	124	230
8	110	123	127 *	128 *	340
9	108	110	107	115 *	240
10	107	100	110 *	120***	610
11	106	116	121 *	119	310
12	105	93	111 *	113 *	370
13	103	101	109 *	111 *	480
14	101	105	137 *	120	600
15	96	102	117 *	125***	590
16	92	91	101 *	106***	450
17	83	110	99	132***	530
18	81	97	108 *	122***	260
Mean	106.05	103.22	113	116.72	
SD	11.8	11.25	11.27	9.37	

* indicates an increase in points from pre/mid/post-intervention assesments and *** indicates a 15 point increase in points from baseline to post- intervention assesments that represents a Standard Deivation. Trials to Mastery are displayed the treatment group PEAK E. Mean and Standard Deviation are displayed for all assessments.
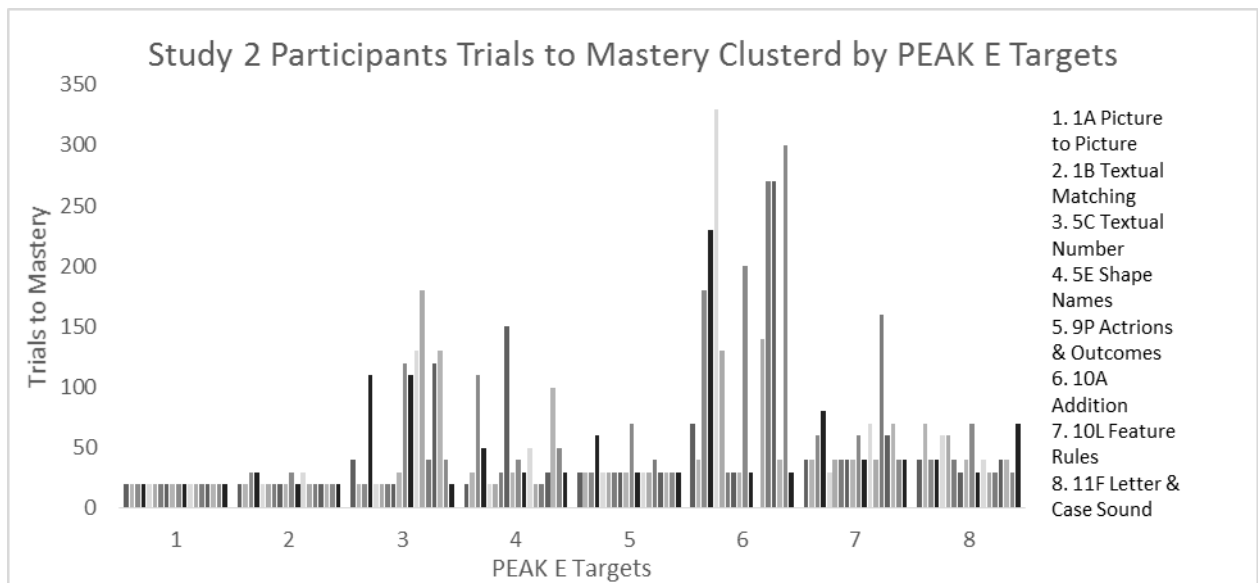
Figure 11. Shows trial to mastery clustered by PEAK-E targets.

Figure 11 indicates participant's trials to mastery per PEAK-E programme. Programmes 5C Textual Matching (reflexive), 5E Shape Name (reflexive) s and 10A Addition (transitivity), required the most training.

Figure 12 shows mean scores for BRSA-3 assessment results across treatment group PEAK-E and TAU group. Visual analysis shows scores for PEAK-E increased across all three times. Baseline ($M = 103.22$, $SD = 11.25$) mid-intervention ($M = 113$, $SD = 11.27$) and post-intervention ($M = 116.72$, $SD = 9.37$). While scores for control group varied across BRSA-3 assessment results. Baseline ($M = 97.11$, $SD = 11.91$), mid-intervention ($M = 101.55$, $SD = 13.18$), and post-intervention ($M = 99.38$, $SD = 13.62$).

Figure 12: Shows mean scores on BSRA-3 for both treatment group PEAK-E and control group.

A mixed between-within subject ANOVA was conducted on the BSRA-3 scores which showed a statistically significant main effect for Group (intervention versus control), Time (pre, mid and post) and a significant interaction effect for Group x Time.
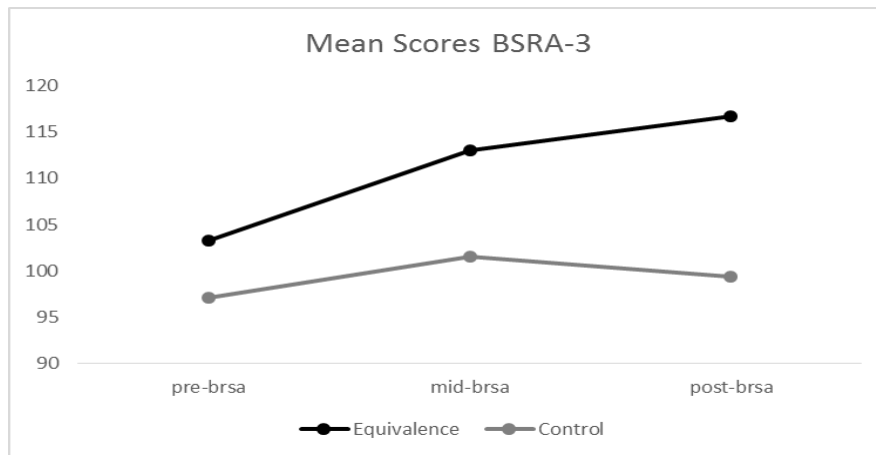
Group. The main effect for Group was significant, F (1, 34) = 10.35, p = .003, partial eta squared =.233. The results showed that individuals in the PEAK-E group scored significantly higher overall, on the BRSA-3 compared to those in the control group.

Time. There was a substantial main effect for Time with Wilks' Lambda = .461, F (2, 33) = 19.31, p < .001, partial eta squared = .539. Overall, participants scores increased over time.

Interaction. There was a significant interaction between Group and Time, Wilks' Lambda = .654, F (2, 33) = 8.713, p =.001, partial eta squared = .346, indicating that the change in scores over time was significantly different for the two groups.

Three Independent sample t test were conducted to compare scores on the BSRA-3 for PEAK-E group and control group at three times, baseline, mid-intervention and post-intervention times.

Baseline BSRA-3. An independent-samples t-test was conducted to compare the BSRA-3 scores for PEAK-E and control at baseline. There was no significant difference in

scores for PEAK-E (*M*=103.22, *SD* =11.25) and control (*M*=97.11, *SD*=11.91; t (34) = -1.58, *p* = .123, two-tailed). The magnitude of the differences in the means (mean difference = -6.11, 95% CI:-13.96 to 1.74) was moderate (eta squared = 0.068).

Mid-intervention BSRA-3. An independent-samples t-test was conducted to compare the BSRA-3 scores for PEAK-E and control at mid-intervention. There was significant difference in scores for PEAK-E (*M*=113.00, *SD* =11.27) and control (*M*=101.55, *SD*=13.18; t (34) = -2.79, *p* = .008, two-tailed). The magnitude of the differences in the means (mean difference = -11.44, 95% CI:-19.75 to -3.13) was large (eta squared = 0.187).

Post-intervention BSRA-3. An independent-samples t-test was conducted to compare the BSRA-3 scores for PEAK-E and control at baseline. There was significant difference in scores for PEAK-E (*M*=116.72, *SD* =9.37) and control (*M*=99.38, *SD*=13.62; t (34) = -4.44, *p* = .000, two-tailed). The magnitude of the differences in the means (mean difference = -17.33, 95% CI:-25.25 to -9.41) was large (eta squared = 0.367).

Within Participant Comparisons

Two One-way repeated measure ANOVA was conducted to explore within group differences at time points. A follow-up pairwise comparison was also conducted.

Effect of time on PEAK-E. A one-way repeated measures ANOVA was conducted to compare PEAK-E scores on the BSRA-3 at Time 1 (prior to the intervention), Time 2 (mid-point of the intervention), and Time 3 (post-intervention). There was significant effect for time, Wilks' Lambda = .180, *F*(2, 16) = 36.54, *p*=.000, multivariate partial eta squared = .820. Follow-up pairwise comparisons showed that the PEAK-E scores were significantly lower at Time 1 (*M* =103.22, *SD* = 11.25) than at Time 2 (*M* = 113.00, *SD*=11.27) (*p* = .001) and Time 3 (*M*=116.72, *SD* = 9.3) (*p* = .000). However, there was no difference between Time 2 and Time 3 (*p* = .416).

Effect of time on Control. A second one-way repeated measures ANOVA was conducted to compare control group scores on the BSRA-3 at Time 1 (prior to the intervention), Time 2 (mid-point of the intervention), and Time 3 (post-intervention). There was not significant effect for time, Wilks' Lambda = .776, $F(2, 16) = 36.54$, $p=.132$, multivariate partial eta squared = .224.

Summary. Results showed that the PEAK-E group performed significantly better than the control group on a measure of school readiness, and that PEAK-E resulted in significant baseline to post-intervention increases in school readiness scores. Follow-up tests confirmed that reflexivity/ symmetry intervention stages were required to significantly impact school readiness scores.

There was an increase upon teaching PEAK-E reflexivity/symmetry intervention stage (i.e Time 2) but no further significant increase upon delivery of transitive/equivalence intervention stage (i.e Time 3).

Overview of Results: Procedural fidelity, Inter-observer Agreement

Procedural fidelity

The IOA for PEAK-E train/test data was 36% with a 90.9% agreement. IOA meet criteria indicating that the data is reliable. Fidelity for PEAK-E was obtained for 33.3% of participants with 99.7% of overall procedural fidelity suggesting that programmes were run within the parameters of PEAK instructions.

Inter-observer Agreement

For the PPVT-4, baseline assessment scores were obtained at 25.0% of trials with 98.3% of agreement. The IOA scores on the assessment meet criteria, indicating that the data is reliable. For the BSRA-3, baseline assessment scores of IOA were obtained at 27.7% of trials with 99.0% of agreement. Mid-assessment scores were obtained at 27.7% of trials with 99.8% of agreement. Post-assessment scores were obtained of 30.5% of trials with 99.7% of

agreement. The IOA scores on all three assessments meet criteria, and suggesting that the

data is reliable.

Overview of Results: Generalisation

Visual analysis of the Generalization scores show that participants in the treatment

group PEAK-E achieved higher scores on seven out of eight generalization tests in

comparison to the TAU group. Figure 13 shows the mean scores on tests of generalization

with novel Montessori material.

Figure with chart titled "Mean of Generlizaiton":

	1A	1B	5C	5E	9P	10A	10L	11F
Control	96.1	58.8	58.8	41.1	66.1	54.4	67.2	68.3
EQ	100	76.6	70	55	83.8	43.3	77.7	88.8

Legend:
1A. Picture Match
1B. Text Match
5C. # Quantity and symbol
5E. Geometric Cabinet
9P. Time Line
10A. Stern Board addition
10L. Object sorter
11F. Movable Alphabet
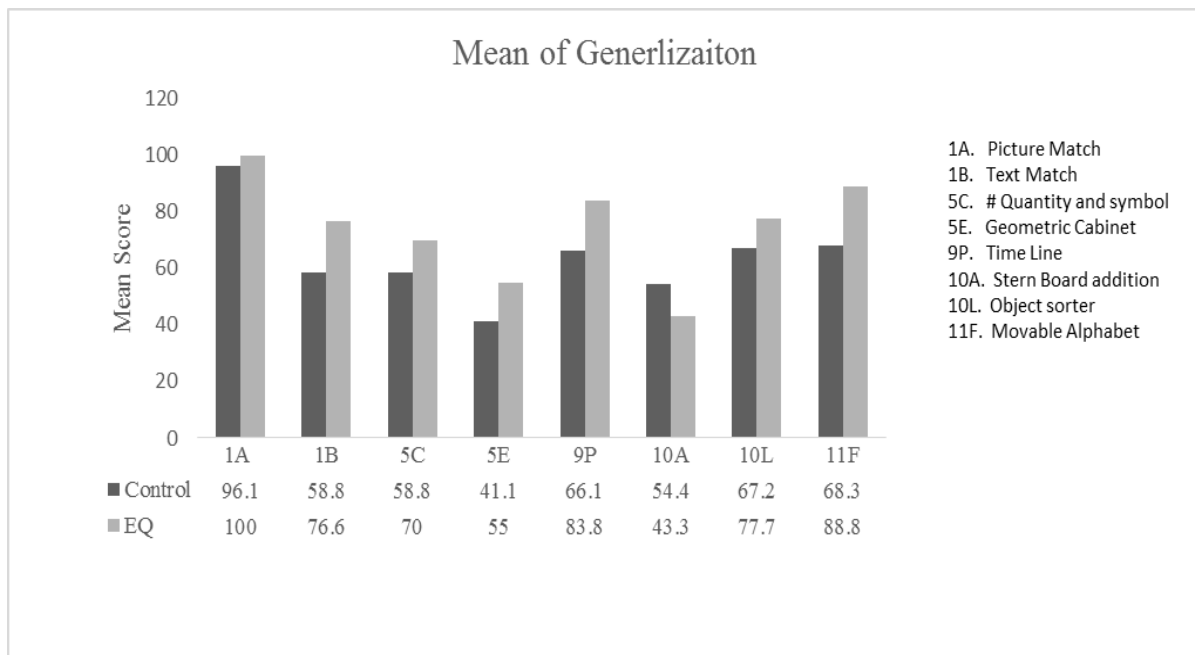
Figure 13. Shows the mean scores on tests of generalization with novel Montessori material.
Visual analysis of the generalization scores show higher scores to the treatment group PEAK-
E group when compared to TAU group.

Inferential statistics. Independent samples t-tests (see Table 10) were conducted to

compare generalization scores on 8 programmes between PEAK-E and control group. A

Bonferroni correction was applied thus the *p* value was adjusted from .05 to .00625.

Statistically significant differences between the PEAK-E and controls were reported across

two of the eight programmes. Specifically, the "*What happens when…?*" measure and the

Movable Alphabet measure. There was a significant difference in scores on novel Montessori

material "What happens when…?" for Control ($M = 6.61$, $SD = 2.11$) and PEAK-E ($M =$

8.38, $SD = 1.37$); $t\,(34) = -2.98$, $p = .005$. Results of novel Montessori material *Movable*

Alphabet indicated there was a significant difference in scores for Control ($M = 6.83$, $SD =$

1.94) and PEAK-E ($M = 8.88$, $SD =1.94$); $t\,(34) = -3.917$, $p = .000$.

Table 10
Results of the independent sample t-test comparing generalization scores.

	N	Control		Equivalence		Df	t	p (2-tailed)
		M	SD	M	SD			
1A	36	9.61	1.42	10	0	34	-1.16	0.253
1B	36	5.58	3	7.66	2.27	34	-2	0.054
5C	36	6.38	3.05	7	3.39	34	-0.568	0.574
5E*	36	4.11	2.13	5.5	1.46	34	-2.27	0.029
9P**	36	6.61	2.11	8.38	1.37	34	-2.98	0.005
10A	36	4.11	2.13	5.5	1.46	34	1.56	0.127
10L*	36	6.72	1.17	7.77	1.21	34	-2.64	0.012
11F**	36	6.83	1.94	8.88	1.94	34	-3.917	0

* indicates significant difference ** indicates significant difference with Bonferroni Correction

Summary.   The treatment group scored higher than controls on seven out of the eight

generalisation tests, however only two of these reached significance. These results indicate

that PEAK-E may have some (albeit minimal at a statistical level) benefit in promoting

generalisation of skills to novel Montessori material.

Discussion

The results of Study 2 build on and confirm findings from Study 1 and support the hypothesis that PEAK-E programmes will produce gains in school readiness scores, in comparison to the TAU group. Results showed that the PEAK-E group performed significantly better than the control group, on a measure of school readiness, and that PEAK-E resulted in significant baseline to post-intervention increases in school readiness scores. Results of follow-up independent samples T-tests indicated that there was no significant difference in BSRA-3 scores between PEAK-E and control at Time 1 (baseline). There was a significant difference in BSRA-3 scores for PEAK-E over control, at Time 2 (mid-intervention, after reflexivity/symmetry) and also at Time 3 (post-intervention, after transitivity/equivalence), however. These results indicate that statistical differences were only reported between the groups at Time 2 after the introduction of reflexivity/symmetry treatment. The results of this study may have positive implications for interventions in the applied settings. Preliminary results from this study suggest that the implementation of eight programmes from the PEAK Relational Training System Equivalence Module may be able to have a positive impact on school readiness assessments, to that of treatment as usual. These results should be interpreted with caution, as they require replication before any firm conclusions can be drawn. This indicates that there is scope for implementing specific programmes within the TD applied setting to help children develop behavioural skill sets in a quick and efficient manner that are not present in their repertoire and, additionally, to help strengthen the relational operant that is already being established by schooling. However, it should be noted that, while the interventions may indicate positive implications for interventions in the applied setting, the study itself was quite short (only eight programs) and the trials to mastery (Figure 11) show that the individual participants mastered programs quickly. This may indicate that typically developing preschool populations are not pushed by

PEAK-E programs, even though previous research on PEAK-D linked the modules to a typically developmental age of 8 (Dixon et al., 2017a). It should be noted however that program 10A Addition took longer to reach mastery than other PEAK-E programs. Nevertheless, by addressing cognitive and school readiness issues as they arise both in the preschool, and early primary setting with proven interventions, will help children attain education levels to that of their peers, and ensure that no child is left behind (Nores & Barnett, 2010).

Within participant comparisons for treatment group PEAK-E indicated that there was a significant difference on BSRA-3 scores between Time 1 (baseline) and Time 2 (mid-point of intervention, after reflexivity/symmetry), and a significant difference between Time 1 (baseline) and Time 3 (post-intervention). However, there was no significant effect seen between Time 2 (mid-intervention) and Time 3 (post-intervention, after transitivity/equivalence). These results may indicate that the significant increases reported for treatment group PEAK-E on the scores of the BSRA-3 assessment at Time 2 (mid-intervention after reflexivity/symmetry) also accounted for the significant difference at Time 3 (post-intervention after transitivity/equivalence). This conclusion can be drawn, as there was no within group significant difference reported between Time 2 (mid-intervention) and Time 3 (post-intervention), however these results are preliminary in nature and should be replicated in future studies. .

While these results may suggest that the introduction of two PEAK-E programmes, which taught reflexivity and symmetry led to a statistical increase on measures of school readiness for PEAK-E participants, it is interesting to note that visual analysis of the PEAK-E treatment scores for BRSA-3 pre-intervention to post-intervention showed a standard deviation jump for six participants (1/3 of population); no standard deviation jumps were seen for pre-intervention to mid-intervention scores and mid-intervention to post-intervention

(Table 8). This seems to indicate that standard deviation jumps from pre-post intervention were the result of all eight programs (Dixon, 2014d) and visually supports the statistical increase seen from Time 1 to Time 3 on within participant comparisons. It may be that increased fluency in the very basic components of cognitive performance (reflexivity/symmetry) might facilitate the emergence of other skills that depend on these, such as transitivity and equivalence. This makes intuitive sense when looking at functional equivalence and how it is related to verbal behaviour. Sidman refers to this as symbolic behaviour and it involves transfer of function from objects to symbols. Language training is a result of transfer of function from an object to a word. (Tonneau, 2001). So, training PEAK-E in order of early matching to sample such as reflexivity (match A to A) and systematically moving to more complex relations such as symmetry (match A to B and B to A) allows for fluency to be established through multiple exemplars, which makes transfer of function detectable in transitivity (match A to B and Match B to C and test for A to C). The more children who can speak about and name objects, the more fluency they gain in language and verbal contingences and the more likely the transfer of functions can occur. As previously discussed, RFT has embraced Equivalence as AARR under the frame of coordination (Ming & Stewart, 2017; Rehfeldt et al., 2009). RFT theorises that, after a history of MET, resulting in fluency, relating may become arbitrarily applied. In other words, non-arbitrary relational properties can function as contextual cues for established repertoires of AARR. While RFT may discount reflexivity, as it mimics formal similarity, it may be that it is an important first component in training language, which leads to object to symbol transfer of functions (Barnes Holmes, 2004a). Thus, ease of acquiring relations of Transitivity and Equivalence may depend on being fluent in early reflexivity and symmetry relations acquired through a history of MET.

The findings outlined above lend weight to previous research that suggests training in DRR affects intelligence and higher cognitive functioning (Gore et al., 2010; Kilroe et al., 2014). Additionally, this research may help support theories that suggest that early non-arbitrary relational responding can be considered fundamental and must come before other advanced frames (Ming & Stewart, 2017). It also suggests teaching fluency in reflexivity and symmetry may lead to increases in cognitive assessments and may help support research that showed that MET training with SE protocol increased scores on cognitive measures (Cassidy et al., 2011). While this research appears to justify some of the research by Fields et al. (1992), specifically, that fluency in symmetry leads to increases in equivalence relations, this study did not find that the addition of transitivity encouraged higher yields in equivalence relations in tests sensitive to school readiness. This may indicate that teachers may only need to teach reflexivity and symmetry to increase school readiness scores; however, it is important to stress that this research is very preliminary in nature and should be interpreted with caution until such time as more research can be conducted to confirm results.

Results of fidelity measures show that PEAK-E, with the addition of one session of BST, can be run within the parameters of PEAK instruction and that IOA data from assessment and PEAK-E train/test results are reliable. These results may help to lend support to previous PEAK research, which has shown that PEAK can be run by trained frontline staff with fidelity and reliability (Dixon, et al., 2014; Belisle, et al., 2016). However, due to the limited number of staff who participated in this research, results should be viewed with caution.

Results of generalisation probes indicated that PEAK-E interventions resulted in minor gains in generalisation of PEAK-E target skills. Specifically, the PEAK-E group had statistically higher scores in two of the eight measures on generalisation skills in the natural environment. The results support research that indicates that a history of MET in relational

responding leads to increases in generalisation in the natural environment, as students exposed to intervention have additional chances to experience direct reinforcement (McKeel et al., 2015; Rehfeldt, 2011; Stewart et al., 2013). It is of interest, in light of previous findings on the importance of reflexivity/symmetry, that the two measures that reported statistically higher scores in generalisation corresponded to the PEAK-E targets of Transitivity: 9P Actions and Outcomes (novel Montessori material, "What Happens When"?) and Equivalence: 11F Letter Case and Sounds (novel Montessori material, Movable Alphabet). This, taken in context, may indicate that training early equivalence relations in order (reflexivity, symmetry, transitivity, equivalence) increases fluency in DRR, with the specific addition of transitivity, equivalence programmes leading to an exponential increase in novel skills. This led to a minor statistical difference in the generalisation scores observed. These results may support research that shows minimal training leads to exponential increases in novel skills for TD children (Barnes Holmes, et al., 2004; Dixon, et al., 2014). Results support the hypothesis that the PEAK-E treatment group should generalize new skills in the environment at a higher rate than the TAU group; however, as the results are so minimal, this should be treated with caution. Given the low generalisation scores that resulted, it may be that a type 1 error occurred in the interpretation of data and PEAK-E did not occasion fluency in generalization skills. This may be a result of the train/test method used, which may not expose typically developing students to enough multiple examples before they reach mastery criteria for the programs; results of generalization in the natural environment of PEAK-E skills could have been strengthened if PEAK G had been run previous or in conjunction with PEAK-E.

To recap, the four PEAK modules have been designed to be run both as individual programmes and also as a combined four book approach. PEAK-D and PEAK-G utilise a contingency-based framework of language development and PEAK-E and PEAK-T utilise

new SE and RFT approaches to language development. As stated before, PEAK runs in an

alphanumerical order, allowing for the selecting of similar or related goals between books.

PEAK-G uses a train/test methodology, which embeds trained stimuli with untrained test

stimuli in a trial block, in the hopes that non-reinforced targets will be similar enough to

occasion a correct response to a test, thus indicating the skill of generalisation (PEAK-G;

Dixon, 2014). PEAK researchers caution that, although earlier PEAK-G programs used

empirically established response repertories, later programs are in need of further evaluations

(Dixon et al., 2017a). PEAK researchers have noted that it is currently unknown how the

four modules of PEAK may interact and affect other PEAK programs and if that interaction,

or lack of it, affects global development. They question whether or not all individual

programs are actually necessary and how certain skills from the modules may influence

behavioural cusps (Dixon et al., 2017a). It may be speculated, that due to the train/test nature

of PEAK-G, which can run a combination of 5 train to 5 tests in a trial block, participants

need to score more consistently in order to reach mastery. For example, trial blocks are still

scored according to the peak prompt level scoring, where test blocks are scored a 0 or a 10. It

is easy to see how, either requiring more prompts, or not scoring correct on the test

component, would not allow a student to reach mastery. This would then require additional

trial blocks to be delivered, which may result in increased examples of stimuli and, thus,

fluency in relational responding. This is in marked contrast to PEAK-E, which utilises a 10

train per trial block and 10 test per trial block strategies. During a test, a student could be

prompted 5 times in PEAK-E at prompt level 8 and still pass mastery in two trial blocks, with

a mastery criteria of 90x2 or 100; to look at it another way, a pass train criteria in under 20

trials. Unfortunately, due to the often unknown element of how PEAK modules affect each

other, it is not possible to say with certainty that PEAK-G could have increased the

generalisation ability of preschool students exposed to PEAK-E targets to the novel

Montessori environment.

As in Study 1, Study 2 was subject to some of the same limitations, including but not

limited to sample size, parental expectations, and time of year and group design. It should be

noted that Study 2 took place during the fall, for a period of three months, thus, at the start of

the semester, all participants would have only been exposed to a few weeks of preschool

education and may not have reached a developmental celling, with regards to language and

academic content. Visual analysis of the results of the BSRA-3 show that 20 of the 36

students (55%) had a score of 100 (average) at pre-assessment.

As discussed earlier, preschool education targets similar relational skills that PEAK targets.

The addition of PEAK-E programs, at this time, when the students in the preschool classes

were learning new and novel material may have helped solidify relational skills that were

being learned. However due to the design of the study, no data was taken on any related

targets in the preschool environment thus it is not determined that treatment as usual had any

effect on the study outcomes. This issue may be addressed in future by taking data on

preschool targets that are similar to PEAK targets, or by conducting a traditional ABA design

study, such as multiple baselines across behaviours. While the sample size was increased by

the introduction of the two armed quasi-RCT design of study 2, it could still be considered a

small n design. Recommendations for future studies that would incorporate an RCT design

include increasing sample sizes for student and staff participants, perhaps looking to recruit

from more than one preschool. Additionally, as no power analysis was conducted before the

study began, the researcher did not know what sample size was suitable to detect effects. It

would be recommended, then, that a power analysis be conducted before recruiting

participants and before beginning data collection on any future studies. Furthermore, the

same limitations regarding group design also apply to this study. Lack of individual data,

does not allow for the consideration on variability of individuals, and this may have been of particular importance in understanding the statistical differences that occurred between symmetry/ reflexivity and transitivity/equivalence, it is recommended that future studies that employ an RCT design should seek to supplement group data with individual results.

In summary, this study demonstrates that teaching PEAK-E targets based on symmetry and reflexivity leads to statistically significant increases in school readiness assessment scores; and that additional training in transitivity and equivalence resulted in minor statistically significant increases in generalisation skills, when compared to a control group. This may suggest that PEAK-E can be used as, not only a valid intervention assessment for children in the preschool setting, but also as an additional curriculum support. Allowing teachers to cherry-pick targets increases both cognition and school readiness targets. This study may help lend support to the effective nature of PEAK Relational Frame Modules, as it addresses the need for effective and scientifically backed ABA interventions in the applied setting.

General Discussion

The studies in this thesis were designed to answer questions arising from existing research regarding the applied implementation of the PEAK relational training systems. Specifically, existing PEAK research has identified several areas of required investigation, including an examination of the efficacy of PEAK as a remediation program for typically developing children in an applied setting, to address gaps in language and cognitive skills (Dixon et al., 2017a). Additionally, PEAK researchers have been critical of the lack of RCTs studies, to date, and suggested that RCTs were required to examine whether PEAK is an effective assessment and curriculum manual (Dixon et al., 2017a). Finally, previous PEAK research has suggested that those implementing PEAK should assess the efficacy of the manualized curriculum format and the fidelity of programme delivery by front line staff (Belisle et al., 2016b). The current research aimed to address these issues. As previously mentioned, this is the first quasi-randomized control study, to date, to present PEAK-E and PEAK-T targets to TD preschool children, to evaluate the impact of teaching PEAK on language and cognitive measures. The study also explored the reliability and fidelity of front line staffs' implementation of PEAK programs, and, additionally, the staffs' perceptions of PEAK, in terms of ease of use and practical application. A second study explored the finer nuances of the order of PEAK-E programme delivery and its impact on school readiness measure. The final phase investigated whether skills acquired through PEAK-E training/testing protocol generalize to novel stimuli in the Montessori environment.

Study 1: Overview

The current study explored the impact of teaching PEAK-E and PEAK-T modules on language and school readiness outcome measures, using a three-armed quasi-randomized intervention study. Thirty-nine TD preschool students between the ages of 3-4 participated. Following baseline assessments with the Peabody Picture Vocabulary Test-4 (PPVT-4),

participants were divided into three equal groups (PEAK-E, PEAK-T and TUA). The remaining pre-intervention assessment of Bracken School Readiness (BSRA-3) and Theory of Mind Battery (ToMI) followed. Training/testing in PEAK programs were conducted with intervention groups and follow-up assessment tests were then conducted with all groups. The aim of the study was to compare the intervention effects of PEAK-E and PEAK-T treatments to a TAU group, and, secondly, to evaluate the impact, within-groups, of PEAK treatment on outcome measurements of language (PPVT-4), school readiness (BSRA-3), and deictic relations (ToMI). It was hypothesised that training in SE and DRR would produce gains in cognitive and language outcome assessment scores, in comparison to the TAU group.

Discussion of Study 1

The results of the between groups analysis indicated that there was a statistically significant difference on the BSRA-3 measure between the PEAK-E and PEAK-T intervention groups, and between PEAK-E and control groups; with the PEAK-E group outperforming PEAK-T and controls. A within-groups analysis indicated that, while all groups increased in ToMI scores, only PEAK-E and PEAK-T had statistically significant increases. There were no other significant increases between pre-intervention and post-intervention scores reported.

The findings of this study provide support for the ability of the PEAK Relational Training manualised curriculum to promote positive and socially significant outcomes for preschool children. The results lend support to prior research that has shown that PEAK manuals are an effective training system in promoting intelligence by combining both SE and RFT protocols with traditional ABA practices (Dixon et al., 2014d). The results of this study have implications for the field of education, as this, and previous studies, show that skills in relational responding lead to increases in performance on cognitive outcome measures, which correlate with scholastic acumen (Barnes-Holmes, Barnes-Holmes & Murphy 2004c,

Cassidy, et al., 2001). Previous calls have been made for the effective dissemination of

RFT/ABA practices into the applied setting (Rehfeldt & Barnes-Holmes, 2009). This study

may show the importance of moving these combined technologies into the TD school

populations, and not necessarily relying on them solely as a treatment for children with

intellectual disabilities, or as an adjunct treatment for children with learning difficulties in

mainstream schools (Dixon et al., 2017a). Importantly, in an Irish context, these results show

that TD populations of preschool learners also benefit significantly from the application of

PEAKs blended ABA /RFT/SE programs. This could, in future, provide, not only an

assessment, but also a "plug-in" intervention for children in preschool, Junior/Senior Infant

classes, which may allow teachers to correct gaps in skill sets as they emerge in their

students. Addressing issues that arise early in a child's education provides them with the

support they need to keep them on par with their peers; as noted in an international review on

evidence on the benefits of early childhood interventions (Nores & Barnett, 2010). One

limitation of this study was the number of participants recruited and the subsequent division

into three equal groups, as this resulted in small sample sizes (n=13 per group). While this

was addressed in the second study (2 groups n=18), it does suggest that results from Study 1

should be considered preliminary. Future studies should aim to replicate this study, utilising

larger groups.

Within-group analysis of ToMI scores lend support to ideas promoted though RFT

studies that have shown that increases in relational responding can affect cognitive

functioning and can be considered a prerequisite for more complex relational framing

(Barnes-Holmes et al., 2004b). Specifically, results indicated that, while all groups did

increase in ToMI scores, only PEAK-E and PEAK-T had statistically significant increases.

These results suggest that teaching DRR may increase children's abilities in perspective

taking skills. It may come as no surprise then that a statistical increase in ToMI scores were

found in the treatment group PEAK-T, as two programs specifically taught deictic relation frames of perspective taking, using the Cue of You/I and You/I reversal. This is similar to results of PEAK studies on You/I relations, which also found increases in PEAK score when training deictic programs (Belisle et al., 2016a). Our findings support previous research that found training in deictic relations underlie perspective taking ability (Hendrix et al., 2016; McHugh et al., 2009; Rehfeldt, et al., 2007). Additionally, these preliminary results also appear to support research that has indicated that accuracy in perspective taking correlates with performance on ToMi measures (Hendriks et al., 2016). Research on deictic relations suggest that performances on simple ToMi tasks develop between the ages of four and five, and that prerequisite relational skills may be required before perspective taking can be established (Barnes-Holmes et al., 2004b). For example, in one study on perspective taking and theory of mind, a three and half year old child was trained in You/I and Here-There perspective taking protocol. Researchers found that extensive MET was necessary to establish both deictic relations (Barnes-Holmes et al., 2004b). A further study with a four year old child found that extensive MET was required to establish the Now/Then relation (Barnes-Holmes et al., 2004b). Again, while this study appears to support previous research that shows training, combining traditional ABA techniques such as MET, along with new RFT protocols, allows for gains to be found in relational responding the results are preliminary in nature and require replication before any concrete conclusions are drawn.

It is interesting to note, however, that the treatment group PEAK-E, which was not exposed to any deictic training, also had statistically significant increases in ToMI scores. As previously discussed, PEAK-E includes four primary types of SE relations (symmetry, reflexivity, transitivity, and equivalence); Programs are scaffold from simple non-arbitrary symmetrical relations to more complex arbitrary relations. This may lend support to the theory that relational responding (using co-ordination and comparison contextual cues such

as "same") is indeed a prerequisite for more complex relational framing such as deictic relations. These are believed to underpin cognitive perspective-taking (Barnes-Holmes et al., 2004b, Ming & Stewart, 2017; Rehfeldt et al., 2009). Future research could look at what combination of PEAK-E programs (symmetry, reflexivity, transitivity, and equivalence) affect perspective-taking ability.

Results reported high procedural fidelity (PEAK-E 97.6 %/ PEAK-T 95.5%) in implementation of PEAK programs and high IOA (PEAK-E 94.3% / PEAK-T 98%), suggesting that PEAK programs were run within the parameters of PEAK instructions. This indicates that non ABA frontline staff can be trained with one session of BST to implement PEAK with fidelity. This, then, implies that high levels of implementation fidelity and IOA can be achieved by combining the written PEAK instructions (published within the PEAK-E and PEAK-T) with BST training. These results suggest that teachers with both higher qualifications (Level 8 and above on the Quality and Qualifications Ireland -QQI) and front line staff with lower level qualifications (Level 6 on the QQI) can administer assessment tools with high reliability. These results have implications for time and resource constraints in the applied settings, in so far as PEAK can be run within instructional parameters, with frontline staff of differing qualifications, without the need for extensive training time. Results from data on Social Validity of PEAK as a viable teaching tool suggest that teachers had a positive experience implementing both PEAK-E (M=35.2, SD=2.4) and PEAK-T (M=36.8, SD=2.3) modules, with higher scores (maximum score of 40) representing higher levels of satisfaction. While previous studies suggest that PEAK is an effective curriculum and language programme, which can be implemented by front line staff with fidelity, no studies, to date, have explored the social validity of PEAK protocols (Belisle et al., 2016b).

Teacher Evaluation- Overview

Study 1 explored both reliability and fidelity of PEAK implementation by non ABA trained front line staff and also examined staffs' perceptions of the social validity of PEAK programs, in terms of ease of use and application. Two preschool teachers were recruited to implement PEAK programs for Study 1. Teachers received one BST session on how to deliver PEAK programs and assessment measures. IOA and fidelity measures were taken as Teachers implemented pre-assessment /post-assessment test and PEAK-E and PEAK-T training/testing with participants. Five days after post-assessment measures had been completed; a 7-point Likert questionnaire on the social validly of PEAK-E and PEAK-T was administered to the teachers. It was hypothesised that non ABA trained staff could be trained, using behavioural skills training (BST) approach, to implement PEAK with high fidelity. Additionally, we hypothesised that staff will deem PEAK interventions as socially valid.

Discussion of Teacher Evaluations

Research on social validity is concerned with the social desirability and usefulness of behavioural change (Kennedy, 1992). Subjective evaluation, which is often used as a data collection measure for social validity, is concerned with an individual's ratings regarding features of interventions. It is often centred on outcome (post-intervention) validation, through the use of questionnaires and rating scales (Carroll & Peter, 2014). Inaccurate reporting from participants is one of the limitations of Likert scales; measurement of social validity should include direct measurement, as well as indirect measurement, as a way of addressing this limitation (Carrol & Peter, 2014). While results from this study have shown that teachers find PEAK to have high social validity, future research should address both the direct and indirect service user in order to more sensitively reflect behavioural changes in a societal context. For example, in an applied Montessori setting, this could be as simple as offering a child the choice of what they would like to work with - a PEAK target program or

a Montessori program that targets the same skill set - and then recording the choice. An

Additional example of an easy to use measure for social validity is the Intervention Rating

Profile (IRP -15), (Martens, Witt, Elliott, & Darveaux, 1985), which may provide a more

quantifiable measure than traditional Likert scales. Overall, the results, which align to the

effective nature of ABA, supports the justification that manualized protocols allow for the

standardization of PEAK implementation, which can provide treatment for clients that are

data driven and considered socially valid and reliable (Baer, 1968, Belisle et al., 2016b,

Dixon et al., 2014d, Rowsey et al., 2014). However, all results should be treated with caution,

as they are preliminary in nature and require replication.

Study 2: Overview

Study 2 explored the impact of teaching the PEAK-E module on school readiness

outcome measures (BSRA-3), at three time-points: baseline, mid-intervention, and post-

intervention. The study (utilising the same protocol as study 1) also explored reliability and

fidelity of front line staffs' (n=3) implementation of PEAK programmes.

This was a quasi-randomized intervention study, with n=36 TD preschool students

between the ages of 3-4. Participants were divided into two equal groups (PEAK-E n=18 and

control n=18) following baseline assessments with the PPVT-4. The PPVT-4 was used to

divide the groups, in line with Study 1 protocols. The remaining pre-intervention assessment

of BSRA-3 followed for both groups. Training/testing in four PEAK-E programs (2

reflexivity, 2 symmetry) were then conducted with the intervention group. Mid-intervention

assessment of BSRA-3 was conducted with both groups. Training/testing in four additional

PEAK-E programs (2 transitivity, 2 equivalence) were then conducted with the intervention

group, and a follow-up assessment test (BSRA-3) was conducted with both groups. The aim

of the study was to compare the intervention effects of PEAK-E treatment to a TAU group,

and to evaluate the impact within group of PEAK-E treatment on outcome measures of

school readiness (BSRA-3), at mid-intervention and post-intervention times. It was hypothesised that, although school readiness may be affected at the midpoint, significant gains would not be observed until post-intervention.

Discussion of Study 2

Results from Study 2 showed that the PEAK-E group performed significantly better than the control group on a measure of school readiness (BSRA-3). Follow-up tests confirmed that reflexivity/ symmetry intervention stages were required to significantly impact school readiness scores in the treatment group, as no further significant increases were seen upon delivery of the transitive/ equivalence intervention stage. Findings from Study 2 support findings from Study 1 and also provide support for previous PEAK research, which shows that PEAK may result in improvements in important academic outcomes (Belisle et al., 2016c; Dixon et al., 2014d). This study specifically suggests that training in PEAK-E promotes concepts related to school readiness (colours, letters, numbers/counting, sizes/comparisons and shapes) by combining SE protocols with traditional ABA practices, which lend support for the effective dissemination of PEAK-E combined ABA/SE programs into the applied setting (Dixon et al., 2014d).

Outcomes of Study 2 suggest that the implementation of four programmes from PEAK-E module, specifically the SE skills of reflexivity and symmetry, significantly affect scores on school readiness assessments, over that of a TAU group. Results bolster previous research that shows preschoolers exposed to programs that emphasise academic instruction show significantly greater improvements on cognitive tests for reading, writing, and math, than the control group (Gormeley et al., 2005). It may be of interest to note that, while all participants had been exposed to a preschool curriculum that utilised the Montessori method, and which may have a strong emphasis on academic instruction, it was not seen to translate to

measurable changes in the BSRA-3 with control group in this study. Future studies should attempt to replicate these preliminary findings.

As previously discussed, the generativity of language for young children is first targeted with non-arbitrary relations and then with more complex arbitrary relations (Ming & Stewart, 2017). PEAK-E targets implemented in Study 2 ranged on a continuum of responding, from simple non-arbitrary relations (based on physical properties), as in the case of the first reflexive programs (i.e. matching to sample), to more complex arbitrary relations such as the equivalence programs (i.e. letter case and sound). This continuum of responding, from non-arbitrary to arbitrary, may help to scaffold composite skills that lead to fluent responding, as it is theorised that non-arbitrary relations may be a required skill for advanced arbitrary responding. The results of Study 2 would indicate that this may be the case, as even though continuous increases from pre-mid-post intervention BSRA-3 assessment scores were seen in the treatment group, it was the introduction of reflexivity and symmetry programs (pre-intervention - mid-intervention) that led to a significant increase in BSRA-3 scores. This may supports research that shows that derived relational responding and training with MET and SE can be seen to encourage cognitive functioning. Cassidy et al. (2001), in a study with TD and educationally disadvantaged individuals, found that TD children exposed to MET in SE frames of more than/ less than and same/opposite exhibited significant increases in IQ, compared to a control group. Additionally, many research studies suggest that the use of ABA technologies of DTT and MET encourage fluency in relational responding, which has a subsequent correlation with IQ scores (Murphy et al., 2009, Murphy et al., 2010, O'Hora, Pelaez & Barnes-Holmes, 2005). This study did not include IQ assessments; it is recommended that future PEAK research should include IQ assessments.

PEAK research has indicated a strong, positive correlation between IQ scores and PEAK DT assessment scores (Dixon et al., 2014d). In a PEAK study to explore normative

data, 208 TD students were administered PEAK DT. The results indicated a strong positive relationship between PEAK DT total scores and age, specifically that most participants were able to complete all PEAK DT targets by the age of eight (Dixon et al., 2014b). Of interest in relation to the current research, it would be beneficial if future studies were also conducted to ascertain similar correlations with normative samples for the PEAK-E and PEAK-T manuals. The present research has shown that TD children of the age of four are capable of mastering, to fluency, 8 programmes from PEAK-E across reflexivity, symmetry, transitivity and equivalence, ranging from simple non-arbitrary "match to sample" programs to more advanced complex arbitrary programmes such a "feature rules". However, without corresponding normative data, it is unknown if the target skills were within developmental norms. It may be that the ABA method of instruction of PEAK programs made mastering advance cognitive concepts easier for the treatment group who were exposed to both PEAK and preschool. Correlating age with mastery of individual programs will give future researchers a better understanding of the age at which these relations become apparent, and, additionally, what cognitive celling level manifests with ABA/SE training. The Mastery Train/Test Criteria Flow Chart (Figure 4) developed for this Study may prove beneficial in quantifying how long a participant should be trained before the decision to stop the programme is made, thus making large scale train/testing RTC a possibility. A limitation of study 2 was the small sample size of $n=18$ per group; no power analysis was done to determine an appropriate sample size. Conducting a power analysis, along with the recruitment of greater numbers of participants, would be recommended for future studies.

Results of measures of intervention fidelity from Study 2 add additional support to the fidelity results from Study 1. Results of fidelity measures from Study 2 shows high procedural fidelity (PEAK-E 99.7%), in the implementation of PEAK-E programmes and high IOA (PEAK-E 90.9%), indicating that PEAK-E programmes were run within the

parameters of PEAK instructions. This indicates that non ABA trained pre-school staff, with different levels of qualifications, can be trained with one session of BST to implement PEAK with fidelity. Additionally, this supports previous PEAK research on BST training (Belisle et al., 2016b). Dixon (2014) suggested that PEAK is designed to be an easy to use curriculum manual for frontline staff and parents. One limitation of the study may come from the fact that teachers were trained in BST by an experienced ABA research student. Given the complexity of the interventions, it is not certain whether positive outcomes would have ensued if procedures were implemented by front line staff without training. It may be that teacher training with BST, by an ABA trained tutor, allowed for the necessary transfer of skills, which explain the high fidelity results observed. Future research may look at fidelity and validity for consumers of PEAK who are not in a position to undertake BST, and who must rely on dissemination of PEAK protocols from the manuals alone. This would give a clear indication of whether PEAK is truly an "off the shelf product", or if it requires training to implement with high fidelity.

One additional confound that must be discussed in light of the findings of Study 2 result from the order of the studies, in comparison to the time of year. Study 1 took place in the spring semester, and Study 2 took place in the fall semester of the following school year. No children from Study 1 participated in Study 2. The results of Study 2 display stronger pre-intervention mean and standard deviation scores across measures than Study 1. This may be due to the fact that children in Study 1 had been exposed to 5 months of prior preschool education, whereas Study 2 participants had not been exposed to any formal preschool education before the start of the study. It may be that Study 2 is a fairer representation of the impact of a targeted ABA/DRR blended programme, as the study started at the beginning of the preschool year. As the BSRA-3 was sensitive to growth in School Readiness Skills, children in the first study from both groups would be expected to have already reached some

of the targets assessed by the BRSA-3. This may mean they may not have displayed scores with wide discrepancies between groups as a result of treatment specific to educational goals. Due to the limitations mentioned above, future researchers should be sensitive to the time of year they undertake research in the applied preschool setting when using measures that are sensitive to School Readiness. Additionally, as previously discussed, limitations of group design must be considered when interpreting data, mainly that intrasubject replication is absent; group data may not be representative of the individual subject's performance; and that variability in the data is often masked (Cooper, 2007; Horner et al., 2005). Recommendation for future studies suggests including supplemental data displaying individual results to represent individual performances that may not be apparent on group data.

Generalisation Probes

The second phase of Study 2 examined if PEAK-E skills that were taught to fluency though MET would generalize with novel Montessori materials in the natural environment. Participants (n=36) from treatment group PEAK-E and the control group from Study 2 completed eight test, with ten trails each, on novel Montessori material in the natural environment. Responses were recorded on PEAK data sheets, with 10 for correct response and a 0 for incorrect response. The results of generalisation probes indicated that PEAK-E interventions resulted in moderate overall gains in the generalisation of PEAK-E target skills. Specifically, the PEAK-E group had significantly higher scores in two of the eight measures on generalisation skills in the natural environment: PEAK-E targets of Transitivity: 9P Actions and Outcomes (novel Montessori material, what happens when) and Equivalence: 11F Letter Case and Sounds (novel Montessori material, movable alphabet).

This study, taken in context with results from Study 2, indicates that, while reflexivity and symmetry training were required to significantly raise BSRA-3 scores within the PEAK-E group, it was only with the additional training of transitivity and equivalence programmes

that participants received statistically significant scores in the generalisation test. These results are important, as they highlight how PEAK-E skills may be generalised in the natural environment. This may allow children greater opportunities to experience reinforcement from successful exploration of materials in their environment. These results may lend support to the theory that training in DRR increases generalization skills. In a study on relational responding, researchers used MET to train three children aged 4 to 6 in relational responding with the cue of "more-than/less-than" using identical sized coins of different values (Barnes Holmes, Barnes Holmes, Smeets, Strand & Frimanet, 2004d). Follow-on tests found that training in relational responding established increasingly complex patterns of relational responding in all children and that these skills generalised to novel stimuli (Barnes-Holmes et al., 2004d). A limitation of the current study was that no baseline assessments were conducted for the natural environment materials before the introduction of PEAK-E and, as a result, it is not certain whether the treatment group PEAK-E already had these skills in their repertoire. It is recommend that future PEAK studies should include a generalisation phase of targets into the natural environment, with appropriate pre and post measures taken for groups. In addition, future PEAK research should ascertain if introducing PEAK-G module, which specifically train for generalisation skills, would have an impact on generalization scores when combined with PEAK-E in the natural environment.

Conclusions

In conclusion, this study set out to address several research questions, regarding the efficacy of PEAK as a curriculum model and its effect on scholastic and language assessment measures with TD preschool students (Dixon et al., 2017a). It examined PEAK's ability to be disseminated by frontline staff with fidelity and reliability. Lastly, it explored the generalizability of PEAK targets to the naturalised Montessori environment (Belisle et al., 2016b). This study has provided additional insights into PEAK relational training

programmes. It has found PEAK to be conceptually sound as an effective intervention to increase DRR skills (specifically SE skills) in preschool children, which were shown to generalise into the natural Montessori environment. The results suggest that the combined nature of traditional ABA techniques and modern SE/RFT protocols can be blended in an easy to use manualised curriculum format. It has been shown to be able to be effectively implemented by frontline staff (with different levels of qualification), with both high fidelity and high reliability. The results indicate that largely staff found PEAK-E and PEAK-T to be socially valid and easy to use. Overall, PEAK-E has shown itself to be psychometrically robust and this may indicate that it can be considered an effective intervention tool, which can be seen to positively affect outcome measures of school readiness in preschool children. It is reasonable to suggest, however, that future research should replicate this study, as one study alone, is not enough to warrant that PEAK increases school readiness scores.

Coming back to the Irish context, it would be remiss of us, as educators, if we discounted a curriculum that, with the implementation of eight of its programs, achieved such significant results in such a short amount of time. The Irish National Curriculum for Early Years (Aister) is broad and wide. It was written in such a way that early years practitioners of every method can construct and implement their own curriculum while still adhering to national standards. It would not dilute the aesthetics of typical Irish preschools (Montessori/Play base/Steiner) curriculums to incorporate the ideas and programme plans of PEAK within the preschool environment. If gains are made, they may just be the stepping stone that one child needs to keep on par with their peers and enjoy the benefits of accessing all strands of their early years education, thus providing the necessary path towards an easy transition to Primary school.

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Appendices

Letter to Tiddlywinks & Scallywags

Title: PEAK Relational Trainings System and the Preschool Environment: Assessing the Relationship between School Readiness in typically developing preschool children and the PEAK Relational Training System, a Random Control Trial (RCT)

Research Objectives:

1. Does learning PEAK targets (e.g., equivalence or same-different relations; perspective-taking I-You/Here-There/Now-Then) result in improved scores on ability assessments with preschoolers?
2. Are instructors readily able to use PEAKor do they require training?
3. Do instructors rate PEAK as an effective and useful teaching tool?
   Can PEAK programmes be combined with the T-IRAP (interactive computerised teaching programme) to teach preschoolers?

The Project: Teaching Relational Frame Theory to a group of preschool children using the PEAK Equivalence and Transformation Modules Training module to investigate its impact on school readiness. This study will also look at Theory of Mind relational training in Perspective taking and Deictic Relations. The study will involve a randomised control group. Group 1 will work with material driven by PEAK RFT modules and Group 2 will work with Montessori Materials. I hope that this study will help to advise teaching practice and lead to practical methods and curriculum that lead to increased school readiness in preschool children.

- Pupils' involvement in this research will be during their timetabled school day. I will only use students who are first year ECCE children.
- All students who partake will either receive additional PEAK training or "treatment as usual" Montessori Education training.
- The exercises will be done in the classroom in which the child is located.
- All information recorded will be pseudo-anonymized. This means that no child will be identified by name. A control sheet that identifies work will be kept in a locked box.
- The researcher will not have the ability to determine the results of any IQ, verbal intelligence or school readiness tests. Data will only be used for the purposes of the study. All parents will have the right to all information and notes on their children; however no interpretation of the data will be given.
- All information ascertained in the study will be stored securely for a period of 5 years, after which it will be deleted and/or destroyed.
- All children partaking in the study will be asked if they would like to work with the researcher daily. If the child does not wish to take part, they will be asked for 5 consecutive days, and removed from the list for a period of 2 weeks and asked again. If they refuse at that stage, they will be removed entirely from the study. However, if the child decides on their own accord at any stage after they have originally said no, they will be allowed back into the study.
- All participation is entirely voluntary and children and parents may choose not to consent or to withdraw consent and discontinue participation in the study at any time.

Signed: I have read the proposal and agree to its content:
Date:

Details about Researcher

- Name: Roberta Hines B.A. Psych., H-Dip Mont., Doctoral Student at Maynooth University
- Address: Baltracey, Maynooth, Co. Kildare
- Contact number: 086 846 1096
- Email: roberta.hines@nuim.ie

Details about Supervisor
- Name: Dr Carol Murphy, BCBA-D
- Address: Department of Psychology, Maynooth University, Maynooth, Co. Kildare
- Contact Number : 01 708 6723
- Email: Carol.A.Murphy@nuim.ie

- *If during your participation in this study you feel the information and guidelines that you were given have been neglected or disregarded in any way, or if you are unhappy about the process, please contact the Chairman of the Research Ethics SubCommittee, Dr Sinead McGilloway Tel: 01 798 6052 Email: sineade.mcgilloway@nuim.ie Please be assured that your concerns will be dealt with in a sensitive manner.*

Appendix A

Recruitment Document: Letters to Parents about Research Proposal

Dear Parent/Carer

You are invited to read the following information regarding a PhD research project that will be taking place in your child's preschool during the 2015–2016 term. Any questions can be directed to Roberta Hines, the researcher, information below.

Assessing the impact of PEAK relational learning on school readiness and other measures in typically-developing preschool children

The Researcher: Roberta Hines is a Doctoral Student in Psychology at Maynooth University. Roberta is also a Directress at Tiddlywinks & Scallywags. She has a B.A in Psychology, a H.Dip in Montessori Education and over 16 years working with children in the Early Childhood Sector. This year I am seeking participants for my Doctoral research project titled: Assessing the Relationship between School Readiness in typically developing preschool children and the PEAK Relational Training System, a RCT.

The Project: The researcher will carry out a **Randomized Controlled Trial** with a **Treatment as Usual** comparison. This is a study where participants are assigned to treatment conditions at random. **Treatment as Usual** means that one group will receive an additional treatment to the Montessori Education, in this case **PEAK Relational Training** and one group will continue to receive Treatment as Usual in this case only the **Montessori Method of Education**. TAU comparisons studies answer practical questions of whether introducing new treatments (PEAK) could improve outcomes over and above the current state of practice (West, Spring). The study will be carried out at Tiddlywinks and Scallywags Montessori. The Montessori school has two teaching rooms for ECCE children. The school uses a standardized Montessori curriculum manual that insures that the Montessori Method of education will be taught the same to each group. The material within each classroom is considered identical to resources stated in the curriculum manual. The level of qualification for staff is standardized at FETAC 6 level and management at HETAC level 8. The **sample groups** will be targeted from the ECCE Morning Montessori Classrooms.
I hope that this study will help to advise teaching practice and lead to practical methods and curriculum that lead to increased school readiness in preschool children.

Who am I looking for? I am looking for children who are attending a MORNING MONTESSORI ECCE CLASSROOM at Tiddlywinks & Scallywags, Maynooth.

How will children be chosen for the study? A brief talk on the study will be held during open evening at Tiddlywinks & Scallywags. All parents of enrolled children will be given an information leaflet. Parents who are interested in participating can give assent for their child. A parental consent form will be provided for all parents/carers to sign to enrol their child in the study. A child's information sheet will also be provided. Parents are advised to read this document to their children to ensure voluntariness.

How are children separated into groups? The children's class will be divided into groups randomly. All groups will be taught the Montessori Method of Education. Control Group will receive only Montessori Method of Education. Experimental Group will receive the

Montessori Method of Education PLUS ADDITONAL brief training with the PEAK Relational Training System.

Where? Tiddlywinks & Scallywags Montessori, Maynooth, Co. Kildare

When? Research will be conducted during the preschool hours.

Title: Assessing the impact of PEAK relational learning on school readiness and other measures in typically-developing preschool children
Research Objectives:

       Research Objectives:

1. Does learning PEAK targets (e.g., equivalence or same-different relations; perspective-taking I-You/Here-There/Now-Then) result in improved scores on ability assessments with preschoolers?
2. Are instructors readily able to use PEAKor do they require training?
3. Do instructors rate PEAK as an effective and useful teaching tool?
   Can PEAK programmes be combined with the T-IRAP (interactive computerized teaching programme) to teach preschoolers?

Details about Researcher
- Name: Roberta Hines B.A. Psych., H-Dip Mont., Doctoral Student at Maynooth University
- Address: Baltracey, Maynooth, Co. Kildare
- Contact number: 086 846 1096
- Email: roberta.hines@nuim.ie

Details about Supervisor
- Name: Dr Carol Murphy, BCBA-D
- Address: Department of Psychology, Maynooth University, Maynooth, Co. Kildare
- Contact Number : 01 708 6723
- Email: Carol.A.Murphy@nuim.ie

- *If during your participation in this study you feel the information and guidelines that you were given have been neglected or disregarded in any way, or if you are unhappy about the process, please contact the Chairman of the Research Ethics SubCommittee, Dr Bryan Roche. Tel: 01 7086026 Email: Bryan.T.Roche@nuim.ie. Please be assured that your concerns will be dealt with in a sensitive manner.*

Information Sheet for Parents/Guardians about Study

Title: Assessing the impact of PEAK relational learning on school readiness and other measures in typically-developing preschool children

Dear Parent/Carer

My name is Roberta Hines. I am a Doctoral student in the Department of Psychology at Maynooth University. I am conducting research on School Readiness using the PEAK Relational Training System in participants at Tiddlywinks & Scallywags Montessori School in Maynooth.

What is the Study about? The study aims to see if there is a difference between preschool children who receive brief additional PEAK Trainings System and those who will receive "treatment as usual" of Montessori Education. The study will use the PEAK assessment measure and additional assessment measures of School Readiness, IQ, and Verbal ability.

Who am I looking for? Children who are enrolled in morning ECCE Montessori Classrooms at Tiddlywinks & Scallywags, Maynooth 2016.

When will the study take place? The study will take place during your child's class hours. The study will run from September to April. The researcher has approximated 4 hrs of assessment time in total and 21 hrs of PEAK Relational Training System.
Control Group: 4 hrs of time
Experimental Group: 25 hrs of time.

How are children put in groups? All children who have agreed to the study will be divided randomly into control groups. Group 1 will work with material driven by PEAK Relational Training System modules and Group 2 "treatment as usual" will work with Montessori Materials. The researcher will tell you which group you child is in.

What will your child have to do? Children in Group 1 will be invited to work with the researcher (Roberta Hines) on additional exercises from the PEAK Relational Training System; they will also continue to work on Montessori Materials with their class teachers. Assessments will be conducted of your child's Verbal Ability, I.Q , School Readiness and a PEAK assessment looking at your child's ability to relate, i.e., same/different, more/less. One assessment will be done at a time. Peak Relational Training System will consist of 2 modules – PEAK Equivalence and PEAK Transformation. The modules consist of a series of Goals that can be taught through simple to teach exercises. The children will work through the exercises. When they reach an exercise that they are unable to grasp, the training will give three exemplars, and if the child has not grasped it, the researcher will move on to the next goal. Your child will work with the researcher for approximately 10 to 15 minutes 3 to 5 times a week, depending on the child. Children will also be taught the PEAK Equivalence and PEAK Transformation Modules on a T-IRAP computer programme. This will involve using a computer/tablet to learn relational frames. Assessment will be carried out in September, and Trial Training starts in October and runs till April. The researcher estimates roughly 21 hrs of Trial training and 4/5 hrs of Testing. It is expected that your child will be involved with the research for 24 to 25 hrs of their overall class time during the 2015–2016 school term. All PEAK work is voluntary. Children in Group 2 will work with teachers on

Montessori Material. Children in both groups will be invited to undertake assessment tests at the start and finish of the research. Children in the experimental group will also be assessed after the finish of the first Relational Training System module.

What are the benefits? The research examines the effects of PEAK relational learning in a Montessori classroom. However, the research does not involve a learning intervention or added benefit of any kind. If when the study is done, and Additional learning may be a benefit of this study.
Parents will be told that the research will examine the effects of PEAK relational learning but will also be informed that the research does not involve a learning intervention or benefit of any kind.

What are the risks? Your child may feel uncomfortable saying no to working with the researcher (Roberta Hines) as she is one of your child's teachers.
NOTE: The researcher is a qualified Montessori Teacher HETAC level 8 with over 15 years' experience in the field of Montessori Method of Education. She is keenly aware of the nuances of children within the participants' age range, and feels that she is more than adequately qualified to assess the state of mind of a child engaged within the study to negate any negative side effects.

- Risk of seizure: children who have a diagnosis of Epilepsy and who are prone to seizure may not part take in the study due to the use of Tablets/Screens during the TIRAP portion of the study.

What is done to minimise this risk? Children will be asked at the start of every trial if they wish to work with the researcher (Roberta Hines) or not. If they decided not to, they will be asked for 5 consecutive days; if they continue to say no, it will be concluded they wish to have a break, and they will be removed from the study for 2 weeks. At this stage they will be asked again, and if they say no, they will be permanently removed from the study. However, at any time, from the initial no, the child has the right to request to work with the researcher. They will be allowed back into the study.
As the parent/carer you have a right to remove your child at any time.

What if I/my child do not want to take part? Participation in this study is voluntary and you or your child can choose not to consent or to withdraw consent and stop participating in the study at any time. In addition, you can choose not to consent or to withdraw consent and stop your child participating in the study at any time.
NOTE: You may not withdraw your child's information once the information has been presented for publication.

What happens to the information? The information that is collected will be kept confidential and stored on the researcher's computer with protection password and all handwritten material will be kept in a safe locked box in the researcher's office. The information will be pseudo-anonymized during the research but all data that is analysed for publication will be anonymized; this means that your child's name and school will not be published. The data are kept for a period of five years. Electronic data will be kept in an encrypted file on the researcher's computer, and any hard copy data will be kept in a locked box. After the period of 5 years it will be deleted and/or disposed of via shredding.

Can I request information? As part of the Freedom of Information Act you may request your child's information. This must be done via a formal written request. Please note that

any information you receive will not be interpreted as the researcher is not in a position to do so.

What happens if something goes wrong? In the unlikely event that something goes wrong during the study, the session will immediately stop and the researcher will resume only when both the child and the researcher are ready or the session will be stopped completely.

What happens at the end of the study? The information will be presented in a study. The study may or may not be published. All information will be anonymised. All data will be held for 5 years by the researcher in a locked box or password-protected on computer when it will be deleted and destroyed. The results of the study will be available to participants on written request. You may be asked to take part in follow-on research in the future.
All data collected may be used in a resulting doctoral thesis and/or research publication or conference presentation, but no child will be identified by name or other information that could lead to identification. To reiterate: after all data is analysis is complete and data is anonymized, it will not be possible to retrieve data for a particular participant.

What if I have more questions? If you have any questions that are related to any aspect of the study you may contact the researcher for further clarification.

What if I change my mind during the study? At any stage if you or your child feels that you wish to discontinue being a participant you are free to stop and take no further part. There are no consequences for your child if you or they should decide to change your mind about the participation in the study.

 Questions? If you have any questions or concerns please feel free to contact the researcher.

Details about Researcher
- Name: Roberta Hines B.A. Psych., H-Dip Mont., Doctoral Student at Maynooth University
- Address: Baltracey, Maynooth, Co. Kildare
- Contact number: 086 846 1096
- Email: roberta.hines@nuim.ie

Details about Supervisor
- Name: Dr Carol Murphy, BCBA-D
- Address: Department of Psychology, Maynooth University, Maynooth, Co. Kildare
- Contact Number : 01 708 6723
- Email: Carol.A.Murphy@nuim.ie

- *If during your participation in this study you feel the information and guidelines that you were given have been neglected or disregarded in any way, or if you are unhappy about the process, please contact the Chairman of the Research Ethics SubCommittee, Dr Sinead McGilloway Tel: 01 798 6052 Email: sineade.mcgilloway@nuim.ie Please be assured that your concerns will be dealt with in a sensitive manner.*

Parental/Guardian Informed Consent Form for Child Participant in Doctoral Research

Title: Assessing the impact of PEAK relational learning on school readiness and other measures in typically-developing preschool children
Research Objectives:

      Research Objectives:

4. Does learning PEAK targets (e.g., equivalence or same-different relations; perspective-taking I-You/Here-There/Now-Then) result in improved scores on ability assessments with preschoolers?
5. Are instructors readily able to use PEAKor do they require training?
6. Do instructors rate PEAK as an effective and useful teaching tool?
   Can PEAK programmes be combined with the T-IRAP (interactive computerized teaching programme) to teach preschoolers?

The current research will be conducted by Roberta Hines, B.A. Psychology H.Dip Montessori Education, who is a Doctoral student at the Department of Psychology, Maynooth University, Co. Kildare. Roberta Hines has worked in the area of Early Childhood Education since 2000 and has been the proprietor and a Head Directress of Tiddlywinks & Scallywags Preschool since 2002. She can be contacted at email: roberta.hines@nuim.ie or via telephone on 0868461096. The research will be supervised by Dr Carol Murphy, Ph.D. BCBA-D a Board Certified Behavioural Analysts

In agreeing that my child participates in a research study carried out by Roberta Hines, a Doctoral student at Maynooth University Co. Kildare, I (Print Name Block Capitals)
_____ understand the following:

- I am aware of what the study consists of: Children in Group 1 will be invited to work with the researcher (Roberta Hines) on additional exercises from the PEAK Relational Training System; they will also continue to work on Montessori Materials with their class teachers. Assessments will be conducted of your child's Verbal Ability, I.Q, School Readiness and a PEAK assessment looking at your child's ability to relate, i.e., same/different, more/less. One assessment will be done at a time. Peak Relational Training System will consist of 2 modules – PEAK Equivalence and PEAK Transformation. The modules consist of a series of Goals that can be taught through simple to teach exercises. The children will work through the exercises. When they reach an exercise that they are unable to grasp, the training will give three exemplars, and if the child has not grasped it, the researcher will move on to the next goal. Your child will work with the researcher for approximately 10 to 15 minutes 3 to 5 times a week, depending on the child. Children will also be taught the PEAK Equivalence and PEAK Transformation Modules on a T-IRAP computer programme. This will involve using a computer/tablet to learn relational frames. Assessment will be carried out in September, and Trial Training starts in October and runs till April.
- I am aware of how long the study will be: The researcher estimates roughly 21 hrs of Trial training and 4/5 hrs of Testing. It is expected that your child will be involved with the research for 24 to 25 hrs of their overall class time during the 2015–2016 school term. All PEAK work is voluntary. Children in Group 2 will work with teachers on Montessori Material. Children in both groups will be invited to undertake assessment test at the start and finish of the research. Children in the experimental group will also be assessed after the finish of the first Relational Training System module.

- I am aware that the study is being carried out by Roberta Hines, a PhD student at Maynooth University and supervised by Dr Carol Murphy, Ph.D. BCBA-D a lecture from Maynooth University. In conducting the current research the student and supervisor are responsible for adhering to ethical guidelines set out by the Psychological Society of Ireland and the Behaviour Analyst Certification Board in all dealings with my child.

- I understand that any information collected by the study will be completely pseudo-anonymous pre analysis stage. All analysed data will be anonymous. My child's identity will not be provided in any subsequent presentation or publication of data.

- I understand that my child's data will be pseudo-anonymous. All data will be assigned false names and will be stored in encrypted (protected) files on the researcher's computer for a period of 5 years or hard data in a locked box, after which the files will be deleted or the data will be held for no longer than is considered necessary as recommended by the Data Commission of Ireland after which the data will be deleted. All analysed data will be anonymized for publication purposes and my identity will not be provided in any subsequent presentation or publication of data.

- I have read and understand the attached information sheet that tells me what procedures will be completed with my child. I am aware of any risks and benefits associated with the study.

- I have had time to consider whether I want my child to take part in this research project and any questions that I had were answered satisfactorily.

- I understand that my child's participation is entirely voluntary and that there will be no negative repercussions for them if they decided not to participate.

- I understand that I have the right to refuse consent to participate and withdraw my consent at any stage without any negative consequence for my child.

- I understand that the information collected will be stored in the Maynooth University of Psychology and may be presented/published in academic journals and at conferences, but no young person will be identifiable form the information.

- I understand that once my child's data has been submitted for publication their data cannot be withdrawn from the study.

- I understand that I may be asked to participate in further research in the future as a continuation of the study. All data collected may be used in a resulting doctoral thesis and/or research publication or conference presentation, but no child will be identified by name or other information that could lead to identification. To reiterate: after all data is analysis is complete and data is anonymized, it will not be possible to retrieve data for a particular participant.

- I understand that no financial or other incentives will be provided to parents or children for participation in the study

- By signing below you are confirming that you have read and understand the above statements and that you agree to take part in this piece of research:

Your child's name (Block Letters): -

_____

Your name:_____

Your signature:-

_____Date:_____

Details about Researcher
- Name: Roberta Hines, B.A. Psych., H-Dip Mont., Doctoral Student at Maynooth University
- Address: Baltracey, Maynooth, Co. Kildare
- Contact number: 086 846 1096
- Email: roberta.hines@nuim.ie

Details about Supervisor
- Name: Dr Carol Murphy, BCBA-D
- Address: Department of Psychology, Maynooth University, Maynooth, Co. Kildare
- Contact Number : 01 708 6723
- Email: Carol.A.Murphy@nuim.ie

- *If during your participation in this study you feel the information and guidelines that you were given have been neglected or disregarded in any way, or if you are unhappy about the process, please contact the Chairman of the Research Ethics SubCommittee, Dr Bryan Roche. Tel: 01 7086026 Email: Bryan.T.Roche@nuim.ie. Please be assured that your concerns will be dealt with in a sensitive manner.*

Appendix A

Continued Consent Form

Dear Parents & Guardians,
Title: Assessing the impact of PEAK relational learning on school readiness and other measures in typically-developing preschool children

I would like to thank you for your cooperation with the current piece research for which you have provided consent for your child to partake in. I would like to take this time to make sure that you are still comfortable with your child's continued participation. The study is approximately halfway through. If you have any concerns please feel free to contact the researcher using the above details. The researcher is always willing to answer questions you may have. The researcher is available to address any issues which may have arisen since the research commenced. This piece of research will continue for approximately three more months. The research will not continue past the end of April 2015.

If you wish to **WITHDRAW** consent for your child's participation, please sign below and return this form immediately. If you wish for your child to continue you do not need to do anything further.

Sign only if you wish to **WITHDRAW** you child from the study.

Sighed

Participant/Parent   Date
Participant/Parent   Date
Researcher   Date

Details about Researcher
- Name: Roberta Hines B.A. Psych., H-Dip Mont., Doctoral Student at Maynooth University
- Address: Baltracey, Maynooth, Co. Kildare
- Contact number: 086 846 1096
- Email: roberta.hines@nuim.ie

Details about Supervisor
- Name: Dr Carol Murphy, BCBA-D
- Address: Department of Psychology, Maynooth University , Maynooth, Co. Kildare
- Contact Number: 01 708 6723
- Email: Carol.A.Murphy@nuim.ie

- *If during your participation in this study you feel the information and guidelines that you were given have been neglected or disregarded in any way, or if you are unhappy about the process, please contact the Chairman of the Research Ethics SubCommittee, Dr Sinead McGilloway Tel: 01 798 6052 Email: sineade.mcgilloway@nuim.ie Please be assured that your concerns will be dealt with in a sensitive manner.*

<div align="right">**Appendix A**</div>

Request for my child's data

Name: Roberta Hines B.A. Psych., H-Dip Mont., Doctoral Student at Maynooth University
Address: Baltracey, Maynooth, Co. Kildare
Contact number: 086 846 1096
Email: roberta.hines@nuim.ie

Title: Assessing the impact of PEAK relational learning on school readiness and other measures in typically developing preschool children

Parents/Guardians

Your child's name (Block Letters): -
_____

I understand that the primary researcher is not sufficiently qualified or experienced to interpret my child's data, especially IQ or subtest results, for practical purposes, or to guide clinical or applied decisions, and because of this my child's data are being made available only upon my specific request in accordance with FOI legislation. I nevertheless wish to have access to my child's data.

Your name:_____
Your signature:-
_____Date:_____

Details about Researcher
- Name: Roberta Hines B.A. Psych., H-Dip Mont., Doctoral Student at Maynooth University
- Address: Baltracey Maynooth Co. Kildare
- Contact number: 086 846 1096
- Email: roberta.hines@nuim.ie

Details about Supervisor
- Name: Dr Carol Murphy, BCBA-D
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- *Please be assured that your concerns will be dealt with in a sensitive manner.*

Appendix A

Debriefing Form

Title: Assessing the impact of PEAK relational learning on school readiness and other measures in typically-developing preschool children

Thank you for taking part in the study on PEAK research and School Readiness in Preschool children. I hope that you have enjoyed your experience. I will be using the data collected during the study to investigate the relation between PEAK Relational Training and its impact on School Readiness in Preschool Children. I will also be examining whether PEAK Relational Training System impact perspective taking. I hope that this research will help to identify practical applications to increase school readiness in preschool children.

I am not in a position to interpret any of the data that was taken during I.Q. School Readiness, Verbal Ability/PEAK assessments. All data has been sudo anonymised and is only used to correlate results with School Readiness.

A reminder that you have the right to all your child's data and have the ability to remove your child's data up until the point of publication. All data for the purposes of publication will be kept sudo anonymised. With this in mind and taking cognisance of **Freedom of Information Act 2014** the test results will not be given out without specific written documentation from the parent or caregiver of the participant. Any results given **will not be interpreted** in any way, as the **researcher is NOT qualified** to do so. It is not the intention of this research project to guide any clinical or teaching decisions. All electronic data will be encrypted on hard drive, and hard copy material will be kept in a locked box. All data will be kept for a period of 5 years and then destroyed.

I hope that you and your children enjoyed participating in this study and found it to be a positive experience. If you or your child has questions about your participation, please feel free to discuss this with me.

Kindest Regards

Roberta Hines

Details about Researcher

- Name: Roberta Hines B.A. Psych., H-Dip Mont., Doctoral Student at Maynooth University
- Address: Baltracey Maynooth Co. Kildare
- Contact number: 086 846 1096
- Email: roberta.hines@nuim.ie

Details about Supervisor

- Name: Dr. Carol Murphy, BCBA-D
- Address: Department of Psychology, Maynooth Univerisy , Maynooth, Co. Kildare
- Contact Number : 01 708 6723
- Email: Carol.A.Murphy@nuim.ie
- *If during your participation in this study you feel the information and guidelines that you were given have been neglected or disregarded in any way, or if you are unhappy about the process, please contact the Chairman of the Research Ethics SubCommittee, Dr. Sinead McGilloway Tel: 01 798 6052 Email: sineade.mcgilloway@nuim.ie*

  Please be assured that your concerns will be dealt with in a sensitive manner.

Appendix A

Information Sheet for Staff
Title: Assessing the impact of PEAK relational learning on school readiness and other measures in typically-developing preschool children
Research Objectives:

Research Objectives:

7. Does learning PEAK targets (e.g., equivalence or same-different relations; perspective-taking I-You/Here-There/Now-Then) result in improved scores on ability assessments with preschoolers?
8. Are instructors readily able to use PEAKor do they require training?
9. Do instructors rate PEAK as an effective and useful teaching tool?
   Can PEAK programmes be combined with the T-IRAP (interactive computerised teaching programme) to teach preschoolers?

Aim? This study aims to look at findings by the creators of PEAK that testing measures incorporated in PEAK are easy to use and require no formal training. We will be looking qualification levels and results of IOA measures. Do one set of assessments results measure the same across level of qualifications for the same test subject?

What happens to the information? The information that is collected will be kept confidential and stored on the researcher's computer with protection password and all handwritten material will be kept in a safe locked box in the researcher's office. The information will be pseudo-anonymized during the research but all data that is analysed for publication will be anonymized, this means that your child's name and school will not be published. The Data and kept for a period of five years, Electronic data will be kept in an encrypted file on the researcher's computer, and any hard copy data will be kept in a locked box. After the period of 5 years it will be deleted and/or disposed of via shredding.

Can I request information? As part of the Freedom of Information Act you may request your child's information. This must be done via a formal written request. Please note that any information you receive will not be interpreted as the researcher is not in a position to do so.

What happens if something goes wrong? In the unlikely event that something goes wrong during the study, the session will immediately stop and the researcher will resume only when both the child and the researcher are ready or the session will be stopped completely. This means that some sessions where you will assess may be stopped and started another time.

What happens at the end of the study? The information will be presented in a study. The study may or may not be published. All information will be anonymised. All data will be held for 5 years by the researcher in a locked box or password-protected on computer when it will be deleted and destroyed. The results of the study will be available to participants on written request.

What if I have more questions? If you have any questions that are related to any aspect of the study you may contact the researcher for further clarification.

What if I change my mind during the study? At any stage if you wish to discontinue being a participant you are free to stop and take no further part. There are no consequences to your changing your mind about the participation in the study.

 Questions? If you have any questions or concerns please feel free to contact the researcher.

Kindest Regards

Roberta Hines

Details about Researcher
- Name: Roberta Hines B.A. Psych., H-Dip Mont., Doctoral Student at Maynooth University
- Address: Baltracey, Maynooth, Co. Kildare
- Contact number: 086 846 1096
- Email: roberta.hines@nuim.ie

Details about Supervisor
- Name: Dr Carol Murphy, BCBA-D
- Address: Department of Psychology, Maynooth University, Maynooth, Co. Kildare
- Contact Number : 01 708 6723
- Email: Carol.A.Murphy@nuim.ie

- *If during your participation in this study you feel the information and guidelines that you were given have been neglected or disregarded in any way, or if you are unhappy about the process, please contact the Chairman of the Research Ethics SubCommittee, Dr Sinead McGilloway Tel: 01 798 6052 Email: sineade.mcgilloway@nuim.ie Please be assured that your concerns will be dealt with in a sensitive manner.*

Staff Informed Consent Form Participant in Doctoral Research

Title: Assessing the impact of PEAK relational learning on school readiness and other measures in typically-developing preschool children
Research Objectives:

Research Objectives:

10. Does learning PEAK targets (e.g., equivalence or same-different relations; perspective-taking I-You/Here-There/Now-Then) result in improved scores on ability assessments with preschoolers?
11. Are instructors readily able to use PEAKor do they require training?
12. Do instructors rate PEAK as an effective and useful teaching tool?
    Can PEAK programmes be combined with the T-IRAP (interactive computerised teaching programme) to teach preschoolers?

The current research will be conducted by Roberta Hines, B.A. Psychology H.Dip Montessori Education, who is a Doctoral student at the Department of Psychology, Maynooth University, Co. Kildare. Roberta Hines has worked in the area of Early Childhood Education since 2000 and has been the proprietor and a Head Directress of Tiddlywinks & Scallywags Preschool since 2002. She can be contacted at email: roberta.hines@nuim.ie or via telephone on 0868461096. The research will be supervised by Dr Carol Murphy, Ph.D. BCBA-D a Board Certified Behavioural Analyst.
I agree to participate in a research study carried out by Roberta Hines a Doctoral student at Maynooth University Co. Kildare, I (Print Name Block Capitals) _____
understand the following:

- I am aware that the study is being carried out by Roberta Hines, a PhD student at Maynooth University and supervised by Dr Carol Murphy, Ph.D. BCBA-D a lecturer from Maynooth University. In conducting the current research the student and supervisor are responsible for adhering to ethical guidelines set out by the psychological society of Ireland and the Behaviour Analyst Certification Board in all dealings.

- I understand that any information collected by the study will be completely pseudo-anonymous at collection stage and anonymized for publication purposes. My identity will not be provided in any subsequent presentation or publication of data.

- I understand that my data will be pseudo-anonymous. All non-analysed data will be assigned false names and will be stored in encrypted (protected) files on the researcher's computer for a period of 5 years or hard data in a locked box after which the files will be deleted or the data will be held for no longer than is considered necessary as recommended by the Data Commission of Ireland after which the data will be deleted. All analysed data will be anonymised for publication purposes and my identity will not be provided in any subsequent presentation or publication of data.

- I have read and understand the attached information sheet that tells me what procedures will be completed. I am aware of any risks and benefits associated with the study.

- I have had time to consider whether I want to take part in this research project and any questions that I had were answered satisfactorily.

- I understand that participation is entirely voluntary and that there will be no negative repercussions for them if they decided not to participate.

- I understand that I have the right to refuse consent to participate and withdraw my consent at any stage without any negative consequence.

- I understand that the information collected will be stored in the Maynooth University of Psychology and may be presented/published in academic journals and at conferences, but no young person will be identifiable form the information.

- I understand that once my data has been submitted for publication the data cannot be withdrawn from the study.

- I understand that I may be contacted in future to take part in future research.

- I understand that no financial or other incentives will be provided to staff members for participation in the study

- By signing below you are confirming that you have read and understand the above statements and that you agree to take part in this piece of research:

Your name:_____

Your signature:-

_____Date:_____

Details about Researcher
- Name: Roberta Hines B.A. Psych., H-Dip Mont., Doctoral Student at Maynooth University
- Address: Baltracey, Maynooth, Co. Kildare
- Contact number: 086 846 1096
- Email: roberta.hines@nuim.ie

Details about Supervisor
- Name: Dr Carol Murphy, BCBA-D
- Address: Department of Psychology, Maynooth University , Maynooth, Co. Kildare
- Contact Number : 01 708 6723
- Email: Carol.A.Murphy@nuim.ie

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SubCommittee, Dr Sinead McGilloway Tel: 01 798 6052 Email: sineade.mcgilloway@nuim.ie Please be assured that your concerns will be dealt with in a sensitive manner.

Appendix B

Study 1 - Equivalence Programme 1

Participant Scores Showing Prompt Level, Total PEAK Scores and Tirals to Criterion

Where you see a 10 it = a correct score

| | | Probe | | Prompt Level Number of Scores | | | | Score | | | Blocks to | Trials to |
Participant	Train/Test	(Yes / No)	# of 0	# of 2	# of 4	# of 8	# of 10	PEAK TOTAL	# Train	# Test	Criterion	Criterion
					Reflexivity - 1A Picture to Picture								
1	Train1	y					10	100				
	Test 1						10	100	1	1	2	**20**
2	Train1	n				1	9	96				
	Test 1						10	100	1	1	2	**20**
3	Train1	y					10	100				
	Test 1						10	100	1	1	2	**20**
4	Train1	y					10	100				
	Test 1						10	100	1	1	2	**20**
5	Train1	n					10	100				
	Test 1						10	100	1	1	2	**20**
6	Train1	y					10	100				
	Test 1						10	100	1	1	2	**20**
7	Train1	n		2		1	7	82				
	Train 2			1		1	8	90	2	1	3	**30**
	Test 1						10	100				
8	Train1	y					10	100				
	Test 1						10	100	1	1	2	**20**
9	Train1					2	8	96				
	Test 1						10	100	1	1	2	**20**
10	Train1	y					10	100				
	Test 1						10	100	1	1	2	**20**
11	Train1	y					10	100				
	Test 1						10	100	1	1	2	**20**
12	Train1	y					10	100				
	Test 1						10	100	1	1	2	**20**
13	Train1	y					10	100				
	Test 1						10	100	1	1	2	**20**

Appendix B

Study 1 - Transformation Programme 1

Participant Scores Showing Prompt Level, Total PEAK Scores and Tirals to Criterion

Where you see a 10 it = a correct score

				Spatial - 2A Cue of Closer									
		Probe		Prompt Level Number of Scores					Score				
Participant		(Yes / No)	# of 0	# of 2	# of 4	# of 8	# of 10	PEAK TOTAL	#Train	#Test	Blocks to Criterion	Trials to Criterion
1	train1	Y		2			8	88				
	train2						10	100	2	1	3	**30**
	test 1						10	100				
2	train1	Y					10	100	1	1	2	**20**
	test 1						10	100				
3	train1	Y					10	100	1	1	2	**20**
	test 1						10	100				
4	train1	N				2	8	96				
	test 1		1				9	90				
	test 2		2				8	80	2	3	5	**50**
	train2						10	100				
	test 3						10	100				
5	train1	Y					10	100				
	test1		1				9	90	1	2	3	**30**
	test2						10	100				
6	train1	Y					10	100	1	1	2	**20**
	test1						10	100				
7	train1	Y					10	100	1	1	2	**20**
	test1						10	100				
8	train1	N				2	8	96	1	1	2	**20**
	test1						10	100				
9	train1						10	100	1	1	2	**20**
	test1						10	100				
10	train1						10	100	1	1	2	**20**
	test1						10	100				
11	train1	Y					10	100	1	1	2	**20**
	test1						10	100				
12	train1	N				1	9	98				
	test1		1				9	90	1	2	3	**30**
	test2						10	100				
13	train1	Y					10	100	1	1	2	**20**
	test1						10	100				

Study 3 Equivalence Programme 2

Participant Scores Showing Prompt Level, Total PEAK Scores and Tirals to Criterion

Where you see a 10 it = a correct score

			Reflexivity - 1B Textual Match									
		Probe	Prompt Level Number of Scores					Score				
Participant	Train/Test	(Yes / No)	# of 0	# of 2	# of 4	# of 8	# of 10	PEAK TOTAL	# Train	# Test	Blocks to Criterion	Trials to Criterion
1	Train 1	y				2	8	96	1	1	2	20
	Test 1						10	100				
2	Train 1	y				1	9	98	1	1	2	20
	Test 1						10	100				
3	Train 1	y				1	9	98				
	Test 1		1				9	90	1	2	3	30
	test 2		1				9	90				
4	Train 1	y				1	9	98				
	Test 1		1				9	90	1	2	3	30
	Test 2		1				9	90				
5	Train 1	y				1	9	98	1	1	2	20
	Test 1						10	100				
6	Train 1	y					10	100	1	1	2	20
	Test 1						10	100				
7	Train 1	y					10	100	1	1	2	20
	Test 1						10	100				
8	Train 1	y					10	100	1	1	2	20
	Test 1						10	100				
9	Train 1	y					10	100	1	1	2	20
	Test 1						10	100				
10	Train 1	n				3	7	94				
	Test 1		1				9	90	1	2	3	30
	Test 2		1				9	90				
11	Train 1	y				2	8	96	1	1	2	20
	Test 1						10	100				
12	Train 1	y				2	8	96				
	Test 1		1				9	90	1	2	3	30
	Test 2		1				9	90				
13	Train 1	y				1	9	98	1	1	2	20
	Test 1						10	100				
14	Train 1	y					10	100	1	1	2	20
	Test 1						10	100				
15	Train 1	n				1	9	98	1	1	2	20
	Test 1						10	100				
16	Train 1	y				1	9	98	1	1	2	20
	Test 1						10	100				
17	Train 1	y					10	100	1	1	2	20
	Test 1						10	100				
18	Train 1	y				2	8	96	1	1	2	20
	Test 1						10	100				

Appendix C

PEAK Programmes and Procedures PEAK Equivalence Module

training/testing:[4] PEAK Equivalence Module programme was designed to help relate

concepts together that have not been directly taught and that do not have formal similarity.

The programmes focus on the four areas of stimulus equivalence: reflexivity, symmetry,

transitivity, and equivalence. The researcher picked eight programmes that roughly matched

the areas of curriculum that were taught in the children's everyday environment of the

Montessori class.

Reflexivity: 1A Picture to Picture, 1B Textual Matching;

Symmetry: 5C Textual Number Identification, 5E Shape Names;

Transitivity: 9P Actions & Outcomes, 10A Addition;

Equivalence: 10L Feature Rules, 11F Letter Case & Sound.

Probe Data was taken for each participant at the start of every programme to

determine if the training skill was in the participant's repertoire. Figure 5 shows an example

of typical stimuli used during training.

Reflexivity: 1A - Picture to Picture. The goal of the programme was to train children

how to match a sample picture (stimulus A) with an identical picture (stimulus B) (A-B) by

presenting a sample picture (A) and an array of pictures (B). Then the child was tested to see

if they could match the identical sample picture (stimulus B) to the original picture (stimulus

A) (B-A).

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[4] These protocols for scoring the responses on each trial for PEAK Equivalence and PEAK Transformation
instructions were the same for all programmes, and as such are not reported henceforth.
Training: The instructor rated the response on a 0–10 score card which measured the prompt level necessary to
occasion the matching. The training continued until the participant finished all 10 trials.
Testing: A zero was recorded for no response or a 10 for correct response on first attempt with no prompts.
Testing continued until the participant finished all 10 trials.

Training: A sample picture "Toy Car" was placed in front of the participant, along with an array of 3 pictures with one being the same as "Toy Car". The instruction was given "Put with the same". If the participant did not respond[5], the instructor picked up the sample picture "Toy Car" and placed it on the top of the array picture "Toy Car" while repeating the Sd "Put with the same". Then placing the picture of "Toy Car" back in front of the participant the Sd was repeated again. When the participant correctly matched the picture "Toy Car" to the array picture of "Toy Car" they were rewarded with verbal praise and a jelly[6] sweet. The instructor rated the response on a 0–10 score card which measured the prompt level necessary to occasion the matching. Training continued until the participant finished all 10 trials and met mastery criteria[7].

Testing: Testing involved the same procedure; however no prompts and no reinforcement were used. The participant matches "Toy Car" to the picture of "Toy Car". The participant received a 0 for no response, or a 10 for correct response on first attempt with no prompt. Testing continues until the participant finishes all 10 trials[8].

Reflexivity: 1B - Textual Matching. The goal of this programme was to train children how to match a sample written word (stimulus A) with an identical written word (stimulus B) (A-B) by presenting a sample word (A) with an array of words (B). Then the child was tested to see if they could match the identical word (Stimulus B) to the original word (stimulus A) (B-A).

Training: A sample word "Cup" was placed in front of the participant, along with a sample array of three words with one being the same "Cup". The instructions was given "Put

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[5] This example of prompt level flow was the same for all programmes, and as such is not reported henceforth.
[6] This example of reinforcement for correct response was the same for all programmes, and as such is not reported henceforth.
[7] This example data recording was the same for all programmes, and as such is not reported henceforth.
[8] This example data recording was the same for all programmes, and as such are not reported henceforth.

with the same". The participant picked up the word "Cup" and placed it on top of the sample word "Cup".

Testing: Testing involved the same procedure; however no prompts and no reinforcement were used. The participant matched the sample word "Cup" to the word "Cup".

Symmetry: 5C - Textual Number Identification. The goal of this programme was to match a sample written number (stimulus A) with an array of pictures of various numbers of items (stimulus B). The participant was trained in the (A-B) relation and then tested the (B-A) relation by matching a picture of a number of items (stimulus B) to an array of written numbers (stimulus A).

Training: A sample written number 3 (stimulus A) was presented in front of the participant along with an array of pictures of various numbers of items (stimulus B), one being the same as the amount of 3 (stimulus A). The instruction Sd was given "Put with the same". Then placing the number 3 back in front of the participant, the Sd was repeated again. The participant picked up the written number 3 and placed it on top of the sample picture with 3 items.

Testing: Testing involved the same procedure; however, no prompts and no reinforcement were used. The participant matched the written number to the picture of the quantity.

Symmetry: 5E - Shape Names. The goal of this programme is to match a named shape (stimulus A) with a shape picture (stimulus B) (A-B). The test (B-A) saw the participant respond by stating the shape name (stimulus A) when presented with the shape picture (stimulus B).

Training: An array of shapes were placed in front of the learner with one shape being a "Triangle". The Sd "Which shape is a Triangle?" was presented. The Participant was then asked "Which shape is a Triangle?" and the participant pointed to the "Triangle".

Testing: Testing involved the same procedure; however, no prompts and no reinforcement were used. The participant responded with the correct answer when asked "What shape is this?"

Transitivity: 9P - Actions & Outcomes. The goal of this programme is to match an action (stimulus A) with an outcome from an array of outcomes (stimulus B) (A-B), and then to match an outcome (stimulus B) from a follow-on array of actions that is produced by the outcome (stimulus C) (B-C). The test (A-C) shows the learner matching an action (stimulus A) to a second action (stimulus C) that has not been trained. The typical stimulus includes A = pictures of an action, B = pictures of outcomes and C = pictures of follow-on actions.

Training: An array of outcomes and a sample action picture are placed in front of the participant. The Sd "what happens when you drop a glass?" is presented while pointing to the sample action picture. The participant then moves the picture of "Drop a glass" and places it on top of "Glass breaks" picture. This procedure was trained again in the follow-on (BC) relations. In this relation you train an outcome with an array of actions. What happens when "The glass breaks" to outcome picture "You clean up the broken glass".

Testing: Testing involved the same procedure; however, no prompts and no reinforcement were used. The relations A-C are tested by providing a sample action "You drop a glass" and the participant matches to "You clean up the broken glass".

Transitivity: 10A – Addition. The goal of this programme is to match an addition problem (stimulus A) with a picture (stimulus B) (A-B) and then follow on by matching a picture (stimulus B) to a total number (stimulus C) (B-C). The participant is then tested by matching the addition problem (stimulus A) with the total number (stimulus C) (A-C).

Training: An array of quantity pictures to include one sunflower and three ducks (stimulus B) and a sample addition problem 1 + 3 (stimulus A) are placed in front of the participant. The Sd instruction "Match" is presented. When the participant matches (stimulus A) to (stimulus B), training then continues on the (B-C) relation. A sample picture (stimulus B) one sunflower and three ducks and an array of numbers (stimulus C), one being 4, is placed in front of the participant. The instructional Sd "Match" is presented. The participant matches 1 + 3 (stimulus A) to one sunflower and three ducks (stimulus B).

Testing: Testing involved the same procedure; however, no prompts and no reinforcement was used. .The relations (A-C) are tested by providing a sample addition problem (A) 1 + 3 and an array of numbers (stimulus C). The participants match to the number 4

Equivalence: 10L - Feature Rules. The goal of this programme is to train the rule that objects (B, C) have specific features "words" (stimulus A). The relation of (B-A, C-A) was trained. The participant was tested on the ability to match a sample object (stimulus C) with another object (stimulus B) that shares a common feature (C-B).

Training: The participant was presented with an Sd "Flowers (stimulus B) have leaves (stimulus A)" and asked "What do flowers (stimulus B) have?" The participant responds with "Leaves". Training then continues on the (C-A) relation. The instructor presents the rule "Trees (stimulus C) have leaves (stimulus A)", and asks "What do trees have?" with the correct response being "Leaves".

Testing: Testing involved the same procedure; however, no prompts and no reinforcement was used. The (C-B) relation is tested by presenting the Sd "What has something in common with Trees (stimulus C)?" The participant picks Flowers.

Equivalence: 11F - Letter Case & Sound. The goal of this programme was to train matching a letter sound (stimulus A) with a capital letter (stimulus B) (A-B) and a lower case

letter (stimulus C) (A-C). Testing was to match the lower case letter (stimulus C) with the

capital letter (stimulus B) (C-B).

Training: The participant was presented with an array of capital letters (stimulus B)

with "D" being one (stimulus A). The Sd "Which one makes the 'D' (stimulus A) sound?"

was presented. The participant points to the correct capital letter D (stimulus B) which said

"D" (stimulus A). Training then continued on the (A-C) relation. The participant is

presented with an array of lowercase letters (stimulus C), one being "d" (stimulus A). The

participant is presented with the Sd "Which one makes the 'd' sound?" The participant

points to the correct lower case letter d (stimulus C).

Testing: Testing involved the same procedure; however, no prompts and no

reinforcement were used. The (C-B) relation was tested by placing in front of the participant

a sample lower case letter d (stimulus C) and an array of capital letters to include D (stimulus

B). The Sd "Put with the same" was presented. The participant matches D and d.

PEAK Programmes and Procedures PEAK Transformation Module

training/testing. PEAK Transformation Module programmes utilize relational framing as their main tool of instruction. This establishes relations between stimuli and then tests for the functions that are selected by the established relations though contextual cues. Eight programmes picked comprise four relational frames: spatial, temporal, comparison, and perspective taking:

Spatial: *2A Cue of Closer, 2B Cue of Further*;

Temporal: *4C Cue of Before, 4D Cue of After*;

Comparison: *7E Cue of More Than, 7F Cue of Less Than*;

Perspective taking: *12A Cue of You and I, 12B Cue of You and I Reversal*.

Probe Data were taken for each participant at the start of every programme to determine if the training skill was in the participant's repertoire.

Spatial: 2A - The cue of "Closer". The goal of this programme is to train the cue of "Closer" to an array of objects (stimulus A) and (stimulus B) that vary in distance from the participant. The participant will then be able to select the closest item to them when tested with novel stimuli.

Training: An array of objects (stimulus A) and (stimulus B) are placed in front of the participant with (stimulus A) being closest to the participant. The Sd of "Show me which is closer" is provided. If the participant does not respond then the instructor prompts by pointing to the item (stimulus A) that is closest to the participant and saying "Closer"[9]. The Sd is repeated and, if the participant gets the correct response, verbal praise is delivered along with a small edible[10]. The instructor rated the response on a 0–10 score card which measured

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[9] This example of prompt level flow was the same for all programmes, and as such are not reported henceforth.
[10] This example of reinforcement for correct response was the same for all programmes, and as such are not reported henceforth.

the prompt level necessary to occasion the matching. The training continued until the participant finished all 10 trials[11].

Testing: The participant is presented with an array of novel (stimulus A) and (stimulus B) objects where (stimulus B) is closest to the participant. The instructor says "Show me which is closer". The participant receives a 0 for no response or a 10 for correct response on first attempt with no prompts. Testing continues until the participant finishes all 10 trials.[12]

Spatial: 2B - The cue of "Further". The goal of this programme is to train the cue of "Further" to an array of objects (stimulus A) and (stimulus B) that vary in distance from the participant. The participant will then be able to select the furthest item to them when tested with novel stimuli. The procedure is the same as Spatial: the cue of "Closer" – 2A with "Closer" replaced with "Further".

Temporal: 4C - The cue of "Before". The goal of this programme is to train the cue of "Before" (stimulus A) from an object that comes after (stimulus B) (A-B). The (B-A) relation is then tested and the participant will be able to identify the object that was shown first.

Training: The participant is asked to "Watch" as the instructor shows object small orange (stimulus A) followed by a second object small blue fish (stimulus B). The instructor then places both objects on the table in front of the participant in random order and asks the Sd "Which was before?" where (stimulus A) small orange is correct. The participant correctly identifies the small orange as "Before".

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[11] The following instructions are the same for all programmes, and as such are not reported henceforth. Training: The instructor rated the response on a 0–10 score card which measured the prompt level necessary to occasion the matching. The training continued until the participant finished all 10 classes. Testing: The participant received a 0 for no response, or a 10 for correct response on first attempt with no prompts. Testing continues until the participant finishes all 10 classes. Training: The instructor rated the response on a 0–10 score card which measured the prompt level necessary to occasion the matching. The training continued until the participant finished all 10 classes. Testing: The participant received a 0 for no response, or a 10 for correct response on first attempt with no prompts. Testing continues until the participant finishes all 10 classes.

[12] This example data recording was the same for all programmes, and as such are not reported henceforth.

Testing: The participant is asked to "Watch" as the instructor shows an object (stimulus B) small red train and follows by presenting a second object (stimulus A) small grape. The instructor places the objects (B, A) on the table in front of the participant and presents the Sd "Which was before?" where (stimulus B) is correct.

Temporal: 4D - The cue of "After". The purpose of this programme is to train a participant in a sequence of objects (A, B) and ask them to select which came "After" (stimulus B); the participant is then able to correctly identify the object that was shown last (stimulus B) when tested. The procedure is similar to Temporal: the cue of "Before" - 4C where "Before" is replaced with "After".

Comparison: 7E - The cue of "More Than". The purpose of this programme is to train the cue of "More Than". When presented with an array of two stimuli that differ in number, where (stimulus B) is greater than (stimulus A) (A-B) and (stimulus C) is less than (stimulus A) (C-A), the learner will select the greater of the two stimuli. This is tested by an array of two stimuli, where (stimulus D) is more than (stimulus B) (D-B).

Training: The participant was trained in the (A-B) relation and was presented with two pictures, a picture of three cars (stimulus A) and a picture of seven butterflies (stimulus B). The Sd "Which is more than?" was presented, with seven butterflies (stimulus B) being the correct response. Training continued on the (C-A) relation, where the participant was presented with two pictures, three cars (stimulus A) and one sweet (stimulus C) and was asked "Which is more than?" where three cars (stimulus A) was the correct response.

Testing: The participant is presented with two pictures, 7 presents (stimulus B) and 10 ducks (stimulus D). The Sd "Which is more than?" is presented. The participant chooses ducks.

Comparison: 7F - The cue of "Less Than". The purpose of this programme is to train the cue of "Less Than". When presented with an array of two stimuli that differ in number, where (stimulus A) is less than (stimulus B) (A-B) and (stimulus C) is less than (stimulus A) (C-A), the learner will select the lesser of the two stimuli. This is tested by an array of two stimuli where (stimulus B) is less than (stimulus D) (D-B). This procedure is similar to Comparison: the cue of "More Than" – 7E with "More Than" being replaced with "Less Than".

Perspective taking: 12A - You and I. The goal of this programme is to train the participant when shown a piece of paper which has two different images on each side (A-B) to identify who sees which item using "You" and "I" and testing the relation in reversal (B-A) with novel stimuli.

Training: The instructor shows both sides of a piece of paper to the participant, side (stimulus A) a hand and side (stimulus B) a seatbelt. Holding up the paper with the (stimulus A) side a "hand" facing the participant, the instructor delivers the Sd "Who sees (stimulus A) the hand?" where the correct response is "I see (stimulus A) the hand". Next the instructor delivers the Sd "Who sees (stimulus B) the seatbelt?" where "You see (stimulus B) the seatbelt" is the correct response.

Testing: Testing the (B-A) relations requires novel stimuli. The instructor shows both sides of the paper (stimulus A) man and (stimulus B) a comb to the participant. Holding the image with (stimulus B) the comb facing the participant the instructor presents the Sd "Who sees (stimulus A) the man?" with "You see (stimulus A) the man" being the correct response. The instructor then asks "Who sees (stimulus B) the comb?" with "I see (stimulus B) the comb" as the correct response.

Perspective taking: 12B - You and I Reversal. The purpose of this programme is to train reverse perspectives (A-B) (B-A) and test reverse perspectives (C-D) (D-C). When

shown a paper with two different images on each side, the participant will be able to state who sees what when told to reverse perspectives.

Training: The instructor trains the (A-B) relation by showing both sides of the paper to the participant. On one side is a picture of a woman (stimulus A) and on the other a boy (stimulus B). The instructor presents the Sd "If I were you and you were me, what do you see?" with the correct response being boy (stimulus B). Training the (B-A) relations repeated step 1 but the Sd was changed to "If I were you and you were me, what do I see?" where woman (stimulus A) is the correct response.

Testing: The instructor trains the (C-D) relation by showing both sides of the paper to the participant. On one side is a picture of a door (stimulus C) and on the other a gate (stimulus D). Holding side door (stimulus C) facing the learner, the instructor presents the Sd "If I were you and you were me, what do I see?" with door (stimulus C) being the correct response. Testing then continued with the (D-C) relation. The Sd "If I were you and you were me, what do you see?" was presented, with gate (stimulus D) being the correct response.
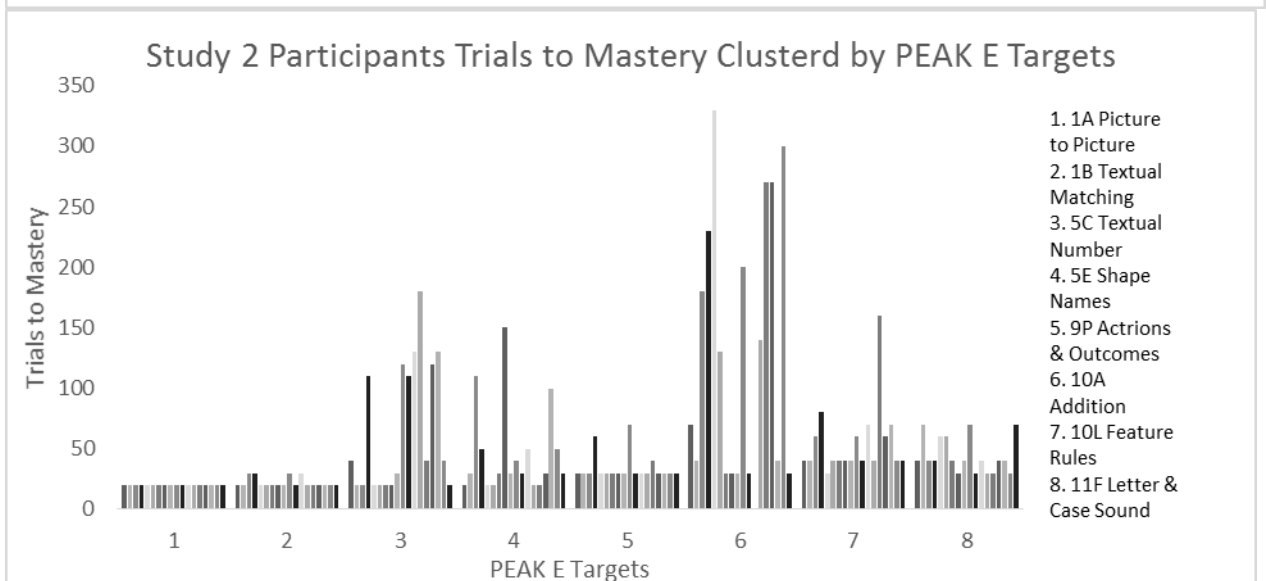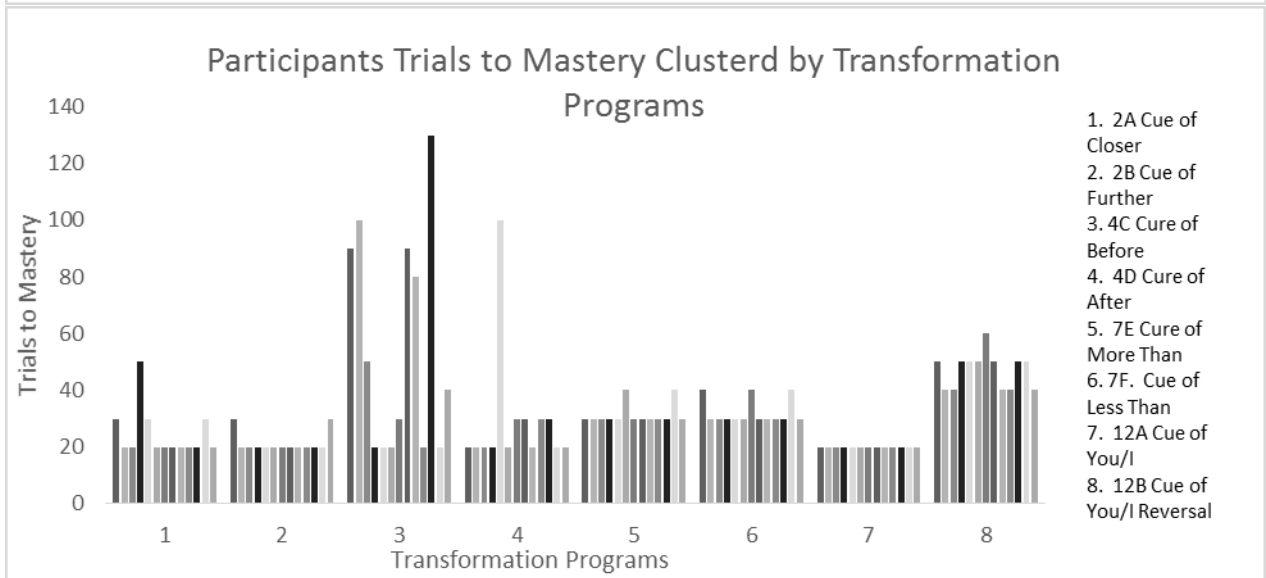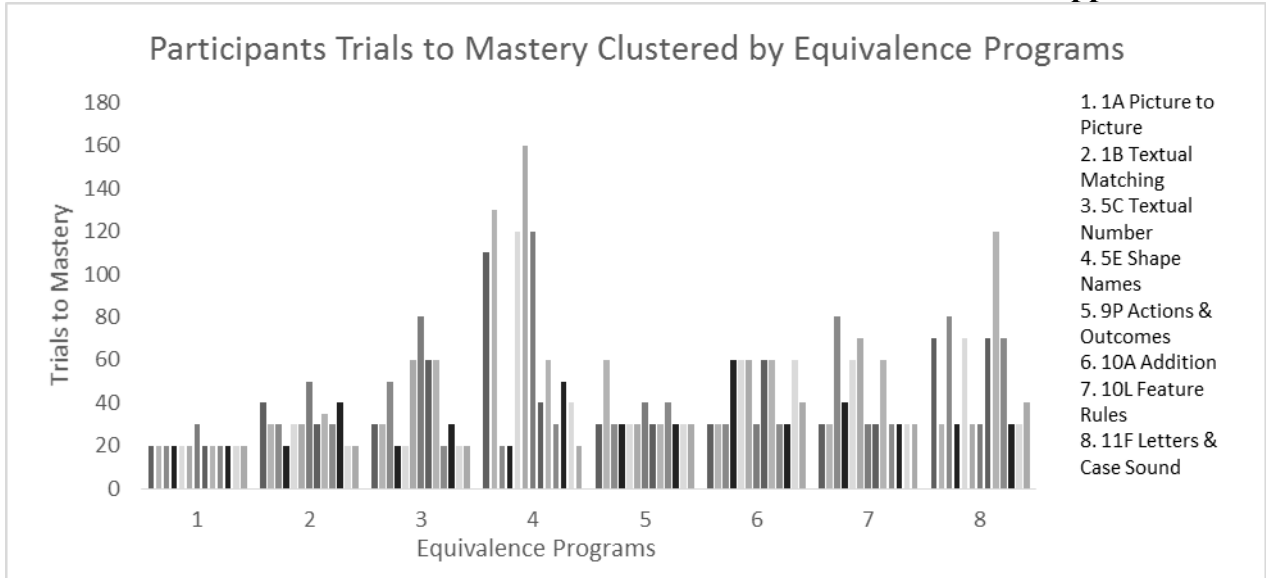
Fidelity Rating Scales

Item/ Fidelity Code for recording O = Yes, X = No, n/a = not applicable		PEAK PROGRAMME: insert code and name									
Trials:		1	2	3	4	5	6	7	8	9	10
Child attendance											
ABC format Conducted in accord with PEAK Manual?	Antecedent										
	Behaviour										
	Consequence										
Correct prompt level?											
Correct prompt sequence?											
Correct score recorded?											
Overall Fidelity?											

Total number of trials run correctly =

Signature Observer:

Item/ Fidelity Code for recording O = Yes, X = No, n/a = not applicable		PEAK PROGRAMME: insert code and name									
Trials:		1	2	3	4	5	6	7	8	9	10
Child attendance											
ABC format Conducted in accord with PEAK Manual?	Antecedent										
	Behaviour										
	Consequence										
Correct prompt level?											
Correct prompt sequence?											
Correct score recorded?											
Overall Fidelity?											

Total number of trials run correctly =

Signature Observer:

Item/ Fidelity Code for recording O = Yes, X = No, n/a = not applicable		PEAK PROGRAMME: insert code and name									
Trials:		1	2	3	4	5	6	7	8	9	10
Child attendance											
ABC format Conducted in accord with PEAK Manual?	Antecedent										
	Behaviour										
	Consequence										
Correct prompt level?											
Correct prompt sequence?											
Correct score recorded?											
Overall Fidelity?											

Total number of trials run correctly =

Signature Observer:

Item/ Fidelity Code for recording O = Yes, X = No, n/a = not applicable		PEAK PROGRAMME: insert code and name									
Trials:		1	2	3	4	5	6	7	8	9	10
Child attendance											
ABC format Conducted in accord with PEAK Manual?	Antecedent										
	Behaviour										
	Consequence										
Correct prompt level?											
Correct prompt sequence?											
Correct score recorded?											
Overall Fidelity?											

Total number of trials run correctly =

Signature Observer:

NB. In calculating fidelity of implementation of PEAK programme a score of O (Yes) across all aspects of the trial means that treatment integrity is observed. Conversely, a score of X (No) on any aspect of a trial means that the trial was not implemented as per PEAK manual.

Appendix F

Participants Trials to Mastery Clustered by Equivalence Programs

1. 1A Picture to Picture
2. 1B Textual Matching
3. 5C Textual Number
4. 5E Shape Names
5. 9P Actions & Outcomes
6. 10A Addition
7. 10L Feature Rules
8. 11F Letters & Case Sound

Participants Trials to Mastery Clusterd by Transformation Programs

1. 2A Cue of Closer
2. 2B Cue of Further
3. 4C Cure of Before
4. 4D Cure of After
5. 7E Cure of More Than
6. 7F. Cue of Less Than
7. 12A Cue of You/I
8. 12B Cue of You/I Reversal

Study 2 Participants Trials to Mastery Clusterd by PEAK E Targets

1. 1A Picture to Picture
2. 1B Textual Matching
3. 5C Textual Number
4. 5E Shape Names
5. 9P Actrions & Outcomes
6. 10A Addition
7. 10L Feature Rules
8. 11F Letter & Case Sound

Appendix G

Teacher: _____

Questionnaire of PEAK Equivalence and PEAK Transformation Modules.

PEAK Equivalence Module Questionnaire	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Program Name: -------------------------------------	1	2	3	4	5
1. The intervention focused on an important skill					
2. I believe that this intervention has produced effective results.					
3. I understood the intervention steps.					
4. The intervention was easily incorporated into my classroom system.					
5. I was able to accurately implement the intervention.					
6. The time requirements of this intervention are reasonable					
7. I would be happy to use PEAK regularly in my classroom.					

PEAK Transformation Module Questionnaire	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Program Name: -------------------------------------	1	2	3	4	5
1. The intervention focused on an important skill					
2. I believe that this intervention has produced effective results.					
3. I understood the intervention steps.					
4. The intervention was easily incorporated into my classroom system.					
5. I was able to accurately implement the intervention.					
6. The time requirements of this intervention are reasonable					

Rate the PEAK programme from Strongly Disagree (1) to Strongly Agree (5)

Please fill out one questionnaire for each of the 8 PEAK Programs in each module.