Combining PEAK (Promoting the Emergence of Advanced Knowledge) with Other Teaching Methodologies with Children with and without Learning Delays.

Emma Fawcett (B.A Hons)

Maynooth University

Research Supervisor: Dr Carol Murphy, Ph.D., BCBA-D.

Co Supervisor: Dr Michelle Kelly, D.Psych., BCBA-D.

Thesis Presented in Part-Fulfilment of the Requirements for the Doctorate in Psychological Science (Behaviour Analysis and Therapy)

Department of Psychology, Faculty of Science and Engineering

February 2017

Table of contents

List of Appendices

Acknowledgements

First, I would like to thank my supervisor Dr Carol Murphy for her guidance and support while keeping me on track. I cannot thank you enough for your patience and advice. I owe you many thanks.

I would like to thank the participants who took part in the research, without which this would not have been possible.

Finally, to my family, whose support and encouragement were never wavering, Thank You.

Abstract

Promoting the Emergence of Advanced Knowledge (PEAK) combines relational learning and applied behaviour analysis in a teaching programme for children with diagnosed autism (Dixon, 2014). Study 1a aimed to expand on this research by examining PEAK Sequencing; if teaching learning targets taken from the PEAK Generalisation Module will negate having to teach learning targets in the more basic PEAK Direct Module (emergent learning) with preschool children (*n*=8) both typically developing (4) and diagnosed with autism (4). Pre and post-training measures of standardised ability; Peabody Picture Vocabulary Test (PPVT-IV; Dunn & Dunn, 2007) and Bracken School Readiness Assessment (BSRA; Bracken, 2007) were compared to determine any positive impact on participant scores, and data were analysed using single-subject design and within- participant data. Study 1a taught 20 PEAK targets using the PEAK Generalisation Module and when tested, 34 emergent skills, previously scored as not in the child's repertoire when assessed on the PEAK Direct module were mastered.

The second part, Study 1b, further aimed to combine PEAK with an interactive computerised teaching programme (T-IRAP) to facilitate 'fluent' (rapid and accurate) participant responding with previously taught (study 1a) PEAK targets such as 'matching' and 'exclusion' were taught using the T-IRAP using 'same/different' relations. The study successfully combined PEAK-ABA with the interactive computerised teaching program, T-IRAP.

Study 2 successfully taught 5 PEAK targets to preschool children (n=3) with speech and language delay and combined PEAK targets with the Rapid Automatic Naming (RAN; Denckla & Rudel, 1976b) for fluency training. Pre and post assessments, BSRA-3 and PPVT-IV were carried out for participants. Results show participants mastered PEAK targets

relatively quickly at table top and on follow up assessment, three skills taught using the RAN show greater generalisation and maintenance than table top alone. Study 3 compared the T-IRAP and RAN as teaching tools for fluent responding, using RESA (Retention, Endurance, Stability, Application) tests with n=2 participants; one with ASD and one with speech delay. Participants (n=2) took part in either study 1 or 2. Pre-post assessment data were taken using BSRA-3 and the PPVT-IV. Mixed results revealed both teaching tools to have strengths in different areas of the RESA tests.

Participants, n=11 in all three studies completed the PEAK training and successfully performed using the T-IRAP and RAN teaching tools. Pre and post IQ and verbal ability tests revealed no statistically significant overall change but individual increases in raw scores were seen for all participants.

-Chapter 1-

Combining PEAK (Promoting the Emergence of Advanced Knowledge) with Other Behavioural Teaching Methodologies with Children with and without Learning Delays.

In recent years there has been an increase in the occurrence of Autism Spectrum Disorder (ASD). Based on research in the USA in 2012 (Christensen, Baio, Braun et al. 2016) figures indicate 1 in 68 children in the U.S.A. have received a diagnosis of ASD. Few disorders are more complex than that of autism, which is a developmental disability that is characterised by difficulties in communication, social interaction and social imagination, and repetitive behaviours, often resulting in inflexibility in relation to both thinking and behaviour (Howlin, 1997). These deficits have been referred to as the 'triad of impairments', however, recent perspectives view autism as a spectrum disorder (Diagnostic and Statistical Manual, 5th Edition., APA; 2013) that may show wide variation in the manifestation and severity of deficits in different individuals. The impairments can be experienced alone or with other physical or psychological disorders (Wing, 1996) and may have a profound impact on the independence and habilitation of the persons affected by it. There is no cure for autism, which is a neurodevelopmental disorder, however, early diagnosis and treatment with Early Intensive Behavioural Intervention (EIBI) using Applied Behaviour Analysis (ABA) has been shown to be effective in facilitating learning in children with ASD (see Larsson, 2012, 2013, for a broad review of supporting evidence from independent research bodies).

Applied behaviour analysis has proven to be successful in many fields such as Acquired Immune Deficiency Syndrome Prevention (DeVries, Burnette & Redman, 1991), emotional disturbance (Matson & Coe, 1992) and especially the area of developmental delay, specifically Autism Spectrum Disorder (Cohen, Amerine-Dickens & Smith, 2006; Sallows & Graupner, 2005). The application of behaviour analysis to populations with language deficits has contributed greatly to the development of verbal repertoires and enhanced skills (Larsson, 2012; Sundberg & Michael, 2001). The efficacy of ABA has been well documented from

sources outside the field of behaviour analysis and through independent studies (see Larsson, 2012; for a full review). Many ABA programs designed to help develop language skills in children with autism use behavioural principles such as reinforcement, shaping, fading, chaining and other similar methods usually commencing on a 1:1 tutor-student basis.

Applied behaviour analysis is based on and involves the application of Skinner's (1938, 1953, 1957) early research on the principles of behaviour, and his functional theory of language as verbal behaviour. Skinner's early experimental research on the analysis of behaviour brought into perspective both operant behaviour and the 'three term contingency'. It is through Skinners experimental efforts that we have an understanding of operant conditioning, positive reinforcement and negative reinforcement, all of which became widely used terms to describe the interactions of the environment and behaviour. The ABA approach is based on Skinners account of verbal behaviour (Skinner, 1957) involving a functional approach to language, which is comprised of a number of individual components called verbal operants such as mands, tacts, echoics, intraverbals, distorted tacts. Skinner (1957) outlined numerous examples of how aspects of language are acquired, strengthened, weakened and manipulated. The core of his work brought attention to verbal operants being similar to any other form of operant behaviour; they served to operate on the environment to produce change.

Not surprisingly, Skinners work (1957) progressed from a theoretical framework to an applied teaching strategy in many different settings. The following are descriptions of verbal operants commonly taught in ABA programs; a mand is taught via motivating operations (MO) and delivery of specific reinforcement; in lay terms this may be understood as arranging for the child to be mildly water-deprived or thirsty (MO) when being taught to request water, and contingent upon requesting reinforcement with water follows (specific reinforcer). A tact is taught via antecedent stimuli and general reinforcement, for example,

the tutor may present a picture of a dog saying "what is this?", and if the child tacts (labels) "dog", the tutor delivers positive reinforcement that may involve a small edible and or praise ("That's right, well done!") (Sundberg, 2004). Echoic responses involve teaching point-to-point correspondence, (e.g., hear *ball* say *ball*), and positive reinforcement is used often to shape successive approximations until the child can repeat the word correctly. Intraverbals are responses under functional control of a discriminative control that does not have point to point correspondence with the verbal stimulus (e.g. 'Hi, how are you doing?'/ 'I'm fine thanks'). Intraverbals form the basis for all social interactions and conversations. A distorted tact is one where the descriptive response in emitted in the absence of the original circumstances in which it was naturally reinforced. Mainly due to slight changes in stimulus control, distorted tacts can be viewed as a type of generalised responding. A lie is an example of a distorted tact; the speaker may modify the verbal response if an advantage is to be gained.

Thus, ABA programmes utilise Skinner's *Verbal Behaviour* (1957) proposition that language, like other behaviour is shaped by the environmental contingencies. This type of contingency has been termed direct reinforcement (Hayes, Barnes-Holmes & Roche, 2001; Kilroe, Murphy & Barnes-Holmes & , 2011) meaning that each targeted response is taught using programmed contingencies, so although effective, this method is laborious and time-consuming. Modern behavioural researchers have proposed enhancing these traditional ABA intervention programmes by adding teaching components to promote generativity, based on the type of behaviour seen in research literature such as stimulus equivalence, derived relational responding and relational frame theory (Hayes et al. 2001)

The emergence of untaught speech has been described as a key feature in a more recent account of human language, Relational Frame Theory (Hayes et al. 2001). Based on the work done by Sidman (1971), stimulus equivalence refers to an emergence of untaught stimulus

relations following initial teaching and reinforcement for taught relations. Stimulus equivalence describes contingencies where reinforcement is less immediately apparent (Sidman, 1971). As an example, training the relations A-B and B-C would typically result in the knowledge of the relation A-C without explicit teaching of this being necessary. This phenomenon has been widely documented in laboratory and applied research, including a study whereby Sidman (1971; 1994) taught developmentally disabled children to associate the word, picture and object to one meaning and subsequently realised the children could match the word and picture without being explicitly taught. While introducing the terms, symmetry, reflexivity and transivity, Sidman (1994), revealed a crucial step in our understanding of the emergence of language. Reflexivity refers to the matching of a sample to itself such as C-C. Symmetry refers to the bi-directional nature of language such as a written word having the same meaning as a picture of the word. Transivity then refers to the person being taught the written word (A) is equivalent to the object (B) which is equivalent to the spoken word (C) and then derives the word is equivalent to the spoken word (AC) (Sidman, 1994). This understanding provided a crucial step in forming a behaviour analytical view of human language and its development. This initial and pivotal research on the basics forms of language created an opening for a more complex and advanced theory to form the modern account of human language known as Relational Frame Theory (RFT; Hayes et al, 2001).

RFT promotes equivalence as one type of derived relational responding (DRR) with many more types existing and terming them relational frames. In this theory, an example of a relational frame being coordination (same) and distinction (difference). However, not all relations involve equivalence, for example, teaching ‘C’ comes before ‘D’ assumes the derivation of ‘D’ coming after ‘C’ which is not an equivalence relation. Mutual Entailment (Hayes et al, 2001) is the term coined to refer to relations such as these. Combinational

Entailment is used to describe transformation of function, meaning that the functions a stimulus has for a person can then be changed based on how it is related to other stimuli (Hayes et al, 2001). An example of this would be if a child learns the word sweet gives direct reinforcement of a sweet and subsequently hears the word jelly being used as an equivalent of sweet, they may become excited if asked if they would like a jelly. Despite the fact jelly has never been reinforced, they have transferred some functions of the word sweet to that of jelly due to their equivalence. This untrained nature seems particularly relevant to the generativity that is seen in human language (Murphy & Barnes-Holmes, 2009). This form of responding is known as arbitrarily applicable relational responding (Hayes et al, 2001) meaning that the relation is not defined by physical properties but contextual cues. Arbitrary applicable relational responding is crucial to the development of human language (Hayes et al, 2001), although it is not readily seen in those with ASD. This form of responding often occurs very early on in a child's life in simple ways when relations such as 'name-object' and 'object-name' are taught and the child learns to derive appropriate relations in novel environments without explicit teaching. For example, a parent might point to 'chair' and say chair reinforcing a naming response or might say 'chair' while pointing to the object to promote an orientating response. In this situation, the relation is trained explicitly for the child, however after a number of these, the child may learn to spontaneously reverse a relation without requiring explicit teaching (Hayes et al, 2001). This describes the process of using multiple exemplar training to teach relations early on resulting in them generalising afterward. Often, without formal training, this progression is not seen in people with developmental disorders or intellectual disability.

This type of relational responding is seen readily in typically developing children even at a very young age yet in populations with developmental disability, this skill doesn't occur quite as easily (Barnes, McCullagh & Keenan, 1990). Emergent language skills and

advanced language is often deficient in children with autism (Barnes et al, 1990). One study (Swallows & Graupner 2006) highlights the importance of these skills with results showing the long term progress of children who develop them as significantly better than the ones that do not. As previously stated, language is now being considered a pivotal behaviour (Koegel, Koegel & Carter, 1998) due to vast amounts of studies highlighting significant gains in access to reinforcement and advanced knowledge through a successfully developed language repertoire. As a result, communication and language have been a primary focus for ABA practitioners, specifically when dealing with the ASD. Utilising the information we know from research with derived relational responding, the need for practitioners to directly teach every utterance could potentially decrease and emergent or derived responding may be more commonly seen (Murphy, Barnes-Holmes & Barnes-Holmes, 2005).

In recent times, studies have synthesised Skinner's work on verbal operants and with that the field of modern ABA with research on derived relational responding (DRR) with a focus on the generativity of language (Barnes-Holmes, Barnes-Holmes & Cullinan, 2000; Murphy, Barnes-Holmes & Barnes-Holmes, 2005). As ABA is heavily criticised for not supporting generative language, these findings are especially relevant. Using this approach, the need to teach every possible utterance to children with autism who do not display any generativity in language could be removed. Research in the recent years has provided evidence for the emergence of untaught responding in children both typical and with developmental delay (Murphy et al., 2005; Rehfeldt & Root, 2007). The above study by Murphy, et al. (2005) provides groundwork in successfully teaching derived mands to a population who do not readily display generativity in language. By synthesising Skinners work with aspects from RFT, the field of ABA now use tactics such as positive reinforcement, extinction and shaping while also using relational training to increase emergent speech.

A recent paper, Ming and Stewart (2017), addressed the issue of relational responding in the field of ABA and teaching children with developmental disorders. One finding revealed that while the majority of teaching programs based on the analysis of verbal behaviour (Sundberg, 2008) do train identical matching and focus on the concept of sameness, none of them address the idea of difference. Only one relatively novel teaching program, PEAK (Promoting the Emergence of Advanced Knowledge; Dixon, 2014) has addressed this issue and places emphasis on the idea of difference through an exclusion program; for example, lessons involve "Which one doesn't belong?" requires that the child selects the item that has no common features with other items in the stimulus array. However, the majority of teaching so far has been done on the basis that teaching the concept of sameness will result in the comparison of 'difference' being derived. As seen from previous research on derived relational responding, this is not always the case and particularly when considering a population with developmental delay such as autism who do not display flexible responding (Ming & Stewart, 2014).

Findings from previous studies have indicated that RFT based interventions have aided in promoting more flexible aspects of language repertoires (Barnes-Holmes, Barnes-Holmes & Cullinan, 2000) If this is the case, it may be very beneficial to individuals with autism. With rigid behaviour being a defining feature of autism and other neurodevelopmental disorders, learning to respond to more general statements and teaching a more flexible and fluent repertoire of responding may in fact help reduce the rigidity of their language and increase intelligent behaviour (Turner, 1999). Fluent responding has also been a target of ABA programs for some time now, for example, precision teaching methods promote accuracy and speed in responding. Research has emphasised that the ability to learn skills in a time based manner in order to promote flexible learning repertoires, is needed to gain access to advanced cognitive skills (O'Toole, Barnes-Holmes, Murphy, O'Connor &

Barnes-Holmes, 2009). In terms of learning basic component skills in order to progress to advanced emergent ones, flexibility in the learning process is required. Fluid responding is proven to promote better results for derived relational responding and emergent relations and may in fact be a pre-requisite to advanced cognitive skills (Hayes et al, 2001). Similar findings in early research on derived relational responding indicate that relational training revealed differences on ability and intelligence scores measured pre-post intervention (Cassidy, Roche, & Hayes., 2011). Findings from one study revealed teaching 'same/opposite' relations then led to participants deriving novel relations, not only generalising to novel stimuli but also novel researchers (Kilroe, Murphy, Barnes-Holmes & Barnes-Holmes, 2011; Lyons & Murphy, under submission).

In relation to those findings, previous research carried out by Kilroe, et al. (2011) utilised the Implicit Relational Assessment Procedure in the adapted form of a teaching tool (T-IRAP) to train participants with developmental disorders to respond to relational targets on a computer. The IRAP is a feely available computer software programme which is used to measure implicit attitudes based on speed of responding (Barnes-Holmes, Barnes-Holmes, Power, Hayden, Milne, & Stewart, 2006 (http://psychology.nuim.ie/IRAP/IRAPSoftware.) the IRAP program presents trials on screen and measures speed and accuracy of responding which is done by pressing keys, D/K on keyboard that represent true or false responses in regard to the onscreen relations. The IRAP has proven successful in many fields concerning socially sensitive implicit attitudes, allowing behaviour analysts to further this into novel domains, such as learning. Many studies have utilised the IRAP to examine and teach relational responding and measure IQ gains pre and post exposure to the IRAP with favourable findings revealed both in typically developing children and those with learning delays (Kilroe et al. 2011; Lyon & Murphy, under submission). Research hypothesised that if RFT and relational responding is crucial to intelligent behavioural skills, measured using IQ

tests, then correlations might be seen between fluent relational responding skills and gains on IQ tests. Studies thus began to determine any such correlation and finding provided support for this hypothesis, in particular relating speed in responding to higher performance on verbal and reasoning skills (O'Toole, et al. 2009).

The above study (Kilroe et al. 2011) compared the use of table top teaching to that of the T-IRAP in terms of speed and accuracy. Results indicated that the T-IRAP successfully taught relations targeted with greater participant responding in speed and accuracy, as well as overall fluency in participant responding being higher when using the T-IRAP as opposed to table top. Current research such as this promotes the idea of teaching advanced cognitive skills to populations with developmental disorders, specifically autism spectrum disorder, known for rigidity in responding and lack of a generalised responding repertoire. It also shows how RFT work on derived relational responding can be synthesised into contemporary ABA programs while also utilising basic tactics from Skinners (1957) approach. A similar study expanded on this research using table top and T-IRAP relational training as an alternating treatments design to teach more complex relational responding with a contingency reversal in the hope of increasing IQ performance (Lyons & Murphy, under submission). Results showed, similar to previous research that using the T-IRAP produced faster responding when compared to table top. The study also successfully demonstrates an increase in IQ on an individual level for one participant, highlighting the potential gains in advanced cognitive skills from relational training in populations with autism.

While RFT promotes the benefits of fluent and flexible relational responding and accounts for this in the T-IRAP, other methods of teaching used commonly in the field of ABA also contribute to the idea that fluency should be a priority when teaching new skills. Precision Teaching (PT) encourages skills to be mastered at a specific celeration, defined as rapid and automatic performance of core skills. Developed by Lindsley in the 1960's

(Lindsley, 1971a), PT further elaborates on the Skinnerian perspective that rate of responding is the most important measure when looking at free operant learning (Lindsley, 1990). Research findings have highlighted the importance of fluency when teaching, specifically in relation to students with learning delays. Binder (1998) defined fluency as the definition of 'true mastery', while other findings indicate its relation to improved IQ scores as well as greater retention and generalisation of skills after teaching to fluency (Binder, 1996).

Similar to the ideas posited in RFT surrounding derived relational responding, PT proposes that once pre-requisite skills are mastered and responding is fluent, the emergence of novel and complex skills that are comprised of the taught skills are seen (Johnson & Street, 2004). For example, fluent responding in letters, sounds correspondence and recognition can facilitate the speedy acquisition of reading (Johnson & Street, 2004). Precision Teaching can offer interventions tailored to the specific learner and allow for rate based targets to be set and monitored by the students themselves using standard celeration charts. While teaching with the aim being speed of responding, PT also allows for flexible and generative responding which is especially important when it comes to language development and intelligent responding (Johnson & Layng, 1992).

Numerous studies carried out with children of different ages as well as those with developmental disabilities have shown successful results for PT (Lindsley, 1990). Studies from the Morningside Academy have even promoting results such as improvements of 2-3 grades per year (Johnson, 1997; Morningside Academy). Research indicates Fluency and flexibility are intrinsically linked to one another and often represent the same outcomes when it comes to teaching skills, as it does in the current study. One concept where both PT and RFT based teaching practices overlap is in the idea of more basic component skills leading to emerging advanced skills. Fluency in relational responding is seen as a core target with

previous research highlighting that flexible and speedy responding can promote more advanced cognitive skills (Hayes, et al, 2001).

One area in the field of fluency based training that has not seen much empirical work is that of generalisation and maintenance. Johnson and Layng (1992) furthered the work done by Haughton in the 1980's to develop the acronym RESA; Retention, Endurance, Stability and Application. It describes the important outcomes relevant to fluency training that should be evident in a skill that was taught to fluency. Retention is seen when the skill is maintained in the student's repertoire for a period of time. Stability is evident when the skill is carried out correctly despite an environment rich in distractors (Weiss, Pearson, Foley & Pahl, 2010) Endurance is shown when the student maintains the rate of responding over a longer period of time. Finally, application is seen when the skill generalises to new people, places and stimuli (Weiss et al, 2010). This often proves very difficult for students with a developmental delay, autism in particular (Fabrizio & Moors, 2003).

Research on this topic is scarce and in particular when working with learners diagnosed with ASD and other developmental delays (Weiss et al, 2010). One study carried out by Weiss, Fabrizio and Bamond, (2010) shows promising results for training skills to fluency and testing using the RESA assessments in children with autism however, the authors point out that very little empirical data is available on this topic to date (Weiss et al, 2010). With generalisation of learned skills being one of the major deficits seen in learners with ASD, more research in to this area could help establish a link between best practices when considering fluency training while also considering outcome data at follow up assessments.

As mentioned above, generalisation in learners with developmental delay often proves problematic to train and is rarely upheld on follow up assessment. It has developed into one of the key focus areas for early intervention programs and curriculum guides. ABA is

currently the primary form of early intervention for people with autism with studies showing great improvements in their language ability, social interactions and adaptability, while also showing significant improvements in the diagnostic measures of the core autism characteristics (Cohen, Amerine-Dickens, & Smith, 2006; Eikeseth, Smith, Jahr, & Eldevik, 2007). To date, significant results seen in people with autism are traced back to an intensive early start model of learning that enables them to get the specific training to fall in line with age matched peers as they develop. Alongside the increases in diagnosis and the current era of managed care, the development of reliable and valid assessment methods and training curricula is of great importance to all professionals in the field. Lovaas (1987) found that correct implementation of an early intensive behavioural intervention using discrete training and reinforcement could increase IQ, with 47% of the children diagnosed with autism in the study reaching IQ scores that matched that of their typically developing peers. Similar results were also seen in other research (Reichow & Wolery, 2009).

Despite a history of empirically validated treatments in the field of ABA, many verbal assessments currently available lack empirical validation. At present, two of the most successful assessment and curriculum tools are the Assessment of Basic Learning and Language Skills-Revised (ABLLS-R: Partington, 2008) and the Verbal Behaviour Milestones Assessment and Placement Program (VB-MAPP; Sundberg, 2008). ABBLS-R serves both as an assessment and curriculum for children with developmental disorders. It has 25 skill sets for general learning and language (Dixon, Whiting, Rowsey & Belisly, 2014). The VB-MAPP assess over 5 skill areas; social, motor, play, academic and language. However, neither assessments have empirically proven reliability and validity, meaning they both lack psychometric evaluation despite their popularity in applied settings alongside numerous amounts of research utilising them as main assessments (Gould, Dixon, Najdowski, Smith & Tarbox, 2011). Unfortunately, not all assessments are comprehensive enough to be used to

develop a full early intensive behavioural intervention curriculum for a child who displays deficits across all developmental domains. If assessments are being used for intervention, they should address specific skills, present or absent, in the persons repertoire, appropriate or not and also effective or not (Sigafoos, Schlosser, Green, O'Reilly, & Lancioni, 2008).

In applied behaviour analysis, where data driven assessments and interventions are representative of the larger field, service providers must hold empirical evidence to back up any claims made. This is especially true in the current era of evidence based practice (Dixon, 2014). Attempts should be made to link the assessments spoken of here to educational tests in order to provide evidence that the methods are meaningful towards desired progress and functioning (Dixon, 2014). The evidence is overwhelmingly suggesting that when it comes to autism, the available assessments or curriculums for education plans are not meeting the standards seen in other areas of clinical practice and education.

One recently developed assessment and curriculum guide that attempts to resolve the previously mentioned problems and aims to teach basic language and learning to fill the gaps they cannot, is the Promoting the Emergence of Advanced Knowledge Relational Training System (PEAK; Dixon, 2014). This approach, designed using aspects of RFT and synthesised with Skinners work on verbal operants was recently introduced to the professional community while having considerable similarities to the other approaches mentioned it does distinguish itself from them in many ways. It is comprised of 4 different modules; the Direct Training, Generalisation, Equivalence and Transformation of Functions, while providing steps for the user to teach the skills in each module (Dixon, 2014a). The direct training module employs a discrete trial training approach which is comprised of reinforcement, prompts and error correction throughout the delivery of training. The generalisation module further attempts to promote the development of treatment effects by regularly testing the

responses made by children in the trials where materials used had not been previously taught. Both the equivalence and transformation of function modules target higher order cognitive skills similar to those seen taught in previously mentioned studies using relational training.

The direct training module of PEAK is the one that most closely resembles a traditional ABA approach of treatment, comprised of 184 skills taught to the learner spanning from basic eye contact to more advanced problem solving. Providing a skill set of targets, methods for data collection and assessment packages to guide treatment decisions (Dixon, 2014), it utilises a train/test method of teaching to promote generalisation in learning by encouraging the use of novel and multiple exemplars in training. The design allows for the assessment to identify gaps in the child's repertoire and then the corresponding curriculum allows for the deficit to be taught. This unique system benefits learners in ways not seen by previously mentioned tools such as the VBMAPP (Sundberg, 2008) and ABLSS-R (Partington, 2008).

As a relatively novel addition to the field of ABA, not much literature is seen to investigate using the PEAK assessment tool to investigate generalisation in both language and learning in different populations such as typically developing children, those with speech delay and children or developmental delay. An area that has not been examined to date is that of sequencing effects within and between the PEAK training modules. Little is known on this subject, including if teaching targets from the PEAK Generalisation module negates the need to teach related targets from the PEAK Direct module. Currently, no work has been done on the sequencing of the PEAK modules, meaning practitioners are free to begin where they see fit while using the PEAK modules. However, it would be an advantage to the assessment as a teaching tool if teaching particular advanced skills using the PEAK Generalisation module resulted in the negation of needing to teach multiple similar skills from the PEAK-Direct module. This may mean the starting point and sequence of teaching skills need to be re-

considered and advised to specific areas for specific skills. By addressing this issue, other PEAK modules such as the Transformation or Equivalence modules could be examined in a similar way to test for relations between each module and sequences for training.

As stated previously, one of the biggest limitations with the assessment methods and curriculums currently available is the lack of psychometric data. The sparse data showing either validity or reliability of these assessment tools limits the confidence with which these can be used (Dixon, Whiting, Rowsey & Belisly, 2014). As a result of this, very little is known as to whether academic gains or advances in learning exist or occur after exposure to these training systems. In addition, comparisons to well-known measures of intelligence or functioning have not been established so whether the content of these packages reflects development in cognitive skills or ability is currently unknown (Dixon, Whiting, Rowsey & Belisly, 2014). Despite the fact that many of these programs are based on Skinners account of verbal language (Skinner, 1957), they do not fully utilise the concepts he presented. Often, they stop at the most basic units of verbal language, for example tacts or mands. Although important to get basics established, the packages do not attempt to approach the more complex verbalisations that need to be targeted, especially when considering gains in ability or IQ scores (Dixon, Carman, Tyler, Whiting, Enoch & Daar, 2014).

Fortunately, this is where PEAK differs from the previously available assessment packages. It does not limit itself to the advances in language that occurred in the 1950's through Skinners work, but synthesised it with modern accounts of language development. One study (Dixon et al. 2014) tested the convergent validity of the PEAK training system to determine the extent to which the scoring of PEAK assessment relates to other known and frequently used assessments for verbal and academic skills. Convergent reliability was obtained with the Peabody Picture Vocabulary Test (Dunn & Dunn, 2007) using a small sample of children with autism, providing evidence that the PEAK training system is

identifying similar deficits as other assessment tools available. Analysis of the literature reveals convergent reliability of other well used tools is scare if existing at all (Dixon, et al. 2014).

Alongside this study, another piece of research carried out by Dixon, Whiting, Rowsey and Belisly (2014) examined the link between IQ and the PEAK program. IQ assessments are often used as a standard by which other assessment measures are compared to in order to validate the measure as one of cognitive function or learning ability (Bishop, Guthrie, Coffing & Lord, 2011). IQ scores are also commonly used as a basis for evaluating intelligence in both typically and non-typically developing children (Dixon, Whiting, Rowsey & Belisly, 2014). The rising frequency of developmental disability diagnoses and the frequency in which those people present with problematic IQ scores has led to an increase in the demand for services to address this issue (Boyle, et al. 2011). Results from this study reveal a strong convergent reliability between IQ measures and PEAK scores. Findings may suggest that PEAK training could increase IQ scores pre-post intervention. As well as yielding psychometric data, this study promotes PEAK as a reliable method of increasing intelligence and ensuring evidence based practice (Dixon, Whiting, Rowsey & Belisly, 2014). Results from studies using relational training revealed similar correlations on pre-post testing for IQ and ability measure (O'Toole, et al. 2009)

PEAK has gathered psychometric support as both a valid and reliable assessment of the directly trained language repertoire of individuals with autism (Rowsey, Belisle, Dixon, 2014). As the underlying focus of the PEAK program is language development, findings from Dixon (2014) have shown the external validity of PEAK when the PEAK-DT score was assessed in relation to the Peabody Picture Vocabulary Test indicating the PEAK system serves as a valid assessment of the vocabulary of children with autism. As language is one of the most important skills for children to develop, a curriculum designed to promote this while

improving other skills and training generalisation would naturally be considered a success. Correspondence of the PEAK-DT score and measures of intelligence have also been obtained (Dixon, Belisle, Whiting & Rowsey, 2014). One other study providing evidence for the PEAK as an assessment package is that revealing a relationship of PEAK and the VBMAPP. When combined, the PEAK-DT and PEAK-G score make a total score which revealed a strong relationship to the VBMAPP (Dixon, Belisle, Stanley, Rowsey, Daar & Szekely, 2014).

The current study aims to build upon research findings from previous studies. The research experiment is very relevant to the problems encountered by people with a diagnosis of autism on a daily basis. The PEAK curriculum and training manuals were chosen due to their success as a relatively novel addition to the field of teaching to populations with deficits. PEAK research has successfully taught skills to children with developmental and intellectual disability using their specific training modules in the areas of direct training and generalisation (Dixon, Peach & Daar, 2014). Research conducted by Dixon, Whiting, Rowsey & Belisle (2014) indicates increased scores in ability tests after exposure to the PEAK training. Based on the current literature, this research will aim to answer the following questions; a) Does teaching PEAK Generalisation module targets negate the need to teach multiple simpler targets from the PEAK Direct module?; b) do targets involving application of relational responding assessed by PEAK correlate with ability scores; Peabody Picture Vocabulary Test 4th edition (PPVT-IV; Dunn & Dunn, 2007) and the Bracken School Readiness Assessment (BRSA-3, Bracken, 2007) with typically developing pre-school children or those diagnosed with autism?; (c) does PEAK training targets readily combine with other fluency teaching tools, T-IRAP and RAN, to promote skills which display RESA characteristics on follow up assessment?; The participants included typically developing children, those with a speech and language delay and children diagnosed with autism

spectrum disorder. Through combining the novel PEAK program with other behavioural teaching methods, more advanced ABA teaching programs may be designed to address the complex needs of students with learning delays instead of relying on existing and commonly used techniques, despite recent basic research findings relating to newer techniques.

Study 1a is a small n design which aims to provide information on PEAK relational learning of individual children as distinct from groups; similarly as with PEAK group studies, standardised testing will be conducted pre and post PEAK training with participants. The ability assessments include, the Peabody Picture Vocabulary Test (PPVT-IV; Dunn & Dunn, 2007), Vineland adaptive Behaviour Rating Scales (Vineland-II; Sparrow & Cicchetti, 2005) and the Bracken School Readiness Assessment (BRSA-3, Bracken, 2007). Study 1a will aim to teach 20 PEAK targets from the Generalisation module and assess if any emergent skills from the PEAK Direct module are seen after training. Specifically, the research will test if teaching higher complexity skills on the PEAK Generalisation module will negate the need to teach multiple similar ones on the PEAK Direct module. Participants are 4 children with diagnosed with autism (aged 3-5) and 4 typically-developing children (aged 3-4) and is designed as a pilot study to examine any evident differences in sequences of relational learning demonstrated, albeit with a small number of participants.

Study 1b aims to build upon research carried out by Kilroe, Murphy, Barnes-Holmes and Barnes-Holmes (2011) in which the IRAP was successfully adapted as a teaching tool called the T-IRAP to teach relational responding skills to children with developmental disorders, specifically autism. The current study will differ from this by teaching relational responding skills to children with and without autism after exposing them to the PEAK training in which some targets involve relational aspects, for example, exclusion and matching. There will be no specific table top training for relational frames as previous research has proven the T-IRAP to have superior outcomes. Both the typically developing

and ASD populations will be taught on the T-IRAP. The T-IRAP will be combined with PEAK with the aim of teaching fluent and accurate responding using a computerised method for skills previously trained using the PEAK train/test method. Combining these relatively novel behavioural teaching methods hope to provide new and advanced teaching methods for children with learning delays.

Generally, the current research aims to examine the sequencing of the PEAK modules and assess its ability to relate skills between modules to different pre-school populations. As PEAK is a relatively novel addition to the field of behaviour analysis, tests will be carried out to see if any differences can be detected between pre and post intervention ability assessments. There will be a small group comparison for exploratory purposes to see if a difference exists between the two participant groups while using this novel curriculum tool. It is predicted that ability scores should see an increase after both PEAK training and also exposure to relational training.

-Chapter 2-

Examining PEAK Sequencing and Teaching through T-IRAP

The current study aims to build upon research findings from previous studies. Study 1a is a small n design which aims to provide information on PEAK relational learning of individual children as distinct from groups; similarly as with PEAK group studies, standardised testing will be conducted pre and post PEAK training with participants. The ability assessments include, the Peabody Picture Vocabulary Test (PPVT-IV; Dunn & Dunn, 2007), Vineland adaptive Behaviour Rating Scales (Vineland-II; Sparrow & Cicchetti, 2005) and the Bracken School Readiness Assessment (BRSA-3, Bracken, 2007). Study 1a will teach 20 PEAK targets from the Generalisation module and then assess if any emergent skills from the PEAK Direct module are seen after training. The research will examine if teaching higher complexity skills on the PEAK Generalisation module will negate the need to teach multiple similar ones on the PEAK Direct module. Participants are 4 children with diagnosed with autism (aged 3-5) and 4 typically-developing children (aged 3-4) and is designed as a pilot study to examine any evident differences in sequences of relational learning demonstrated, albeit with a small number of participants.

Study 1b aims to build upon research carried out by Kilroe, Murphy, Barnes-Holmes and Barnes-Holmes (2011) in which the IRAP was successfully adapted as a teaching tool called the T-IRAP to teach relational responding skills to children with autism. The current study will differ from this by teaching relational responding skills to children with and without autism after exposing them to the PEAK training in which some targets involve relational aspects, for example, exclusion and matching. The study will also examine the ability to combine the PEAK relational training system with the T-IRAP, an interactive computerised teaching tool which has been successfully used to teach relational frames to children with learning delays. It is hoped that these novel teaching tools can provide advanced programs to address complex needs of students on a broader range than currently

available teaching tools alone. There will be no specific table top training for relational frames as previous research indicates the T-IRAP to have superior outcomes. Both the typically developing and ASD populations will be taught on the T-IRAP.

This study aims to examine the sequencing of the PEAK modules and assess its ability to relate skills between modules to different pre-school populations. With PEAK being a novel addition to the field of behaviour analysis, pre and post intervention ability assessments will be conducted for exploratory purposes. There will be a small group comparison to see if a difference exists between the two participant groups while using this novel curriculum tool. It is predicted that ability scores should see an increase after both PEAK training and also exposure to relational training.

Method

Participant Recruitment

The participants in this study were all children attending a pre-school for children with autism which included a mainstream class. Participants consisted of 4 children from the mainstream class and 4 children from the ASD class, all of whom were diagnosed with autism spectrum disorder from an independent clinical psychologist in accordance with the guidelines in the DSM-IV/ DSM-V (APA, 2000; 2013). The diagnosis ranged from moderate to severe with one participant being on the severe end of the diagnosis and 3 being moderate. The age range of the participants was 3-6 with the average being 4.4. All participants in the ASD class were exposed to ABA teaching strategies in their daily schedule. Consent forms were sent out to recruit participants for the study to each child via their schoolbags. An information sheet also accompanied this in which more details of the proposed research was given (Appendix 1 and 2). Parents were also asked to fully read all information sheets and consent forms prior to agreeing to their child participating in the research, and then return the forms after signing it with either consent to participate or declining to take part.

The participants were given pseudonyms that will be used throughout. Mark is a 4 year old boy with a diagnosis of autism spectrum disorder. His verbal ability was assessed using the Peabody Picture Vocabulary Test (PPVT-IV; Dunn & Dunn, 2007). He achieved a standard score of 89. His adaptive behaviour was assessed using the Vineland Behaviour Rating Scales (Vineland-II; Sparrow & Cicchetti, 2005) in which he received a standard score of 85 on the teacher rating scale and 76 on the survey form. Mark displays some aggressive behaviours in order to access tangibles towards other children and staff. He has a DRO procedure in place to help with this.

David is a 4 year old boy diagnosed with autism on a severe level. When assessed for both verbal abilities and adaptive functioning, using the PPVT-IV and the Vineland, he

achieved standard scores of 75, 69 (teacher rating form) and 27 (survey form) respectively. David rarely interacts with his peers or uses verbal language to communicate, despite having a good receptive language ability. He displays a lot of escape behaviours and task avoidance. Due to behavioural problems not connected to the current research, David's consent was withdrawn from the study after completing some of the research. His results are displayed below for the table top and T-IRAP work he completed. He was not included in the follow up assessments or generalisation tests.

Lisa is a 4 year old girl diagnosed with autism on a moderate – severe level. Lisa has a great verbal ability and achieved a standard score of 96 on the PPVT-IV. On the Vineland, Lisa got a standard score of 80 (teacher rating form) and 29 (survey form).

Ann is a 5 year old girl diagnosed with autism on a moderate level. She achieved a score of 71, 71 (teacher rating form) and 76 (survey form) on the PPVT-IV and the Vineland respectively. Ann shows great potential academically and intends to progress to a mainstream school in the next academic year. The only difficulty Ann presents is not having one full vocabulary as she speaks Russian at home and English in school.

The children from the mainstream class are; Libby, aged 4, Megan, aged 4, Izzy, aged 4 and Amy, aged 4. All 4 participants have no developmental or learning difficulties and attend a Montessori class for typically developing children for 3 hours each day.

Ethical Considerations

A research proposal was submitted for ethical approval to the department of ethics subcommittee and approved on the 11th of September 2015. The main issues addressed were related to conducting research with vulnerable participants such as young children with and without diagnosed autism. Issues of consent and voluntariness were addressed throughout the course of the research as outlined in relevant sections within this research. Prior to any data

collection, consent forms and information sheets were sent out with the main information about the study, to the children's parents. (Appendix 1 and 2). Halfway through the research the parents of children in the study were given a continued consent form giving them an opportunity to withdraw if they wished to (Appendix 3).

Often when considering children with autism and developmental or intellectual disability, it is not considered appropriate to get consent from them for procedures or interventions as they do not always have the full mental capacity to understand what is being asked of them or to comprehend any implications of the participation. In cases where the parent/s or guardians/s of the participant are giving consent, it is common practice to gain assent from the participant, meaning an expression of agreement or approval from the individual. As an example, with a verbal child, a simple 'yes or no' would be enough to establish assent when asking them if they wish to work with you. When dealing with a child with no vernal repertoire, facial expression, body language and approach behaviours could indicate if they were happy to take part. If they child displays challenging behaviours or is unwilling to approach the researcher, they would be deemed uncomfortable with the task or researcher and the session would not take place, as voluntariness was not established. In the cases of children with challenging behaviours, if they had a behaviour support plan in place, it was followed throughout the research sessions also. Within the ASD participant group, two children have behaviour support plans in place and could be run alongside tasks in session. The researcher had a well-established rapport with all of the participants having been working with them before, as well as being familiar with reactive strategies and support plans.

An ethical issue pertaining to the researcher is that of competence. The researcher has an undergraduate degree in Psychology and is in third year on the Doctorate in Psychological Science: Behaviour analysis and Therapy. The ethical training completed on the course is to a

very high standard and in line with the revised ethical standards provided by the BACB (Behaviour Analyst Certification Board). The researcher has also received training in the application of ABA techniques in the workplace under the supervision of a Board Certified Behaviour Analyst. The researcher is suitably qualified to deliver standard B tests (according to Sigma Assessment Systems), such as the one described above. Guidelines have also been set by the American Psychological Association (APA taskforce 2000) for test users that states that students with training equivalent to the level of the researcher can administer the test once they are not making or guiding clinical decisions from the interpretation of the results. Data protection guidelines were followed in line with current best practice standards. Confidentiality was protected and respected throughout the research and data were treated as dictated by current ethical standards.

Settings and Materials

All sessions took place in a classroom in the pre-school. The sessions did not interfere with the usual daily routine the children had in place and did not reduce the amount of academic work they did each day. The research was carried out during 1:1 sessions, usually for 30 minutes, with the researcher and participant in a classroom with other tutors and children present. Most sessions were carried out at a table with two chairs. Often a third person; IOA data collector, BCBA or head teacher also sat at the table to observe the sessions.

Assessments. Each participant was assessed using three tests of ability, the Peabody Picture Vocabulary Test-Fourth edition (PPVT-IV), the Bracken School Readiness Assessment Third edition (BRSA-3) and the Vineland Adaptive Behaviour Scales Second edition (Vineland-II). The assessments were carried out during the day or after school with the head teacher present to supervise. Both the PPVT-IV and BRSA-3 are administered using easels with various pictures on them and separate scoring sheets. The Vineland-II assessment

was carried out by performing small tasks and asking parents/carers questions about the participant's ability. After the initial assessments, the research sessions took place weekly.

The PPVT-IV is a norm referenced, widely used test of receptive vocabulary providing an estimate of verbal ability. The test itself only takes up to 30 minutes to administer and provides picture stimuli meaning no verbal or reading repertoire is needed to complete it. Each trial consists of 4 pictures on an easel page in a multiple choice style set up. The participant hears the researcher say a word and can point to the correct answer without verbal responding. The test can be administered to people of ages 2:6-90 years old. It is suited to people with intellectual or developmental disability also. The test has two parallel forms each containing 228 items, ideal for pre and post testing, and each one administered individually. Although the PPVT-IV is not a measure of IQ as the test assesses verbal ability, it does correlate highly to other measures of fluid intelligence and may be considered valuable comparison to be administered especially in the population with learning difficulties or with those who do not have an expressive verbal repertoire.

The PPVT-IV is shown to have good internal consistency with a split half reliability coefficient of .94 and .93 for test retest reliability while also having an alternate form reliability of .84. The PPVT-IV also correlates well to a number of other well established tests. It holds an average correlation of r=.82 with the Expressive Vocabulary Test, Second Edition (Williams, 2007), an average of r=.50 with the Comprehensive Assessment of Spoken Language (CASL; Carrow-Woolfolk, 1999) and an average of r=.71 with the Group Reading Assessment and Diagnostic Evaluation (GRADE; Williams, 2001).

The Bracken School Readiness Assessment (BRSA-3; Bracken, 2007) is used to estimate a child's readiness for school by evaluating their understanding of 85 important foundational academic concepts in categories of colour, letters, numbers/counting, sizes/comparisons and shapes. The above skills are those deemed to be relevant for readiness

to begin formal education. This assessment is a receptive one and therefore suitable for children with no expressive verbal repertoire. It is comprised of a flip chart in which picture stimuli are displayed on each page. The child may point to the one they choose as their answer. On average there are four options to choose from in each stimulus set. The test lasts approximately 15 minutes to administer and is suitable for ages 3:0-6:11.

The BSRA-3 shows good test retest reliability with the school readiness composite score (SRC) of .76-.92, as well as internal consistency using split half reliability coefficient of r=.95. The BSRA-3 also shows correlations to other language assessments such as the Preschool Language Scales, Fourth Edition (PLS-4; Zimmerman, Steiner & Pond, 2002). The average correlation between the two tests is between .61-.66. The BRSA-3 has been effective in its use with participants that have both developmental delay and/or intellectual disability.

The Vineland-II is a measure of adaptive behaviour and level of functioning from birth to adulthood (0-90). It consists of two forms; the teacher rating form and the survey form. The teacher rating form (TRF) is administered to the key teacher with the child and they grade it. The survey form is done with the parent/caregiver as an interview style process. Both forms are scored separately and indicate the participant's level of functioning. The TRF takes 20 minutes to administer while the survey form takes between 20-60 minutes. Both forms have a series of questions that have starting points depending on the participant's age. There are start points and cut off points for each section and a total score is computed for each one. The four domains in the vineland-II are; communication, motor skills, social skills and daily living skills.

Internal consistency of the Vineland-II was assessed using the split half reliability test. The spearman brown formula was used to determine correlations of the domain and subdomain. Across all domains and subdomains, the correlations ranged from .71-.94. Test retest reliability was examined and revealed an average correlation of .72-.98. The Vineland-

II was compared to other measures in the same domain to test for validity. An average correlation of .70 was observed between the Vineland-II and the adaptive behaviour assessment system-second edition (ABAS-II). Another test, the Behaviour Assessment System for Children, Second Edition (BASC-2) parent rating form was compared to the Vineland-II and yielded a correlation score of .80.

PEAK targets. Table top (TT) procedures were conducted at the participant's desk in the classroom under normal conditions. The TT procedures were used to teach PEAK targets so the materials varied including laminated cards with stimuli on them, toys, specific coloured objects etc. The materials used were varied to promote generalisation and avoid rote learning. The responses, correct or incorrect were recorded using pen and paper on a data collection sheet designed specifically for this.

The T-IRAP. This computer program was administered using an Acer Laptop with a 15 inch screen, running Microsoft windows 10 operating system. The T-IRAP is a computer program that is written in visual basic 6.0 and is freely available to download. The researcher enters their chosen stimuli and the program controls all aspects of stimulus presentation and data collection. The program records the incorrect responses and the response latency for each trial. When presented, each trial on the program displays a sample stimulus, a comparison stimulus and two relational targets, 'same/different'. The participants respond using the keys D and K for Same (D) and Different (K). Shorter response latencies in the IRAP trials indicate faster responding on the participant's part. Feedback is displayed on screen for the participant after each trial; they are either presented with new stimuli to respond to or a red 'X' will appear on screen indicting they have answered incorrectly and must answer correctly to proceed. Each block consists of 10 trials for the participant to respond to. Once the participant is finished each block, feedback can be accessed by the researcher showing the response latencies in milliseconds and correct/incorrect responses.

The participants needed to meet the mastery criteria of 80% or higher accuracy responding with response latencies under 2000 milliseconds.

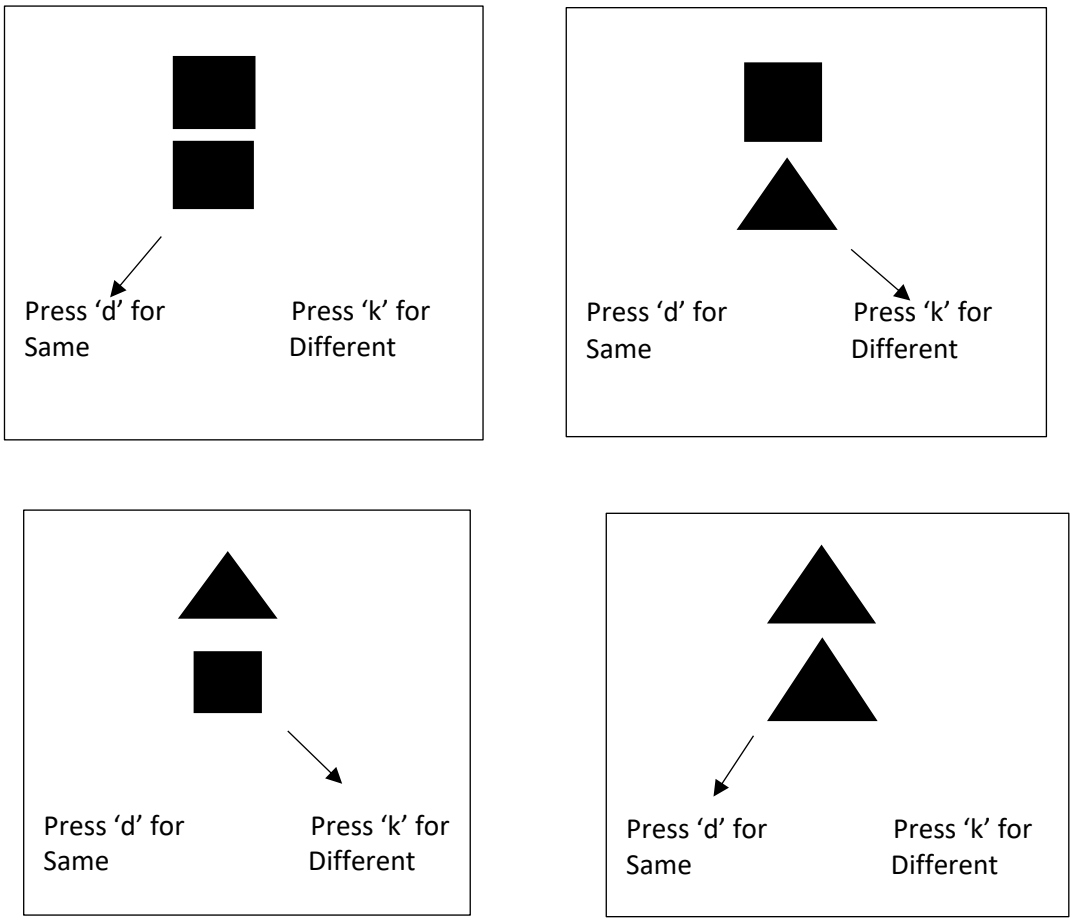


Figure 1: examples of the non-arbitrary stimuli used for same/different responding on the T-IRAP. (Arrows did not appear on screen)

Design

The study used a within subjects design for training PEAK targets and the T-IRAP. Baseline ability test scores were collected using the PPVT-IV, The Vineland-II and the BSRA-3. A PEAK assessment was also carried out on all participants to establish what skills were already in their repertoire. A within subjects design was employed for training PEAK

targets and using the T-IRAP to teach relational frames with an aspect of group comparison of the findings between the typically developing children and those with ASD. Correlational analysis was carried out on the pre and post ability tests for exploratory research purposes. The independent variable being the method of training as well as the content taught to participants with the dependent variable being scores on post teaching assessments, specifically ability scores.

Procedure

Pre training IQ assessments: Baseline PPVT-IV, BSRA-3 and Vineland II assessments were carried out first with each participant and scores were calculated before any TT or IRAP procedures took place. The assessments were conducted in the classroom with other children and staff present. Either the Head teacher or the BCBA were also present for each research session.

PPVT-IV was administered as per the instructions in the manual. The trials consisted of presenting the participant with four pictures on a flipchart page and requiring them to 'find x'. The BSRA-3 was administered using a flipchart with pictures displayed on each page. The participant was told to 'show me X' and they could point to the correct picture. Both assessments were accompanied by separate scoring sheets in which the researcher could fill in as they delivered the assessment. The Vineland-II survey form was given to all parents and the researcher went through the questions with them in an interview style meeting and scored the sheets. The teacher rating form was given to the key tutor working with the child or given to the head teacher in some cases to fill out throughout the day while working with the participant. Depending on the age of the child, the researcher marked where on the record book that the teacher or parent should begin recording, for example; a 6 year old can start at the 5+ section.

An assessment for the PEAK Direct training module was also carried out with each child prior to any teaching beginning but after the ability assessments were done. This consisted of 184 item questionnaire relating to skills and abilities of the participant. The tutor for each participant carried these out over the course of a few days in between work sessions. The researcher then recorded all the answers in a table on the front of the record book to highlight the skills each participant did or did not have in their repertoire.

The ability assessments were randomly presented to participants, both mainstream and ASD class to avoid any sequence effects

PEAK table top training (Study 1a): The TT procedures were used to teach PEAK targets to all participants. 20 targets in total were taught to the participants using a discrete trial training approach. Targets were divided into groups of five and interspersed among the participants folder work already in place. The class were generally at the same academic level and had similar folder programs but some progressed faster than others and moved onto their next targets once previous five were taught and tested. The experimental sequence meant that five targets from the PEAK generalisation module were taught and then the corresponding ones on the PEAK Direct module were probed to see if learning transferred. For teaching the targets from the generalisation module, a train/test strategy was used as instructed in the PEAK manual. This meant, that during training, the participant must get 90% on two consecutive occurrences or 100% once. The test stage would then test those targets using novel stimuli for generalisation. When testing a target, the response either correct or incorrect gets no feedback from the teacher. This is to ensure the performance is as a result of a new generalised skill not from direct training with the stimuli used. Once this was done with the chosen five targets, the Direct Module targets corresponding to them were probed. Positive reinforcement was used throughout the teaching process and breaks were given if needed or requested. Reinforcers in the form of tangibles or edibles were also used with the ASD

population if needed. Reinforcer assessments were carried out regularly to assess the participants highest reinforce and if an edible were used, only a small amount was given in line with ethical standards and school policy. In the case of incorrect responses, prompts were used. The researcher used least to most prompting in accordance with the procedure in the school. When probes were carried out, no consequences were delivered for responding. The direct targets chosen to assess were ones that would usually have been taught as a prerequisite skill or an easier form of a more advanced skill. These corresponded to the generalisation targets chosen as a result of the assessment carried out prior to any teaching. For example, a generalisation target was 'generalised imitation' whereas the direct targets chosen to correspond to this were; motor imitation (gross and fine motor), object imitation etc.

T-IRAP format (Study 1b): Initial probes were carried out with the participants to test their ability to respond to 'same/different' relations on the computer screen prior to training with the T-IRAP. These were done in trial blocks of 10 with mastery criteria being 8/10 correct responses. Three sessions of probes were done before relational training began. For T-IRAP relational training, at the start of each session, the participant was given oral instructions from the researcher. The participants were told that they would see one of two pictures on the screen and another one underneath it. They would then see the words 'same' or 'different' as response options at the bottom of the page and they could choose them by pressing 'D' or 'K'. The instructions given also explained that different trial types would be presented throughout the IRAP, for example, circles, squares, triangles. Prior to starting the IRAP, the participants were given the following instructions;

'Would you like to work on the computer with me today? We are going to do some matching. We are going to see some pictures that are the same and some that are different. If you see two pictures that are the same, you can press the 'D' button (researcher shows

participant D button) and if the two pictures are different, press the K button (researcher shows the K key). So if a circle comes up on the top (points to top picture) and another circle comes up on the bottom (points to bottom picture) then you press this key (points to D) because the pictures are the same. If the pictures are different (points to top and bottom pictures), you should press the K key (points to K). If you get the correct key, then more pictures will appear and if not, a red 'x' will appear. If that happens, we can try again'.

If the participants chose the correct response key, the next trial is presented on the screen. If they chose the incorrect answer, a red 'x' appears on the screen and they are required to select the correct answer before the next trial is presented. If however the participant did not understand the red 'x' and therefore did not select the correct answer to proceed, they were given least to most prompting as corrective action. Throughout the IRAP all participants were given positive reinforcement in the form of social praise, token economy or edibles to encourage responding. Reinforcement was specifically tailored for each student with respect to their daily work schedule of reinforcement and level of motivation on the task. Some needed only social praise while others were on a thicker schedule of reinforcement.

Inter Observer Agreement

For the assessments, an independent observer sat beside the researcher and took data on the responses made by the participant without talking or interfering in the process. For the TT work, an experienced ABA tutor who was trained on the PEAK method of teaching and data collection took independent observation data. They sat at the table and did not interfere or interact with the researcher in any way. The IOA data was taken for approximately 25% of the TT sessions and analysis was conducted on the number of occurrences of agreement per sessions. This was calculated by dividing occurrences per session by all responses and multiplying by 100. The IOA data revealed 97% agreement between the researcher and the

independent observer. The T-IRAP does not require the use of IOA data as it independently records all of the data.

Decision Protocol

The decision protocol followed throughout the research was the one that was in place in the school. If three descending data points are seen in a row or two data points remain at zero, the decision is made to stop running the program and change the instructional procedures and draw a phase line on the graph. If five variable data points are seen, depending on the direction of the trend a decision is made. If the overall direction of the trend is ascending then the decision is made to carry on to a maximum of 10 points. If the overall trend is descending, the decision is made to stop and change the program. The mastery criteria is 90% on two occasions to move on a program or 100% once.

Results

Pre-training IQ Assessment Data

Table 1 shows the pre and post-intervention standard and raw scores on the PPVT-IV for each of eight participants with diagnosed ASD (aged 3-5 years). A standard score of 20 on the PPVT-IV represents the lowest possible score. The PPVT-IV scores are calculated by transforming the raw scores into standard ones directly. If a participant receives a score of 20 or below, they are placed in the lowest 0.1% of the population. These scores represent a very low verbal ability. Another reason for scoring low may be as a result of the test not being sensitive enough to the participant's ability. This issue is expanded on in the discussion section of the paper.

The PPVT-IV results (table 1) reveal the mean score for the autism participants pre-intervention to be 75 (S) and 49 (R) with the post intervention mean scores being 89 (S) and 56 (R). The typically developing participants score an average of 86 (S) and 47 (R) on their pre-intervention assessments with post intervention scores increasing to 96 (S) and 67 (R). The results for the typically developing participants are slightly higher than that of the participants with ASD yet both groups did see increases in both standard and raw scores.

Table 1
Standard scores (S) and raw scores (R) for each participant on the PPVT-IV pre and post intervention.

	Pre-Intervention		Post-Intervention	
Participant	PPVT-IV (S)	PPVT-IV (R)	PPVT-IV (S)	PPVT-IV (R)
Mark	89	63	97	67
David	75	40	85	46
Lisa	96	57	103	68
Ann	71	37	72	42
Libby	86	44	100	65
Megan	95	56	98	68
Izzy	74	32	93	68
Amy	91	57	94	69

Table 2 shows the pre and post-intervention results of the Vineland-II assessment for all participants. It should be noted that the survey form was given to all participants, and the teacher rating form was administered with four ASD participants in addition, as a second similar assessment to ensure a realistic adaptive behaviour score. The adaptive behaviour composite score is calculated for each participant and displayed below, as well as their standard score, percentile rank and adaptive level.

The Vineland results (table 2) reveal a mean standard score of 52 for the participants with ASD at pre-intervention and a score of 55 post intervention. The typically developing participants had a mean score of 99 pre intervention and 101 post intervention. Not large increases were seen for this assessment pre-post intervention.

Table 2.
Results of the Vineland: Survey form for all participant and Teacher rating form for ASD class, pre and post intervention.

Survey Form Results

	Pre-intervention			Post-intervention		
Participant	Standard score	Percentage Rank	Adaptive Level	Standard Score	Percentage Rank	Adaptive Level
Mark	76	5	Moderately low	80	5	Moderate low
David	27	.1	Low	28	.1	Low
Lisa	29	5	Low	32	5	Low
Ann	76	5	Moderately low	78	5	Moderate low
Libby	108	70	Adequate	110	70	Adequate
Megan	105	53	Adequate	111	53	Adequate
Izzy	90	25	Adequate	90	25	Adequate
Amy	92	30	Adequate	93	30	Adequate

Teacher Rating Form Results

	Pre intervention			Post intervention		
Participant	Standard score	Percentage Rank	Adaptive Level	Standard score	Percentage Rank	Adaptive Level
Mark	85	16	Moderately low	85	16	Moderate Low
David	69	2	Low	70	2	Low
Lisa	80	15	Moderately low	85	15	Moderate Low
Ann	71	3	Moderately low	74	3	Moderate Low

Table 3 shows each participants pre and post-intervention results for the BSRA-3. Each participant receives both a raw score and a 'percentage mastered' figure. In line with the previous assessments, standard scores are also presented. A standard score of 85 and lower represents a delayed development, 100 is an average level and above 115 shows advanced development. The raw score for the BSRA is calculated by combining all 5 subdomains. The percentage mastered is calculated from the raw score.

The results for the Bracken assessment (table 3) show that the participants with ASD had a mean score of 88 (S) and 41 (R) for pre-intervention assessment, with 91 (S) and 42 (R) for post intervention. The typically developing peers revealed a mean score of 100 (S) and 39 (R) for pre intervention, while the post intervention scores were 104 (S) and 55 (R). Increases were seen for both groups of participants in both standard and raw scores.

Table 3.
BSRA results displaying raw scores, percentage mastered and standard scores for pre and post intervention.

	Pre-intervention			Post-intervention		
Participant	Raw Score	% mastered	Standard score	Raw score	% mastered	Standard score
Mark	48	56	95	49	58	96
David	44	52	91	45	53	88
Lisa	27	32	89	31	36	95
Ann	45	53	84	45	53	84
Libby	36	42	98	42	49	99
Megan	50	59	111	59	69	114
Izzy	26	31	88	31	36	90
Amy	47	55	103	57	67	112

Assessments and standard scores obtained from the PPVT-IV, Vineland-II and BSRA-3 are useful to place a participant in relation to the wider population standards, however, they are not always sensitive enough at a within-subject level to give a realistic representation of the person's ability. As a result, raw scores are used as a reflection of an individual's progress in the hope they can detect small changes in ability between pre and post-intervention and especially regarding participants scoring in the lower extremes.

Study 1a: Training PEAK

Table 4.

PEAK Generalisation Module target skills selected, alongside corresponding PEAK Direct Module target skill: The research aimed to determine if learning PEAK-G selected target skills would result in appropriate derived responding with selected PEAK-D target skills.

PEAK-G Selected Target Skills		**PEAK-D Selected Corresponding Target Skills**
14E	Generalised Echoic	5B vocal imitation syllable 5C vocal imitation word 7H animal sounds
1A	Imitation	4D oral imitation 4B 1 step motor imitation 4E 2 step object imitation 4F 2 step motor imitation
9B	Identify community helpers	8B label community helpers 10Q tact community helpers
11G	Identify colours	9C label colours
6E	Identify shapes	9B label shapes 9K tact shapes
4E	Matching numbers	9P tact numbers 9G label numbers
4E	Matching letters	9O tact letters 9F label letters
2B	Tact animals	8M tact animals
13K	Taking turns	3B sharing 3A turn taking
4A	Counting groups of items	3D imitate counting
5B	Variation of colour tact	9L tact colours
11J	Fluency counting	13E Intraverbal counting
11A	Identify body parts	9J tact body parts 9A label body parts
1B	Counting objects	
7G	Match items to pictures	7B match colours 7C match numbers/letters 6J matching objects 7A matching pictures
5A	Fine Motor skills	4C 1 step fine motor
11O	Identify emotions	12P tact emotions 11L Intraverbal emotions 12C label emotions
4C	Exclusion	11G exclusion
10L	Waiting	5H follow instruction
12S	Exclusion by function	11R tact item that doesn't belong

PEAK Results: Direct Module Assessment 1

Table 5.
PEAK results from the Direct Module assessments for 8 participants (participant 1-4 are TD and 5-8 have diagnosed ASD).

PEAK Direct Module Initial (Pre-Training) Assessment		Participants 1-8 Y (Yes) N(No)							
PEAK-D number	**Program Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
12P	Tact emotions	N	N	N	N	N	N	N	N
9L	Tact colours	N	N	N	N	N	N	N	N
8M	Tact animals	N	N	N	N	N	N	N	N
7H	Imitate animal sounds	N	N	N	N	N	N	N	N
11G	Exclusion	N	N	N	N	N	N	N	N
9O	Tact letters	N	N	N	N	N	N	N	N
9P	Tact numbers	N	N	N	N	N	N	N	N
4D	Oral imitation	N	N	N	N	N	N	N	N
4F	2 step motor imitation	N	N	N	N	N	N	N	N
7B	Match colours	N	N	N	N	N	N	N	N
7C	Match numbers/letters	N	N	N	N	N	N	N	N
8D	Label animals (rec)	N	N	N	N	N	N	N	N
9C	Label colours (rec)	N	N	N	N	N	N	N	N
9F	Label letters (rec)	N	N	N	N	N	N	N	N
7A	Matching Pictures	N	N	N	N	N	N	N	N
11L	Intraverbal (emotions)	N	N	N	N	N	N	N	N
8B	Label community helpers (receptive)	N	N	N	N	N	N	N	N
9B	Label shapes (receptive)	N	N	N	N	N	N	N	N
10Q	Tact community helpers	N	N	N	N	N	N	N	N
9K	Tact shapes	N	N	N	N	N	N	N	N
3B	Sharing	N	N	N	N	N	N	N	N
6J	Matching Objects	N	N	N	N	N	N	N	N
13E	Intraverbal Counting	N	N	N	N	N	N	N	N
4C	1 step fine motor imitation	N	N	N	N	N	N	N	N
4B	1 step motor imitation	N	N	N	N	N	N	N	N
4E	2 step object imitation	N	N	N	N	N	N	N	N
9G	Receptively label numbers	N	N	N	N	N	N	N	N
5B	Vocal imitation: syllable	N	N	N	N	N	N	N	N
5C	Vocal imitation: word	N	N	N	N	N	N	N	N
11R	Tact item doesn't belong	N	N	N	N	N	N	N	N
3D	Imitate counting	N	N	N	N	N	N	N	N
3A	Turn taking	N	N	N	N	N	N	N	N
9J	Tact body parts	N	N	N	N	N	N	N	N
9A	Label body parts	N	N	N	N	N	N	N	N
5H	Follow instruction	N	N	N	N	N	N	N	N

12C	Receptively label emotions	N	N	N	N	N	N	N	N

Results from the above table indicated that the PEAK Direct Module selected targets were absent in all participants' repertoires when assessed.

PEAK Results: Generalisation Module Assessment 1.

Table 6.
PEAK results from the Generalisation Module assessments for 8 participants (participant 1-4 are TD and 5-8 have diagnosed ASD).

PEAK Generalisation Module Initial (Pre-Training) Assessment		**Participant 1-8 Y (Yes) N(No)**							
PEAK-G number	**Program Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
14E	Generalised Echoic	N	N	N	N	N	N	N	N
1A	Imitation	N	N	N	N	N	N	N	N
9B	Identify community helpers	N	N	N	N	N	N	N	N
11G	Identify colours	N	N	N	N	N	N	N	N
6E	Identify shapes	N	N	N	N	N	N	N	N
4E	Matching numbers	N	N	N	N	N	N	N	N
4E	Matching letters	N	N	N	N	N	N	N	N
2B	Tact animals	N	N	N	N	N	N	N	N
13K	Taking turns	N	N	N	N	N	N	N	N
4A	Counting groups of items	N	N	N	N	N	N	N	N
5B	Variation of colour tact	N	N	N	N	N	N	N	N
11J	Fluency counting	N	N	N	N	N	N	N	N
11A	Identify body parts	N	N	N	N	N	N	N	N
1B	Counting objects	N	N	N	N	N	N	N	N
7G	Match items to pictures	N	N	N	N	N	N	N	N
5A	Fine motor skills	N	N	N	N	N	N	N	N
11O	Identify emotions								
4C	Exclusion	N	N	N	N	N	N	N	N
10L	Waiting	N	N	N	N	N	N	N	N
12S	Exclusion by function								

Results indicated from the above table that the skills selected from the PEAK Generalisation Module were absent from the repertoires of all eight participants.

PEAK Results: Assessment II

Overall results post-training for selected targets in the Generalisation and Direct PEAK modules with 1-8 participants are displayed below in Table 7. All participants showed learning in that the selected Direct Module target skills shown to be absent prior to PEAK-Generalisation training were now present in their repertoires, even though they had not been exposed to PEAK-Direct training and thus had not learned by direct reinforcement for the specific Direct targets.

Table 7

Participant data (N=8) subsequent to PEAK training for selected targets in the Generalisation Module; participants were then exposed to Assessment II for selected targets in the Direct Module thought to correspond with the previously learned Generalisation targets.

PEAK-G Assessment II		Participants 1-8	**PEAK-D Assessment II**	Participants 1-8
14E	Generalised Echoic	Y	5B vocal imitation syllable 5C vocal imitation word 7H animal sounds	Y Y Y
1A	Imitation	Y	4D oral imitation 4B 1 step motor imitation 4E 2 step object imitation 4F 2 step motor imitation	Y Y Y Y
9B	Identify community helpers	Y	8B label community helpers 10Q tact community helpers	Y Y
11G	Identify colours	Y	9C label colours	Y
6E	Identify shapes	Y	9B label shapes 9K tact shapes	Y Y
4E	Matching numbers	Y	9P tact numbers 9G label numbers	Y Y
4E	Matching letters	Y	9O tact letters 9F label letters	Y Y
2B	Tact animals	Y	8M tact animals	Y
13K	Taking turns	Y	3B sharing 3A turn taking	Y Y
4A	Counting groups of items	Y	3D imitate counting	Y
5B	Variation of colour tact	Y	9L tact colours	Y
11J	Fluency counting	Y	13E Intraverbal counting	Y
11A	Identify body parts	Y	9J tact body parts 9A label body parts	Y Y
1B	Counting objects	Y		
7G	Match items to pictures	Y	7B match colours 7C match numbers/letters 6J matching objects 7A matching pictures	Y Y Y Y
5A	Fine Motor skills	Y	4C 1 step fine motor	Y
11O	Identify emotions	Y	12P tact emotions 11L Intraverbal emotions 12C label emotions	Y Y Y
4C	Exclusion	Y	11G exclusion	Y
10L	Waiting	Y	5H follow instruction	Y
12S	Exclusion by function	Y	11R tact item that doesn't belong	Y

Study 1b: Train-Test Teaching

The following graphs represent learning data for participants during PEAK train-test teaching and T-IRAP teaching for targets that are directly related to the relational frame of coordination ('same/different'; Hayes et al., 2001). For both Table Top teaching and T-IRAP, the accuracy data are represented as percentage correct (of 10 trials per block) scaled on the Y axis. Different levels of prompting are introduced as necessary throughout the training, and the prompt level is numbered as per PEAK training programmes A phase line (broken dashed line through the graph) represents a different prompt level indicated by the prompt level number heading above (e.g., PL#4).

Table 8
PEAK Prompt levels used throughout the research.

PL#0	PL#2	PL#4	PL#8	PL#10
No Response.	Multiple responses or reduced stimulus array.	Two prompts at most with a full array.	One single prompt either verbal or visual. E.g: gestural.	Independent correct responding.

The results represented in Figures 2-9 show the accuracy data for 8 participants during PEAK Generalisation train-test methods for the skills "Matching" (i.e., Same) and "Exclusion" (i.e., Different) prior to using the T-IRAP teaching programme. The graphs displays data for each phase separated with a broken line; for example, baseline data with no programmed reinforcement, data for responding with prompt and programmed reinforcement, and independent responding with programmed reinforcement.

Figure 2 shows Marks performance. At baseline measurement, correct responding remained at zero levels for the three sessions. Following the introduction of the GP, the accuracy data steadily increased for both targets with matching reaching the mastery criteria within four sessions and exclusion within seven sessions. Responding remained high and

stable at an independent level when the gestural prompt was removed until criterion was reached (90% x2, 100% x1). An overall steadily increasing learning path can be seen in the data for the matching target while exclusion remains a little more variable.

The results represented in Figure 3 show the accuracy data for David, at baseline David showed no accurate responding for either matching or exclusion skills. When a gestural prompt was introduced for the next phase, accuracy data can be seen to show a slightly variable increase in correct responding with initial accuracy followed by a downward path in responding for both target skills and again returns to steadily increasing accurate responding until mastery criteria is reached. When the GP was faded back to independent responding, David shows an initial dip in accurate responding and then steadily rises over four (matching) and five (exclusion) sessions to criteria. Overall the data show a variable data pattern throughout both teaching phases but reaches criteria.

The results represented in Figure 4 show the data for Ann, at baseline results show accurate responding levels to be at zero. The gestural prompt was introduced which shows both targets on a steadily increasing data path for accuracy with the matching target decreasing for two sessions, 3 and 4, halfway through the teaching phase before recovering and rising to reach mastery. The following phase represents the independent responding for both targets which remain high for accurate responding until reaching mastery.

The results represented in Figure 5 show the data for Lisa, baseline probes show no accurate responding for either target. Data from the gestural prompt phase displays an acceleration trend towards accuracy for both targets with matching reaching mastery within five sessions and exclusion within 8. When independent responding is introduced, matching continues to display an upward trend to mastery and exclusion shows an initial dip in

responding and then rises to reach criteria. An overall increasing trend can be seen in the data.

The results represented in Figure 6 show the accuracy data for Izzy, at baseline, the probes revealed no accurate responding for either targets. The data from the gestural prompt phase and independent phase for matching shows a rapidly ascending trend for accuracy until reaching mastery within 6 data points. The exclusion targets is seen to show an increasing path in the gestural prompt phase with some variability throughout the sessions and a similar trend seen when the gestural prompt is faded to independent responding, taking longer to reach mastery than the matching target.

The results represented in Figure 7 show the accuracy data for Amy, at baseline, no accurate responding was seen for either target. During the gestural prompt phase of the intervention, matching shows an upward trend of accuracy while exclusion displays a more variable trend, initially rising and then remaining stable for two sessions, 7 and 8, before continuing to increase and reach mastery criteria. When independent responding was introduced, exclusion initially showed a large dip in accuracy followed by a similarly large increase to remain stable at the mastery level. This was most likely a result of prompt dependency for the initial independent session. The matching target remained stable at high levels and quickly reached mastery.

The results represented in Figure 8 show the accuracy data for Megan. At baseline, probes revealed no accurate responding for either targets. Initially during the gestural prompt phase, both targets show rapidly ascending trends for correct responding, reaching mastery criteria for both targets within five to seven sessions. When gestural prompts were faded back to independent responding, an initial dip in responding was seen for both targets with

exclusion rising back to mastery and matching revealing a more variable data path but also reaching criteria within three sessions.

The results represented in Figure 9 show the accuracy data for Libby. At baseline, responding remained at zero for three probe sessions. With the introduction of the gestural prompt, matching shows a steadily increasing path for accurate responding while exclusion remains slightly more variable initially increasing then descending before reaching mastery criteria. After fading the prompt, the independent responding phase shows matching initially dipped in accuracy due to lack of prompting but rapidly returned to mastery while exclusion is seen to show a variable trend with an overall increasing data path to reach criterion.

The results below for the table top reveal an overall trend indicating that the matching target was learned faster than the exclusion target. For both participants with ASD diagnosis and typically developing, the trend remained the same with all participants reaching mastery criteria for both targets with only one level of prompting needed prior to responding independently.

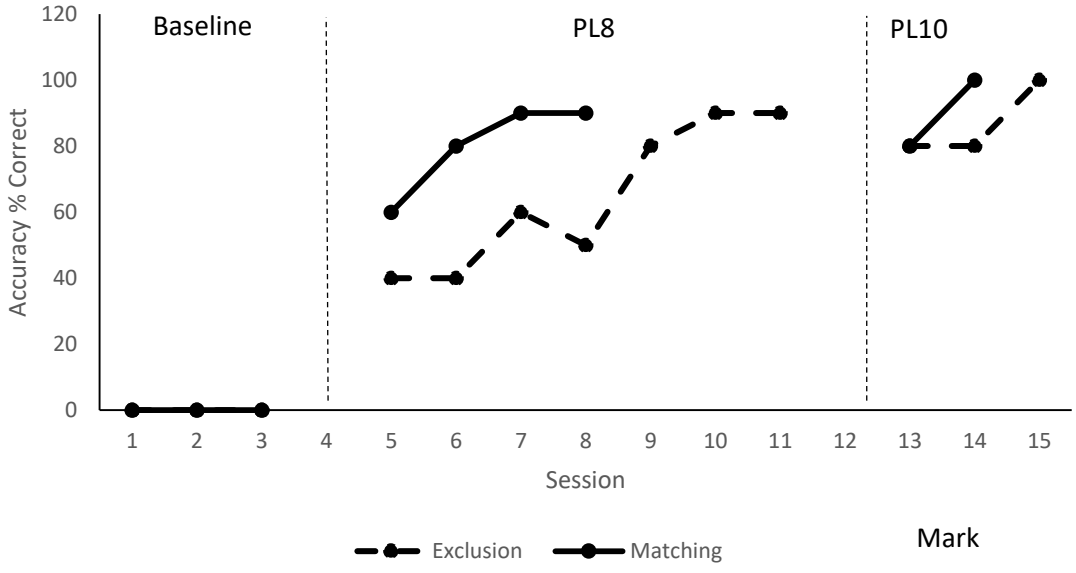


Figure 2: Accuracy (% correct) data for Mark during PEAK Generalisation train/test teaching for the target skills exclusion (4C) and matching (7G), taught using table top methods.

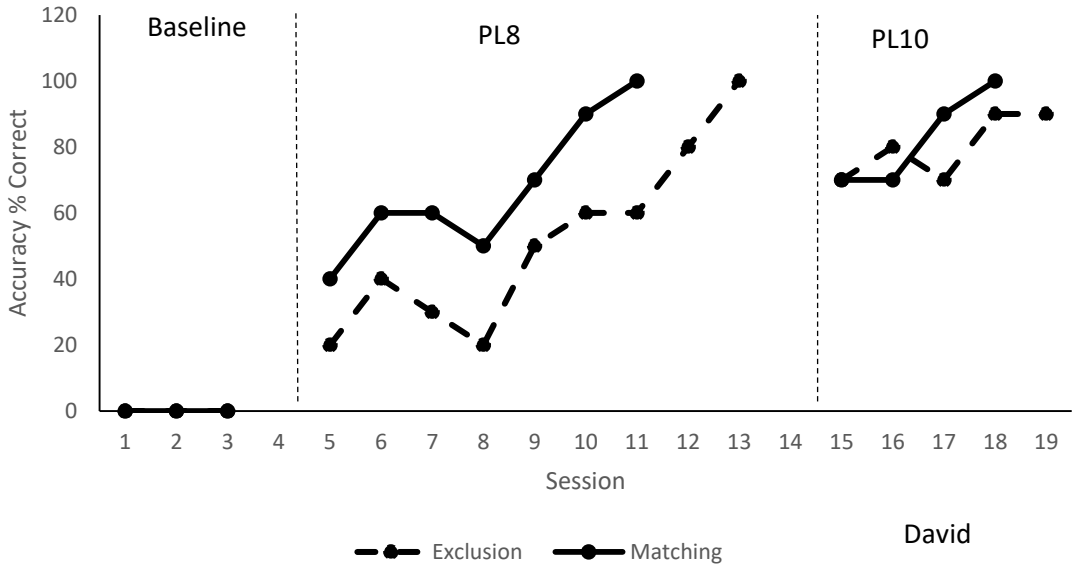


Figure 3. Accuracy (% correct) data for David during PEAK Generalisation train/test teaching for the target skills exclusion (4C) and matching (7G), taught using table top methods.

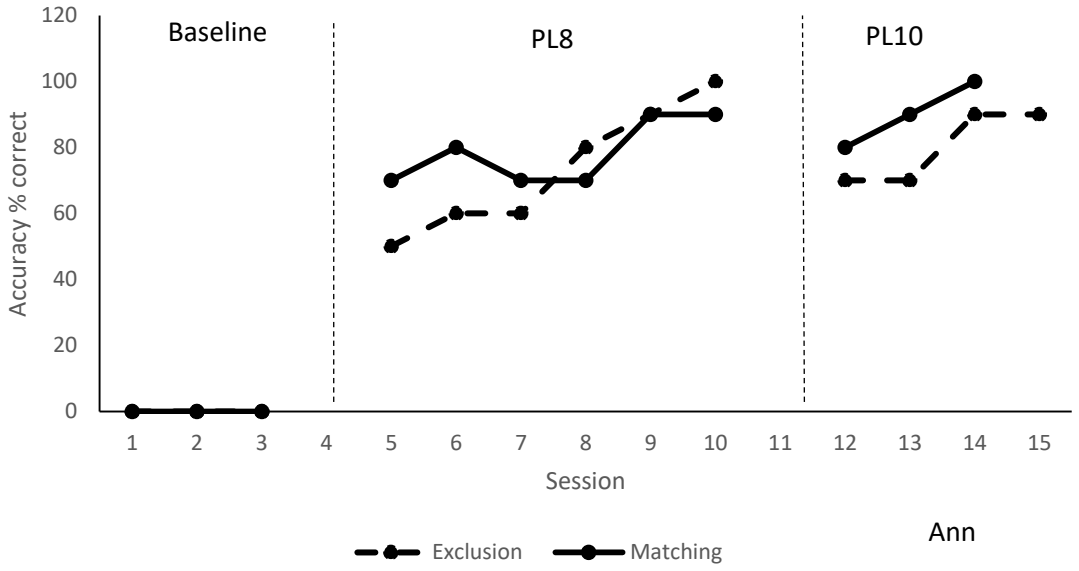


Figure 4. Accuracy (% correct) data for Ann during PEAK Generalisation train/test teaching for the target skills exclusion (4C) and matching (7G), taught using table top methods.

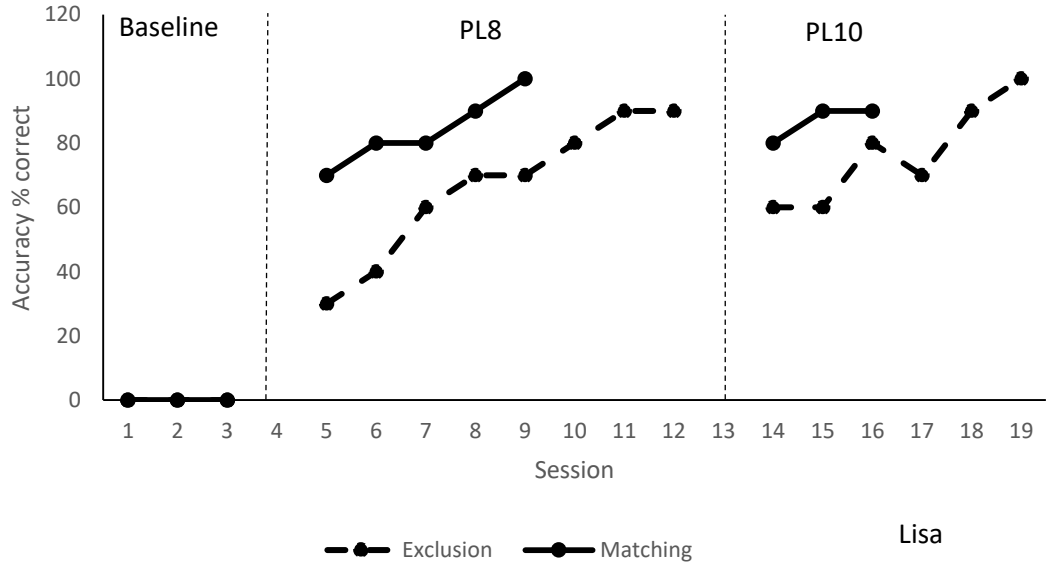


Figure 5. Accuracy (% correct) data for Lisa during PEAK Generalisation train/test teaching for the target skills exclusion (4C) and matching (7G), taught using table top methods.

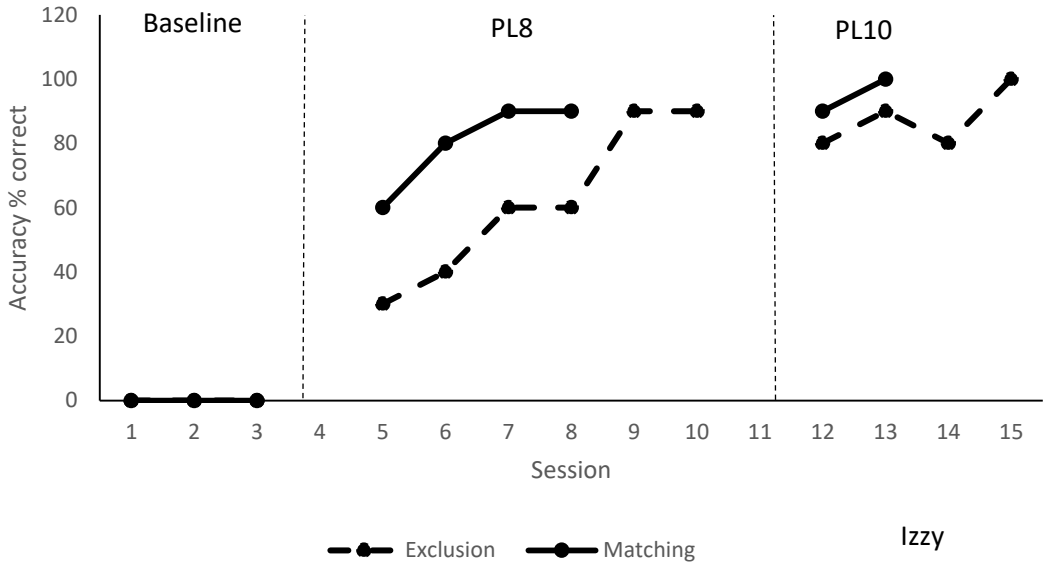


Figure 6. Accuracy (% correct) data for Izzy during PEAK Generalisation train/test teaching for the target skills exclusion (4C) and matching (7G), taught using table top methods.

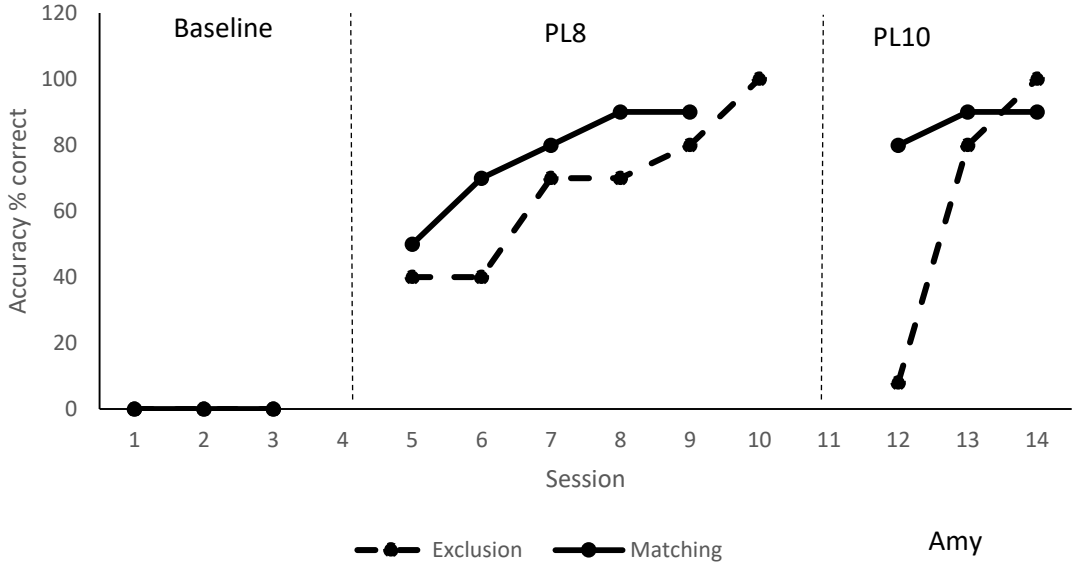


Figure 7. Accuracy (% correct) data for Amy during PEAK Generalisation train/test teaching for the target skills exclusion (4C) and matching (7G), taught using table top methods.

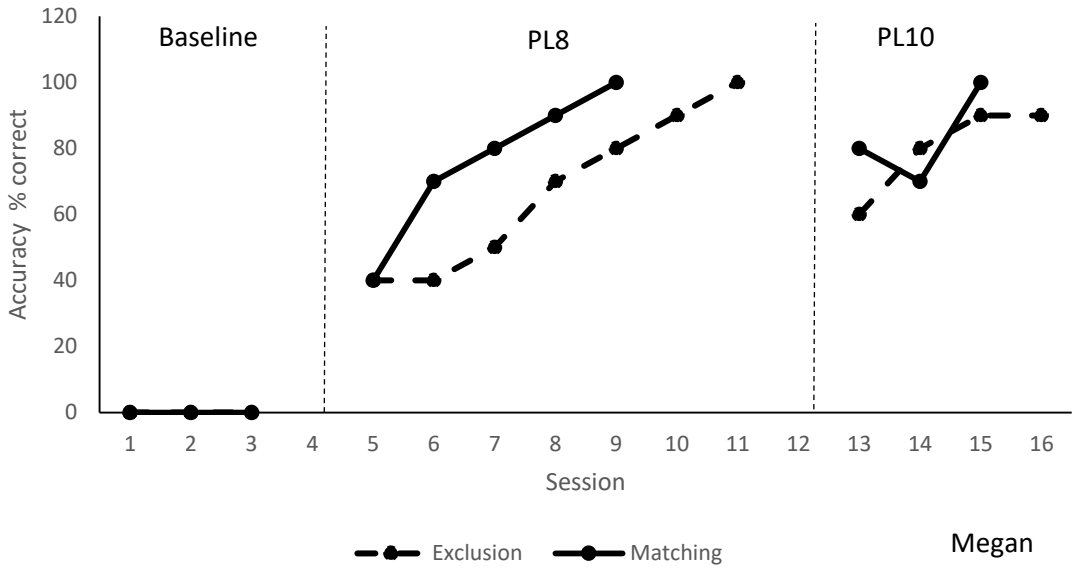


Figure 8: Accuracy (% correct) data for Megan during PEAK Generalisation train/test teaching for the target skills exclusion (4C) and matching (7G), taught using table top methods.

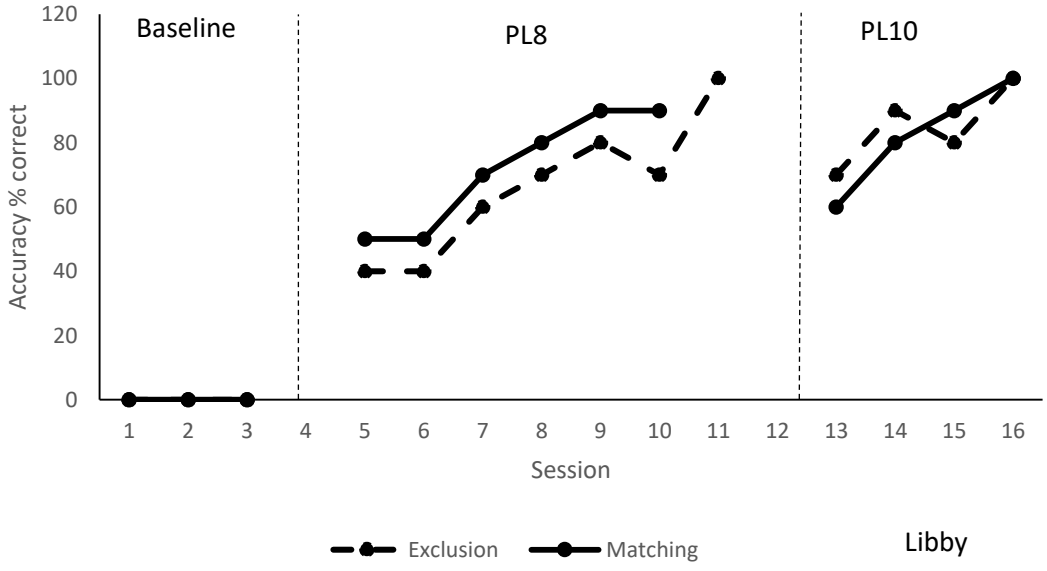


Figure 9. Accuracy (% correct) data for Libby during PEAK Generalisation train/test teaching for the target skills exclusion (4C) and matching (7G), taught using table top methods.

T-IRAP Probes

Probes were carried out prior to the T-IRAP relational training intervention being conducted with the participants. These involved short tests using the T-IRAP procedure. The participant was presented with the screen and asked to identify same and different. Data was taken on which participants could identify 'same' and which could then identify 'different'. Results show that some of the mainstream children could identify the targets that were 'same' but none could independently point out 'different'. The participants from the ASD class all failed to identify the correct response on these probes.

T-IRAP Non Arbitrary Relations

Response latency and accuracy (percentage correct) data were collected throughout the T-IRAP sessions. The intervention was started with all eight participants after they completed their PEAK training. Non-arbitrary stimuli (square/triangle set) were used to teach 'same/different' relations to participants. The initial sessions are displayed on the graphs below, figure 10-17. All participants show they scored 0 for independent responding when probed at baseline. When the intervention stage is introduced after the baseline probe, a gestural prompt (GP) was used (meaning the researcher pointed to the correct key to affirm same/different relations presented onscreen). Each phase line depicts a change in prompt level for the participant. Accuracy data are depicted using a broken line and speed of responding are shown using a solid line. The accuracy data points relate to the left Y axis labelled Percentage Correct (accuracy) and indicate the percent of correct trials for each session. The response latency data relate to the right Y axis labelled Speed in Milliseconds and shows the time taken in milliseconds to complete a trial block. Shorter response latencies indicate faster responding by the participant. The learning criterion for accuracy was set at 100% correct responding across two successive T-IRAP trial blocks. The learning criterion for response latency was set at 2000ms for a response to be made.

The first graph below, figure 10, shows the T-IRAP results for Megan, the graph shows 3 phases in the intervention. At bassline, probes revealed Megan could not identify the 'same/different' relations. The gestural prompt phase shows correct responding (accuracy) to remain stable throughout the intervention and continues when the prompt is faded back to independent. Initially, gestural prompts (GP) were used to point to the correct response option on the keyboard to promote correct responding. As fluency increases, the GP was faded back to an independent level where the participant is using the keys by themselves. A decreasing trend is also seen for response latency during the prompting phase and continues on a downward trend when Megan is responding independently. Megan shows increasing accuracy and decreasing response latency to responding across the 15 sessions.

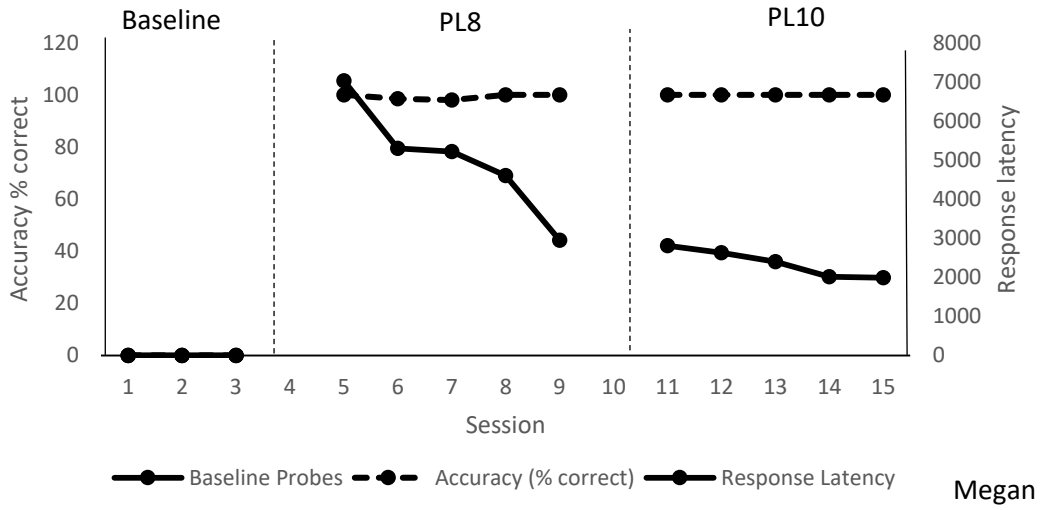


Figure 10: T-IRAP Data for Megan showing accuracy and response latency data for non-arbitrary (square/triangle) same/different relations.

Figure 11, displays the results for Libby's performance on the T-IRAP across three phases. At baseline, Libby shows no independent responding for identifying same/different targets. The first phase of the graph shows responding at the gestural prompt level with a

steadily increasing trend of accuracy in responding and a more rapid downward path for response latency within four sessions. The third phase of the graph shows independent responding after the gestural prompt was faded back. Accuracy is continuing to increase while response latency continues to decline despite one session where performance is seen to dip. This indicates speedy acquisition of the same/different relations and the T-IRAP.

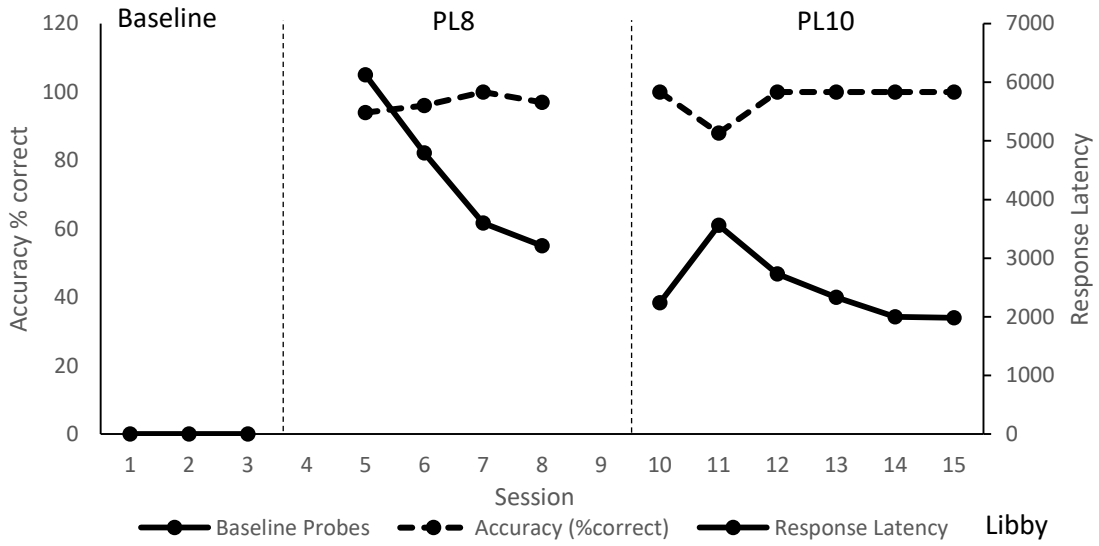


Figure 11: T-IRAP Data for Libby showing accuracy and response latency data for non-arbitrary (square/triangle) same/different relations.

Figure 12, shows Amy's results on the phases of the training sessions of the T-IRAP. The baseline results show no independent responding to the probes prior to training. The first four sessions have utilised a gestural prompt to the response options on the keyboard for responding. Results show a steadily decreasing trend for response latency, after an initial increase in one session for the beginning of independent responding, most likely as she becomes more familiar with the targets. The second trend line shows accuracy also decreasing as independent responding begins. This could be due to the fact she is getting faster at responding so accuracy is not as high as a consequence or adapting to the lack of

prompts from the researcher. Responding accuracy rises again and remains stable for the remainder of the intervention. Overall accuracy remains more variable throughout the training.

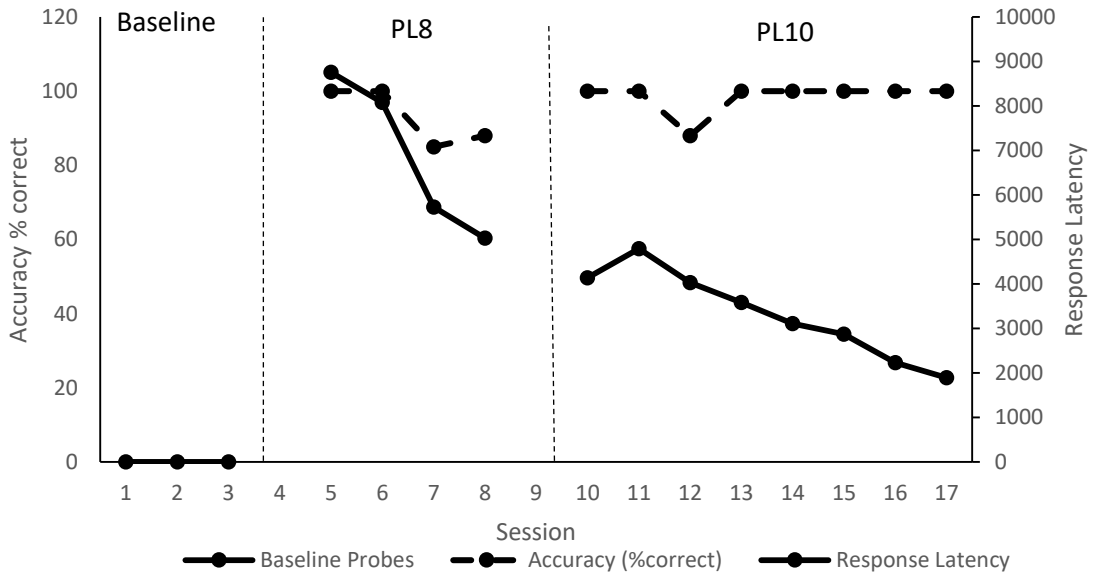


Figure 12: T-IRAP Data for Amy showing accuracy and response latency data for non-arbitrary (square/triangle) same/different relations.

Figure 13, shows Izzy's results on the three training phases of the T-IRAP. The baseline results show no independent responding to the probes prior to training. The first seven sessions have utilised a gestural prompt to the response options on the keyboard for responding. Results show a very variable data path for response latency and accuracy for the first couple of sessions. The gestural prompt was removed due to concerns the participant was becoming reliant on the prompt. Once this was faded and independent responding was introduced, the accuracy became more stable, after 6 sessions with slightly variable trends and the response latency steadily decreasing throughout the following 10 sessions.

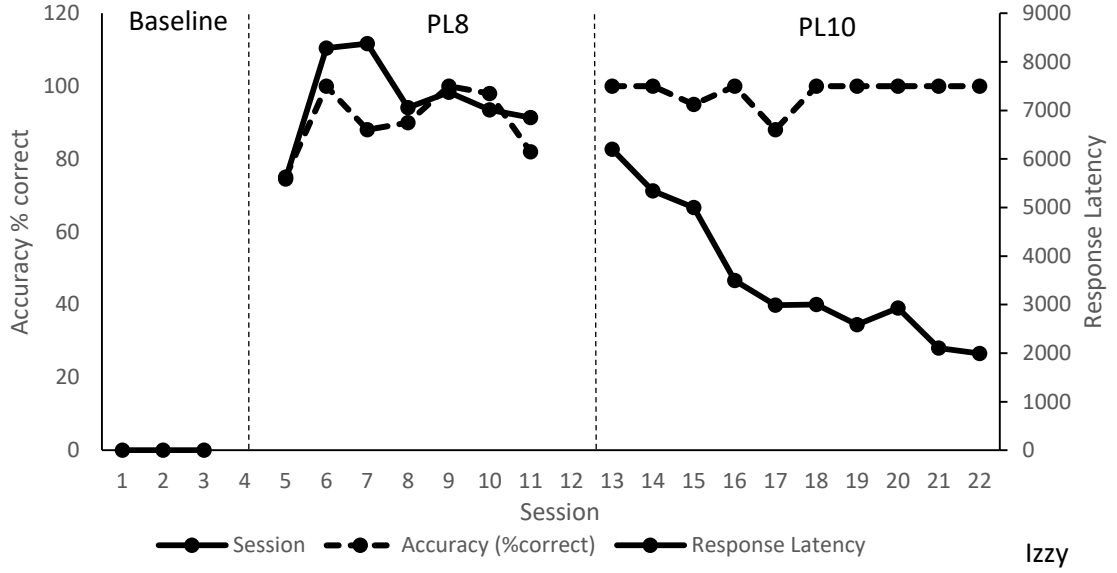


Figure 13: T-IRAP Data for Izzy showing accuracy and response latency data for non-arbitrary (square/triangle) same/different relations.

Figure 14, show's Marks results on the three training phases of the T-IRAP. The baseline results show no independent responding to the probes prior to training. The first four sessions have started using a gestural prompt to the response options on the keyboard for responding. A rapidly descending data path can be seen for response latency in this phase while accuracy remains steadily high. As the independent responding phase begins, initially accuracy levels dip and become more variable while response latency decreases slightly. This was possibly a result of the participant adapting to having no prompts from the researcher. After 3 sessions the accuracy trend begins to rise and remain steady for the remainder of the intervention until reaching criteria. The response latency shows a downward trend for the last 8 sessions of the intervention until mastery criteria has been met. Overall, this graph shows a rapid acquisition of the T-IRAP on an independent level for a participant with ASD.

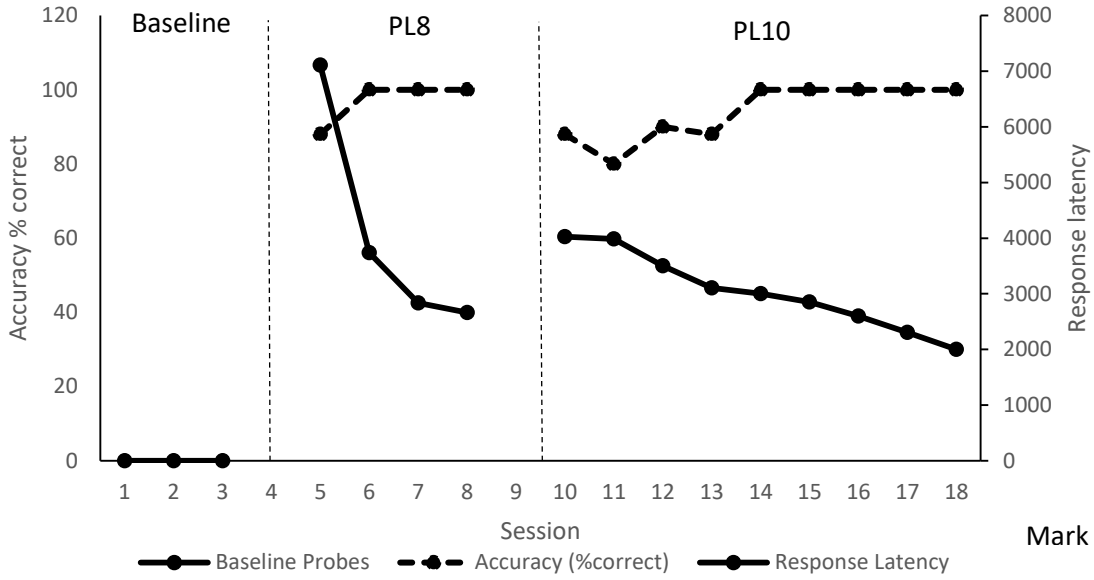


Figure 14: T-IRAP Data for Mark showing accuracy and response latency data for non-arbitrary (square/triangle) same/different relations.

Figure 15, show's Lucy's results on the training phases of the T-IRAP. The baseline results show no independent responding to the probes prior to training. The first seven sessions with Lucy utilised a gestural prompt while the following six were independent responding. The initial sessions show quite a variable trend with accuracy beginning high and then falling for three data points before rising again to meet criteria. The response latency again shows variability with an initial increase followed by a steadily decreasing trend developing towards the end of the gestural prompt sessions. As independent responding is introduced a decrease is seen in accuracy of responding followed by a steady recovery which remains stable at 100%. This could be due to adapting to using the T-IRAP without prompting from the researcher. The response latency is again seen to steadily decrease throughout the final 6 sessions until mastery criteria was reached.

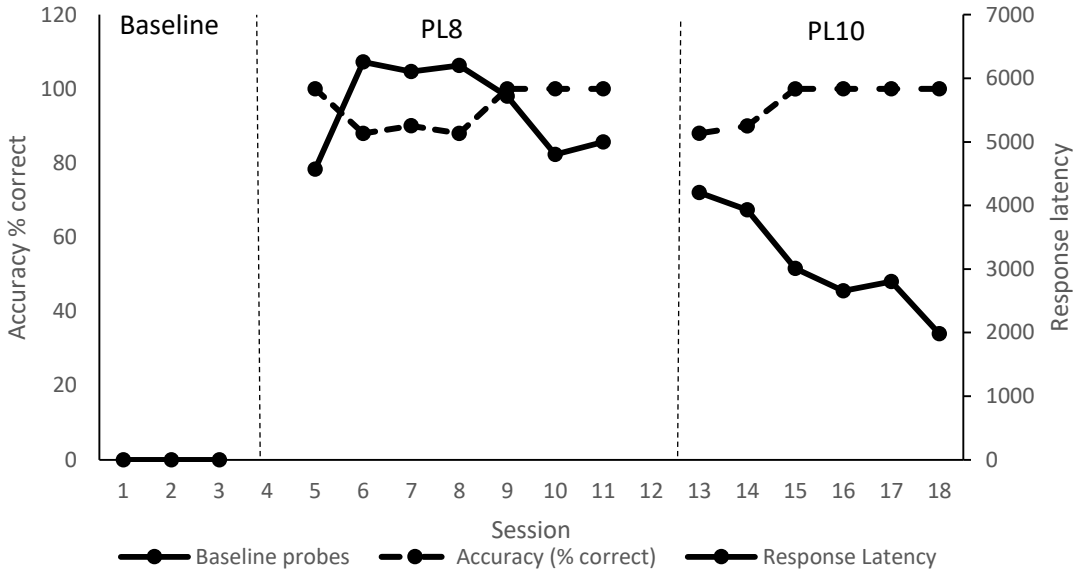


Figure 15: T-IRAP Data for Lisa showing accuracy and response latency data for non-arbitrary (square/triangle) same/different relations.

Figure 16, show's Ann's results on the training sessions of the T-IRAP. The baseline results show no independent responding to the probes prior to training. The first eight sessions utilised a gestural prompt and the final five were completed at independent level. The response latency trend line is seen to initially increase and then follow a downward although variable path with one small increase seen. The accuracy trend seen is variable with initial decreases seen followed by an increase which remains relatively stable. Once the gestural prompt is faded back and independent responding in introduced, accuracy remains high with one session seeing a decrease to 85% and response latency is steadily decreasing.

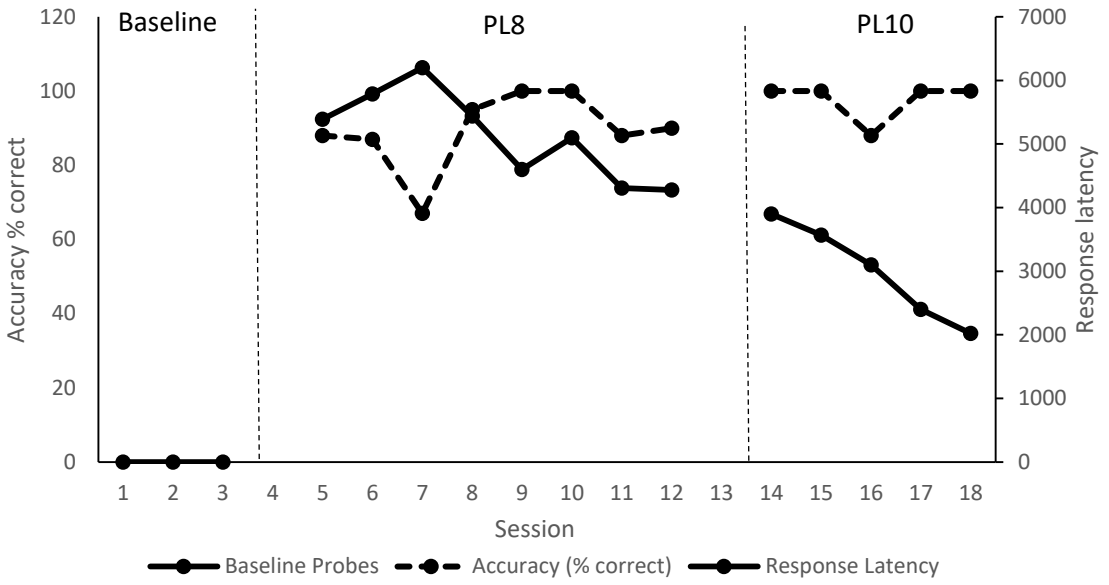


Figure 16: T-IRAP Data for Ann showing accuracy and response latency data for non-arbitrary (square/triangle) same/different relations.

Figure 17, show's David's results on the training sessions of the T-IRAP. The baseline results show no independent responding to the probes prior to training. The first five sessions were taught using a gestural prompt and variable results were seen for both accuracy and response latency. A second phase of prompting was introduced using a stimulus prompt to the keyboard (small post it note in bright colours attached to keys D and K). The results were variable again and no stable trend was achieved. The intervention could not be continued or completed with this participant as behavioural issues took priority over his ability to take part in the research.

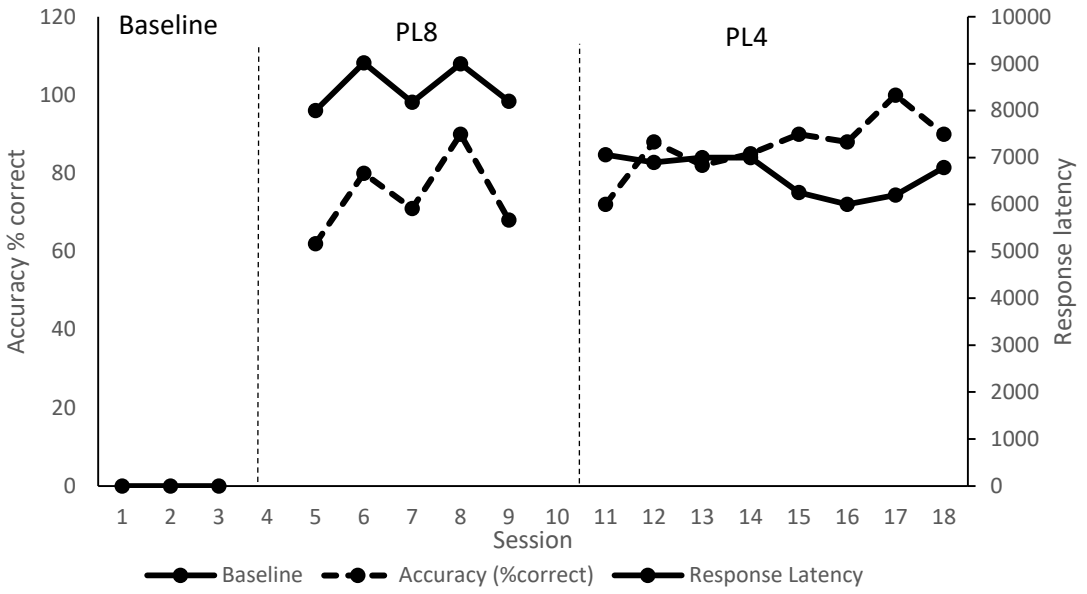


Figure 17: T-IRAP Data for David showing accuracy and response latency data for non-arbitrary (square/triangle) same/different relations.

The following table displays the mean accuracy and response latency data for the ASD and typically developing populations.

Table 8
Mean accuracy and response latency data for all 8 participants on the T-IRAP.

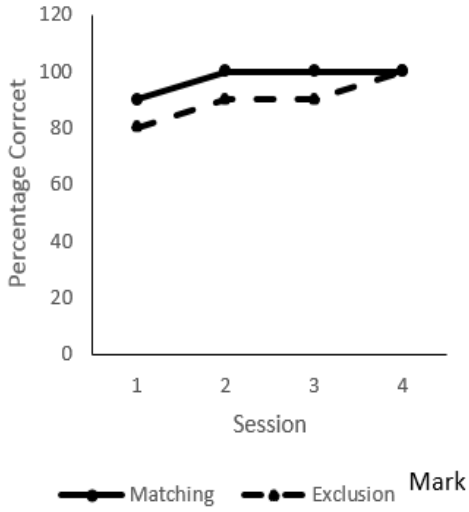
Participant	Mean Response Latency on T-IRAP	Mean Accuracy on T-IRAP
ASD participants		
Mark	3364	95.1%
David	7467	81%
Ann	4314	92.53%
Lisa	4351	95.69%
Typically developing participants	Mean Response Latency on T-IRAP	Mean Accuracy on T-IRAP
Megan	3690	99.65%
Libby	3257	98.7%
Izzy	4038	95%
Amy	3521	97.92%

The above mean data reveals the typically developing participants to have higher accuracy scores on the T-IRAP than the ASD participants. The response latency, indicating faster speed of responding, was also better for the typically developing participants, being mainly between 3000 and 4000ms while the ASD participants averaged at 4000-5000ms. One participant, Mark, shows both accuracy and response latency scores in line with the typically developing participants. Another participant, Izzy, also displays scores which are slightly lower than that of her peers and are more in line with the ASD mean figures. However, the

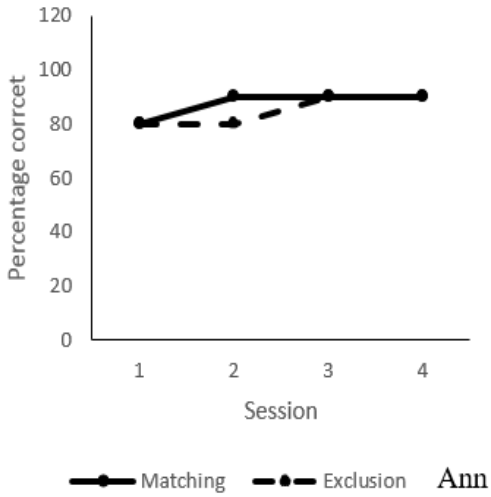
results do not display a large difference between both groups of participants on either accuracy or response latency.

Generalisation for Same/Different Relational Response

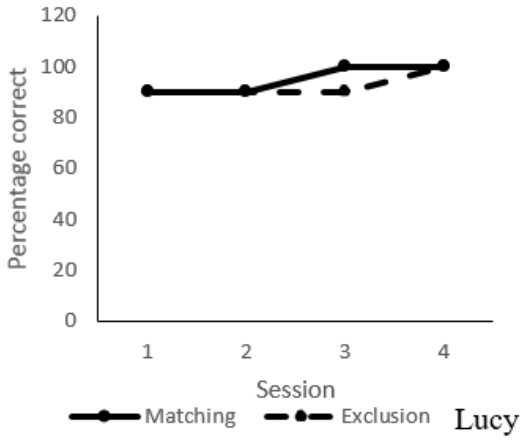
The generalisation data of relational skills learned using table top and T-IRAP procedures are presented in figure 18 below. Seven out of the eight participants show successful generalisation of the target skills while one participant was not assessed for this follow up due to reasons mentioned above as to why he was removed from the study. The results show that all participants scored between 80% and 100% for both matching and exclusion when tested with novel stimuli. Maintenance and generalisation can be seen from the graphs below with high levels of accurate responding retained by all participants.



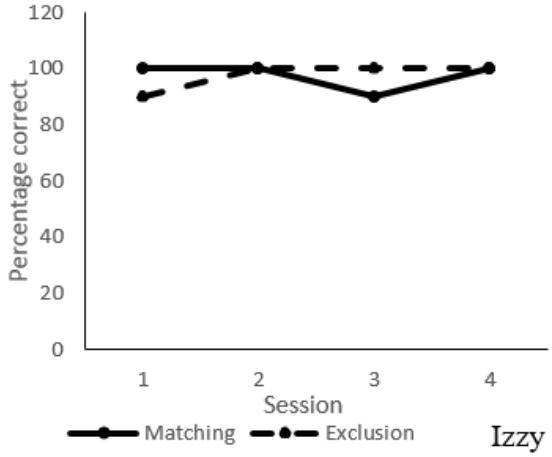
Mark



Ann



Lucy



Izzy

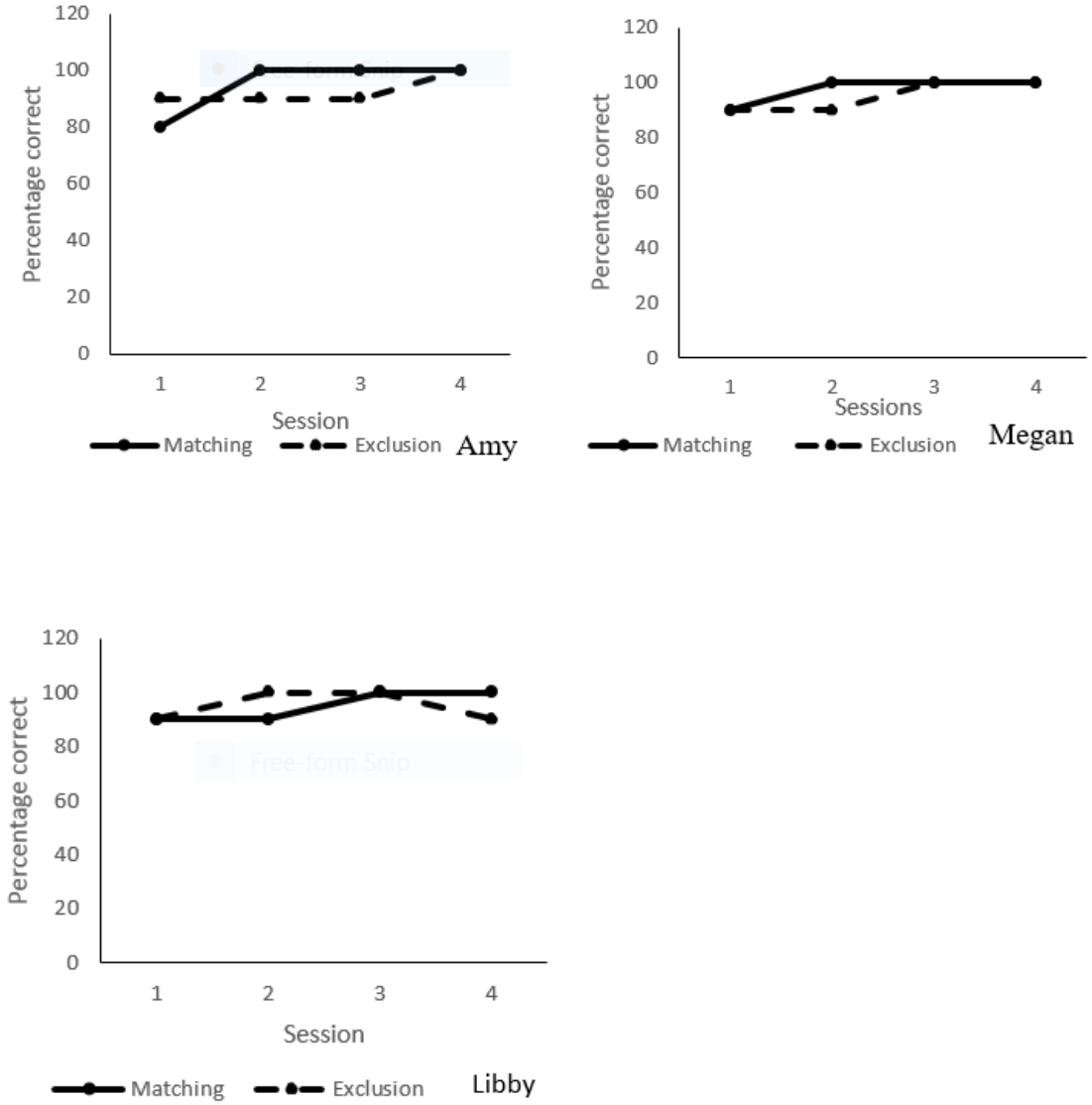


Figure 18: Generalisation data for 7 participants discriminating same/different relations in a natural environment subsequent to IRAP teaching (novel stimuli e.g., book or table top objects as opposed to computer screen).

Discussion

The findings from study 1a show that the learning targets taught directly from the PEAK Generalisation module did result in targets from the PEAK direct module, which were previously seen as 'not mastered' emerge as mastered skills on a follow up assessment. It would seem from the results that teaching the participant's skills from the generalisation module using novel stimuli can increase their emergent untaught lower level skills and negate the need to teach all the targets in the direct module before moving to the generalisation module. The current research taught 20 skills from the PEAK generalisation module and then probed the ones related to these in the PEAK Direct training manual which resulted in a further 34 skills being mastered, and up to one month later when the PEAK Direct assessment and PEAK Generalisation assessment was conducted, these derived skills were recorded as mastered in the participants repertoire.

The results show no substantial difference between the typically developing participants and those diagnosed with autism on their ability to derive new skills without specific training in them. It should be noted that the teaching time for the typically developing participants on PEAK targets was less than that needed to train them with the ASD participants. However, the results are positive for both PEAK as a teaching tool with different populations and for the ability of children with a diagnosis of autism to generalise newly learned targets and derive new skills based on similar targets learned. As a novel study, the results highlight some interesting findings for sequencing the PEAK modules and possible ways to teach them more efficiently. Future research might address a similar approach to other areas of PEAK such as the equivalence or transformation of function modules to test possible teaching protocols and sequencing effects across PEAK modules. At the time of this research however, these were not complete and further research using them could not be conducted.

Study 1b successfully combined PEAK with a separate teaching tool, the T-IRAP. The data from all eight participants show that it is possible to teach same/different relations using the T-IRAP after no specific pre-training on these targets was carried out except for exposure to using PEAK matching and exclusion targets from the table top teaching. The follow up generalisation and maintenance data shows real world relational responding skills and would also suggest the T-IRAP as being a more effective method of teaching skills to a fluent level, when compared to table top procedures.

The data shows that all participants, both the typically developing group and the ASD group required gestural prompts on the keyboard while using the T-IRAP until they became familiar with the response options. For the majority of participants, the progression to independent responding was quickly seen. The data shows a high rate of accurate and speedy responding by all participants. More difficulties for accuracy in responding were seen when teaching the participants using the PEAK table top methods than when using the T-IRAP. While previous research (Kilroe et al, 2011) has used pre training for the T-IRAP, none of the participants in this study were given pre-training and all successfully and readily adapted to using the computer program. It should be noted that one participant did not complete the research due to behavioural issues needing to be prioritised meaning he could no longer partake in the study.

The current study achieved its aims in showing that teaching skills directly from the PEAK generalisation module can negate the need to teach multiple lower level skills from the PEAK direct module. Skills previously marked as not in the participant's repertoire when tested using PEAK direct module were derived as a result of teaching the PEAK generalisation targets. This provides novel and exciting findings for the PEAK modules and possible sequence effects that may prove useful for future teaching. The study also successfully teaches same/different (non-arbitrary) relational responding to both participants

with and without ASD without any pre-training or table top with the same stimuli. The T-IRAP was proven to be a more accurate and rapid method of teaching new skills, however, further research is needed to determine these results.

-Chapter 3-

Combining PEAK Targets with Rapid Automatic Naming to teach Fluent Responding.

Findings from study 1a suggest all participants exposed to PEAK Generalisation training were able to derive previously unlearned skills which were assessed for in the PEAK Direct training module. Results indicate possible sequence effects for PEAK Modules when training similar targets within PEAK D and G. Participants further mastered responding to same/different relations (non-arbitrary) on the T-IRAP to independent level in study 1b, meeting both accuracy and fluency targets. Same/different relations trained using both PEAK table top and T-IRAP training were then generalised to the natural environment using novel stimuli. Thus, findings showed a successful combination of PEAK-ABA targets in the interactive computerised teaching tool, the T-IRAP in both participants with and without ASD.

The current study aims to build on these findings using a second measure, the Rapid Automatic Naming (RAN; Denckla & Rudel, 1976b) method to compare performance with the PEAK targets taught using table top methods alone from the PEAK Direct training module. RAN was chosen to combine with PEAK as the teaching methods targets both accurate and fluent responding, similar to the IRAP, yet this is taught using table top methods as the PEAK is. It is hoped that combining these behavioural methods to create more advanced teaching programs for ABA could address complex needs of students with different learning disabilities instead of solely relying on existing behavioural teaching strategies which fails to include more recently developed to develop a more complete range of interventions. Three participants, n=3, diagnosed with a speech and language delay by an independent specialist took part in the study. Specifically, the research aims to investigate whether PEAK Direct training targets can be readily combined with the RAN and to assess if

skills taught using both PEAK and RAN would show increased fluency and retention on follow up than PEAK training alone.

Originally described and designed by Denckla and Rudel (1976b), RAN tasks have been described throughout the literature using slightly different terminology such as; serial visual naming, rapid serial naming and naming speed (Norton & Wolf, 2012), however the general task involves randomly presenting a series of items and asking the participant to name them as fast as possible (Savage & Frederickson, 2005). Any task can fall into the broader category of a RAN task if it involves rapidly naming familiar stimuli in a timed fashion when repeated at random multiple times. As a timed measure, the RAN focuses on the fluency of responding and therefore the retention and generalisation of the targets. This is especially important when comparing such a method to DTT teaching used with the PEAK as generalisation and maintenance are primary goals of such methods, even more so when working with ASD or learning delays. As PEAK is a relatively novel addition to the field of behaviour analysis, combining it with an existing and proven successful fluency based method of teaching should give some insight into its ability to teach and retain skills to 'fluent' levels. Similarly as is seen with precision teaching, fluent and accurate responding are the goals of most RAN teaching practices (Lindsley, 1992) as higher frequency of naming predicts a higher retention of the material (Ivarie, 1986).

While fluency is considered an important goal in teaching when working with participants with learning or developmental disabilities, very little research to date has been done on a practical level to examine this. One study, (Weiss, Fabrizio & Bamond, 2010) examines the effects of fluency training and retention on a large sample of participants with autism, however it is limited by having no comparison to a different method of teaching such as discrete trial training (Weiss, Pearson, Foley & Pahl, 2010). The current study taught participants five targets from the PEAK direct module using the table top methods set out in

the PEAK direct module. A multiple baseline design was then implemented after table top teaching finished to teach three of those targets using the RAN training to focus on fluent responding. Follow up tests for generalisation of these newly acquired targets were carried out to compare the performance of the three participants after exposure to the RAN training in comparison to the table top training alone.

Method

Participant Recruitment

The participants in this study were all children attending a mainstream pre-school which offered services for children with additional needs. The participants were 3 boys, all of whom were diagnosed with a speech and language delay from an early intervention multi-disciplinary assessment team. The age range of the participants was 4-6 with an average age of 4.8. All participants were exposed to ABA style teaching strategies in their daily schedule. Consent forms were sent out to recruit participants for the study to each child via schoolbags. An information sheet also accompanied this in which more details of the proposed research was given (Appendix 1 and 2). Parents were also asked to fully read all information sheets and consent forms prior to signing it, therefore agreeing to participate in the research or declining to take part. The participants will be given pseudonyms that will be used throughout.

Henry is a 4 year old boy with a diagnosis of speech and language delay. His verbal ability was assessed using the Peabody Picture Vocabulary Test (PPVT-IV; Dunn & Dunn, 2007). He achieved a standard score of 101. His school readiness was assessed using the Bracken School Readiness Assessment (BSRA-3; Bracken, 2007) in which he received a standard score of 113.

Oliver is a 4 year old boy with a diagnosis of speech and language delay in the severe range. He was assessed using the PPVT-IV he achieved a standard score of 91. He was also assessed using the BSRA-3 resulting in a standard score of 75.

Oscar is a 5 year old boy with a diagnosis of speech and language delay. He was given the PPVT-IV assessment and achieved a standard score of 96. The BSRA-3 was also administered and Oscar got a standard score of 60.

Ethics

See details provided in Study 1 for ethical considerations.

Settings and Materials

All sessions took place in a classroom in the Pre-School. The sessions did not interfere with the usual daily routine the children had in place and did not reduce the amount of academic work they did each day. The research was carried out during 1:1 sessions, usually 10 minutes, with the researcher and participant in a classroom with other tutors and children present. Most sessions were carried out at a table with two chairs. Often a third person; IOA data collector or BCBA sat at the table to observe the sessions.

Assessments. Each participant was assessed using two tests of ability, the PPVT-IV and the BRSA-3. The assessments were carried out during the day or before school with the BCBA present to supervise. All PPVT-IV and BRSA-3 are administered using easels with various pictures on them and separate scoring sheets. After the initial assessments, the research sessions took place daily. A more detailed description for each one can be found mentioned above in the previous study.

PEAK Table Top teaching. PEAK assessments were carried out with the three participants. The Direct training module was used for teaching the chosen targets. When

targets were established as not in the participant's repertoire, these were chosen to be taught using the PEAK train/test table top teaching alongside RAN.

Rapid Automatic Naming (RAN: Haughton Learning Centre, 2002). The intervention involved using the RAN as the testing method for the PEAK targets previously taught. The RAN is a term used to describe a 'see/say' activity which is similar to the precision teaching technique and allows the student to build fluency and accuracy across the targets chosen. For this study, the RAN is presented on worksheets containing the specific targets and utilises a timed approach to increase the participant's fluency of labelling and reading. For example; a worksheet with a snake on it with numbers in boxes along his body. The timer begins and the participant names each number along the snake as fast as possible in the time allowed.

Design

This study used a within subjects design for training PEAK targets alongside a multiple baseline design for the RAN targets. Baseline ability test scores were collected using the PPVT-IV and the BSRA-3. A PEAK Direct module assessment was also carried out on all participants to establish what skills were already in their repertoire. Correlational analysis was carried out on the pre and post ability tests for exploratory research purposes. The independent variable being the method of training (RAN) as well as the content taught (PEAK targets) to participants with the dependent variable being scores on post teaching assessments, specifically ability scores and a generalisation follow up assessment.

Procedure

Pre training IQ assessments. Baseline PPVT-IV and BSRA-3 assessments were carried out first with each participant and scores were calculated before any RAN or TT procedures took place. The assessments were conducted in the classroom with other children and staff present. Either the Head teacher or the BCBA were also present for each research session. Assessments were conducted as per the description outlined in study 1.

An assessment for the PEAK Direct training module was also carried out on each child prior to any teaching beginning but after the ability assessments were done. This consisted of 184 item questionnaire relating to skills and abilities of the participant. The researcher then recorded all the answers in a table on the front of the record book to highlight the skills each participant did or did not have in their repertoire.

PEAK table top (TT). The TT procedures were used to teach PEAK targets to all participants. 5 targets in total were taught to the participants using a discrete trial training approach. The experimental sequence meant that a train/test strategy was used as instructed in the PEAK manual. This meant, that during training, the participant must get 90% on two consecutive occurrences or 100% once. The test stage would then test those targets using novel stimuli for generalisation. When testing a target, the response either correct or incorrect gets no feedback from the teacher. This is to ensure the performance is as a result of a new generalised skill not from direct training with the stimuli used. Once this was done with the chosen five targets, the RAN teaching procedure was started. Positive reinforcement was used throughout the teaching process and breaks were given if needed or requested. The researcher used least to most prompting in accordance with the procedure in the school. When probes were carried out, no consequences were delivered for responding. The direct targets chosen were relevant to the participant's folder and programs in place already.

Rapid automatic naming training*:* RAN worksheets were designed to match the PEAK targets chosen for the study. Three out of the five PEAK targets taught using TT methods were used for the RAN intervention. The participants were presented with the worksheet and given 3 attempts to complete it on order for the researcher to get an average score per minute for each participant. The timer was set to 1 minute and the following instructions were given to the participant, 'I am going to set the timer to 1 minute and you can work your way through the snake, labelling the colours/objects, going as fast as you can'. Once the averages

were established, a ceiling and floor were set, meaning the minimum score that could be recorded and the maximum score for each session. The sessions took place daily, with the participant being given one practice session and then the testing ones followed each day. A maximum of three attempts were done for each session. If the participant beat their score from the precious day, then the session was finished for that day. If all three sessions were ran, the best of 3 attempts were chosen to graph for that day. If they got the same score or a decreasing trend for 3 days, an intervention was put in place in the form of a prompt or training errors using DTT prior to running daily sessions. The participants self-recorded their scores using a standard celebration chart which showed correct responses and errors per minute for each day. A personal aim was set for each student for each target and this was used as a mastery criterion for this study. The aims were decided on based on the learners ability, the average per minute ability of the corresponding age matched typically developing peers and previous research studies using targets reported in literature on aims for specific ages. Each session took 5-10 minutes per day for the participants.

Inter Observer Agreement

For the assessments, an independent observer sat beside the researcher and took data on the responses made by the participant without talking or interfering in the process. For the TT work, an experienced ABA tutor who was trained by the researcher on the PEAK method of teaching and data collection took independent observation data. They sat at the table and did not interfere or interact with the researcher in any way. The IOA data was taken for approximately 20% of the TT sessions and analysis was conducted on the number of occurrences of agreement per sessions. This was calculated by dividing occurrences per session by all responses and multiplying by 100. The IOA data revealed 98% agreement between the researcher and the independent observer. The RAN was observed by a second

ABA tutor or the BCBA for at least 20% of the sessions and the inter observer agreement was 100% for these sessions.

Decision Protocol

The decision protocol followed throughout the research was the one that was used in study 1 for the PEAK training. If three descending data points are seen in a row or two data points remain at zero, the decision is made to stop running the program and change the instructional procedures and draw a phase line on the graph. If five variable data points are seen, depending on the direction of the trend a decision is made. If the overall direction of the trend is ascending then the decision is made to carry on to a maximum of 10 points. If the overall trend is descending, the decision is made to stop and change the program. The mastery criteria is 90% on two occasions to move on a program or 100% once. The RAN decision protocol involved altering the intervention if 3 days of descending or stable scores were seen. These interventions involved additional prompts, removing errors on the worksheet and teaching them outside of the intervention through DTT or altering timers from 1 minute to 30 seconds for some sessions.

Results

Pre training IQ Assessment Data

Table 9 shows the pre and post-intervention standard and raw scores on the PPVT-IV for each of the three participants. All three participants (aged 3-4 years) had a diagnosis of speech and language delay from a clinical psychologist independent of the current research. From pre-post assessment, no large increases were seen in the results for any of the three participants. Small increases in the raw scores were seen but not substantial enough to effect the overall standard scores.

Table 9
Standard scores (S) and raw scores (R) for each participant on the PPVT-IV pre and post intervention.

	Pre-Intervention		Post-Intervention	
Participant	PPVT-IV (S)	PPVT-IV (R)	PPVT-IV (S)	PPVT-IV (R)
Henry	101	59	101	60
Oscar	96	73	102	?
Oliver	91	65	?	70

Table 10 shows each participants' pre and post-intervention results on the BSRA-3 measure. One participant, Oscar, made a large increase pre-post assessment moving from the very delayed to average category within the test. His raw score increased by 13 points between testing. The remaining two participants did see increases on their raw scores from pre-post assessment with Oliver moving 18 points, however, neither showed a large increase in their overall standard scores or on the categories they were placed in on pre-assessment.

Table 10
BSRA results displaying raw scores, percentage mastered and standard scores for pre and post intervention.

	Pre-intervention			Post-intervention		
Participant	Raw Score	% mastered	Standard score	Raw score	% mastered	Standard score
Henry	52	61	113	65	76	120
Oscar	57	67	60	69	81	101
Oliver	24	28	75	42	49	81

PEAK Initial Assessment Results

The table below displays the results for the PEAK Direct Module assessment which was administered to all three participants prior to PEAK D training.

Table 11
PEAK initial assessment results from the Direct Module assessments for 3 participants.

PEAK Direct Module Initial (Pre-Training) Assessment		Participants 1-3 Y (Yes) N (No)		
PEAK D Number Code	PEAK Named Learning Target	Oliver	Henry	Oscar
8K	Tact common objects	N	N	N
9K	Tact shapes	N	N	N
9L	Tact colours	N	N	N
9O	Tact letters	N	N	N
9P	Tact numbers	N	N	N

Results indicated that the selected PEAK learning targets were not already in the participant's repertoire at the time of pre-training assessment. All targets were assessed using the procedures described in PEAK Direct Module, and probes using novel stimuli were conducted with each participant. Mastery of each skill is represented as Y (Yes) and the absence of the learning skill is represented by N (No).

PEAK Table Top training

Participant data representing PEAK D learning for three participants show that all participants acquired the targeted skills when exposed to PEAK training procedures.
The following graphs represent learning data for the three participants during PEAK train-test teaching for the targets; Tacting shapes (9K) and Tacting letters (9O). The table top teaching graphs below display accuracy as percentage correct which is represented on the Y axis. This represents the percentage correct figure across 10 trial blocks. Different levels of prompting are introduced as necessary throughout the training. A phase line (broken dashed line through the graph) represents a different prompt level and is labelled above the data points on the graph. Baseline data have no prompt levels or reinforcement, it is a probe to test for mastery of a specific skill. A Full Echoic prompt is when the researcher gives the vocal antecedent and then says the correct answer prior to the participant responding, for example; 'what colour is this?, Yellow'. Then the participant responds by copying the echoic. A Partial echoic is when the researcher says the beginning of the word to prompt correct responding, for example, 'yel' instead of 'yellow'. Independent responding requires no prompting and is done by the participant alone.

The results shown in figure 19 display the accuracy data for Oliver for the table top taught PEAK targets tacting shapes and tacting letters. The initial baseline results show that no correct responding was achieved. The second teaching phase utilised a full echoic prompt which sees both targets rising to meet mastery criteria relatively quickly. Mastery criteria is set at 90% x2 or 100%x1. The next phase displays the results when using a partial echoic prompt. Accuracy scores show a dip initially in this phase. This being most likely due to the participant adjusting to having less prompts. Responding for tacting shapes shows a variable yet increasing trend throughout this phase while tacting letters rises and remains stable across

two sessions before moving to independent responding. Both targets fall initially in the final phase for only one data point and remain high to reach mastery.

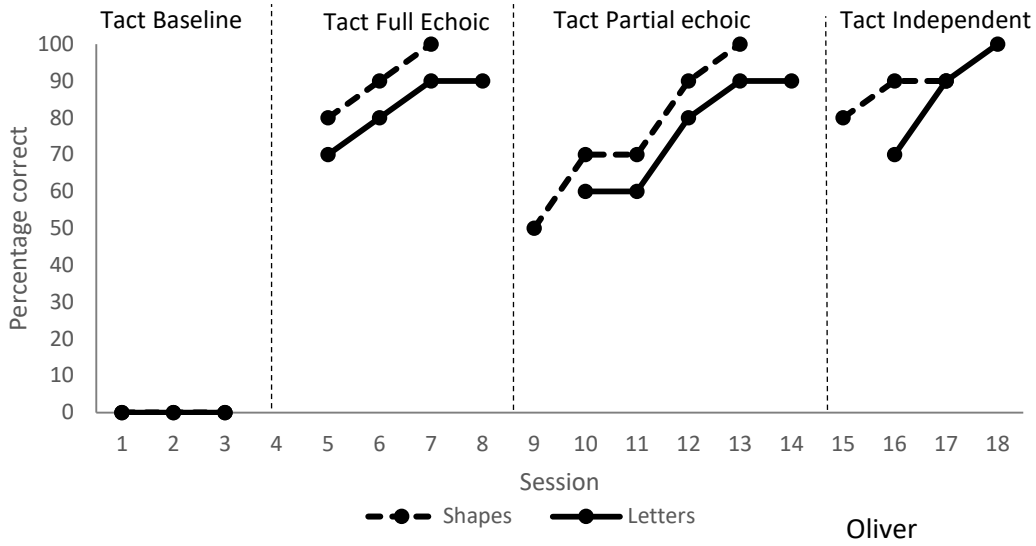


Figure 19: Accuracy (% correct) data for Oliver during PEAK D train/test teaching methods to teach Tacting Shapes (9K) and Tacting Letters (9O), using table top methods.

Figure 20 shows the results for Henry for both PEAK targets tacting shapes and letters using table top methods of teaching. Three phases are displayed on the graph each showing a different teaching phase. At baseline Henry showed no levels of accurate responding. During the next phase, a partial echoic was utilised to assist accurate responding. Henry shows a variable yet increasing trend for tacting letters throughout this phase while tacting shapes shows initially high responding with a small dip and recovering again to reach mastery. For the independent phase, responding begins slightly lower than when prompted but within 3-4 sessions shows high accuracy levels. Overall quite variable learning paths can be seen for both these targets.

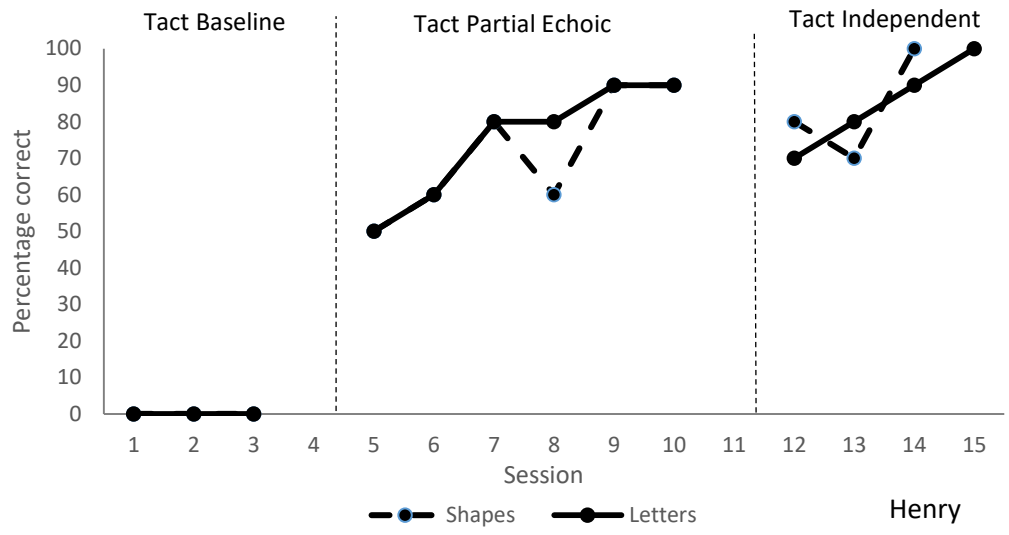


Figure 20: Accuracy (% correct) data for Henry during PEAK D train/test teaching methods to teach Tacting Shapes (9K) and Tacting Letters (9O), using table top methods.

.

Figure 21 shows the results of the PEAK targets tacting shapes and letters taught through table top methods for Oscar. The first phase shows baseline responding to be at zero for both targets. The second phase uses a partial echoic prompt to aid with the teaching. Results show that both targets reached mastery criteria quickly with the prompt. An upward trend of accuracy can be seen for both within 3 data points. At independent level, both targets remain stable with high levels of accurate responding. There is an overall rapidly increasing trend of acquisition seen across both teaching phases.

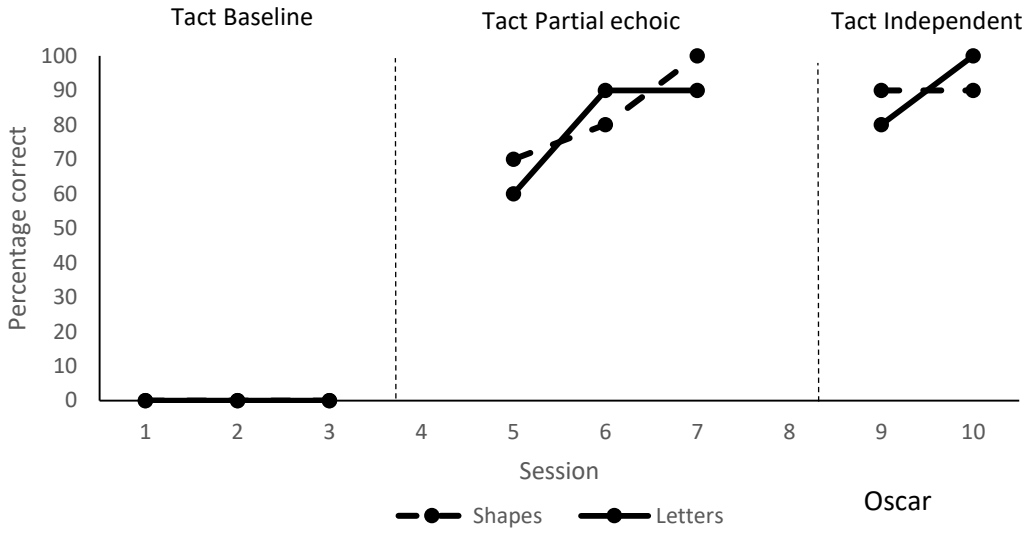


Figure 21: Accuracy (% correct) data for Oscar during PEAK D train/test teaching methods to teach Tacting Shapes (9K) and Tacting Letters (9O), using table top methods.

.

Rapid Automatic Naming

Standard celeration charts were completed by each participant: 3 charts for each participant to represent each learning target using RAN. The charts display the targets tacted per minute for each daily sessions alongside the errors in each one. The floor and the ceiling can be seen on the graph and the overall target for words tacted per minute is also displayed for each graph.

Graphs displaying the progress of the RAN teaching method for all three participants and three chosen targets are seen below. A multiple baseline design was used to measure the staggered introduction of the intervention across three participants. The results show three multiple baseline graphs for each target; tacting common objects, tacting colours and tacting numbers in the order of how the intervention was introduced to each participant. Each graph displays the progress throughout the intervention for each of the three participants. As RAN utilises a precision teaching approach, targets per minute (words tacted per minute) are displayed on the Y axis on a scale of 1-100. Baseline responding can be seen for each

participant which was assessed through giving instructions and no prompts to begin the session. All three participants show zero levels of responding at baseline as all were using the RAN method for the first time. The number of sessions required to meet the overall target of words per minute varied between each participant while the overall results of the intervention show all three participants reaching the desired target with great improvements seen in accuracy and endurance from baseline responding to the end of the intervention. These improvements were then tested for maintenance and generalisation at a follow up session which data are displayed for below the multiple baseline graphs.

The graph below, figure 22, shows the performance for the three participants; Oscar, Oliver and Henry when using the RAN method to teach Tacting Colours. Oscars performance throughout the teaching intervention is seen to increase gradually with some sessions remaining at the same data point for longer periods before continuing to rise. Oliver's performance is quite variable throughout the sessions with initial increases seen then data remaining stable for some sessions before returning to increase again slowly but variably until reaching criteria. Henry's performance with the RAN shows a relatively quick acquisition rate with a relatively stable increasing trend reflecting the words per minute for each session. At one point throughout the teaching, his data does remain stable however it rises immediately afterwards towards mastery.

The second graph, figure 23, shows the results of the RAN intervention for all three participants for the PEAK target tacting numbers. The first participant to start the intervention was Oscar. His data show a stable increasing trend for the first half of the intervention, followed by a more variable data path, although still increasing steadily to the program target of 80 words per minute. The next graph shows the intervention beginning with Oliver. The first few sessions remain stable with him scoring 35 words per minute before a dip is seen in responding to 28 for one session. Immediately after this, the data trend continues to increase

at a variable level with some rises and dips seen in target per minute until Oliver reaches the overall target of 80 words per minute. The final participant, Henry, begins the sessions with a variable although quickly increasing trend. A gap in responding indicates the introduction of a new RAN worksheet (containing more stimuli) due to Henrys rapid acquisition of the skill. After this is introduced, another increasing trend can be seen within the data although slightly more variable at times with some sessions dipping and rising in comparison to previous ones.

The third graph, figure 24, shows the results for the RAN intervention on the PEAK target tacting common objects for the three participants. The first participant, Oscar, shows a steadily increasing data path for the intervention with his words per minute rising at a fast pace until meeting mastery criteria at 80 words per minute. The second participant, Oliver, shows a much more variable data path with initial rises seen, followed by the words per minute remaining stable across some sessions before slowly increasing again and reaching the target. The final participant, Henry, shows a more rapid acquisition of the skills. An ascending trend line is seen for him which remains stable for sessions 17-22 and then again rises steadily to meet the target.

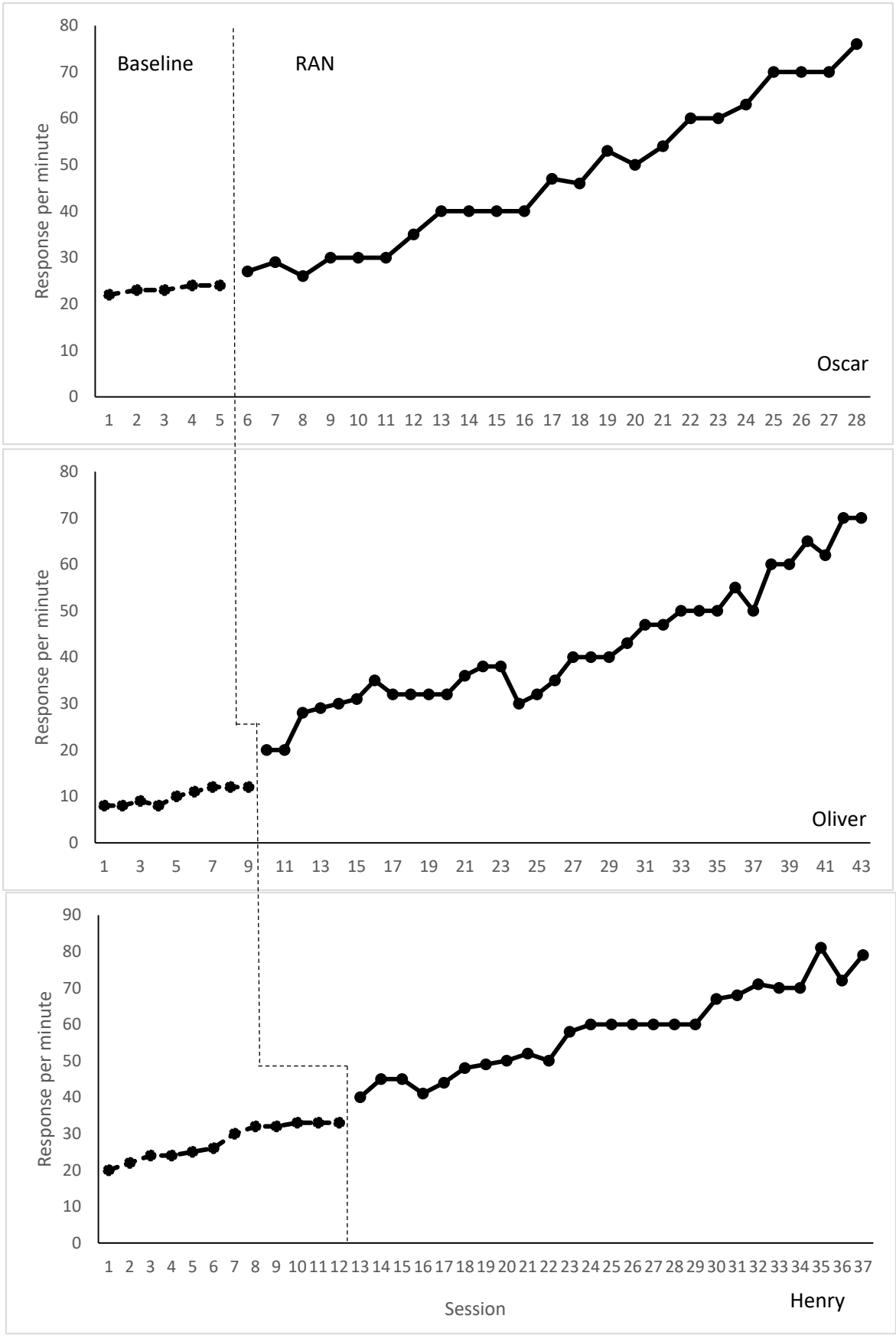


Figure 22: Accuracy (percentage correct) data for PEAK direct target Tacting colours (9L) using RAN teaching procedure for 3 participants.

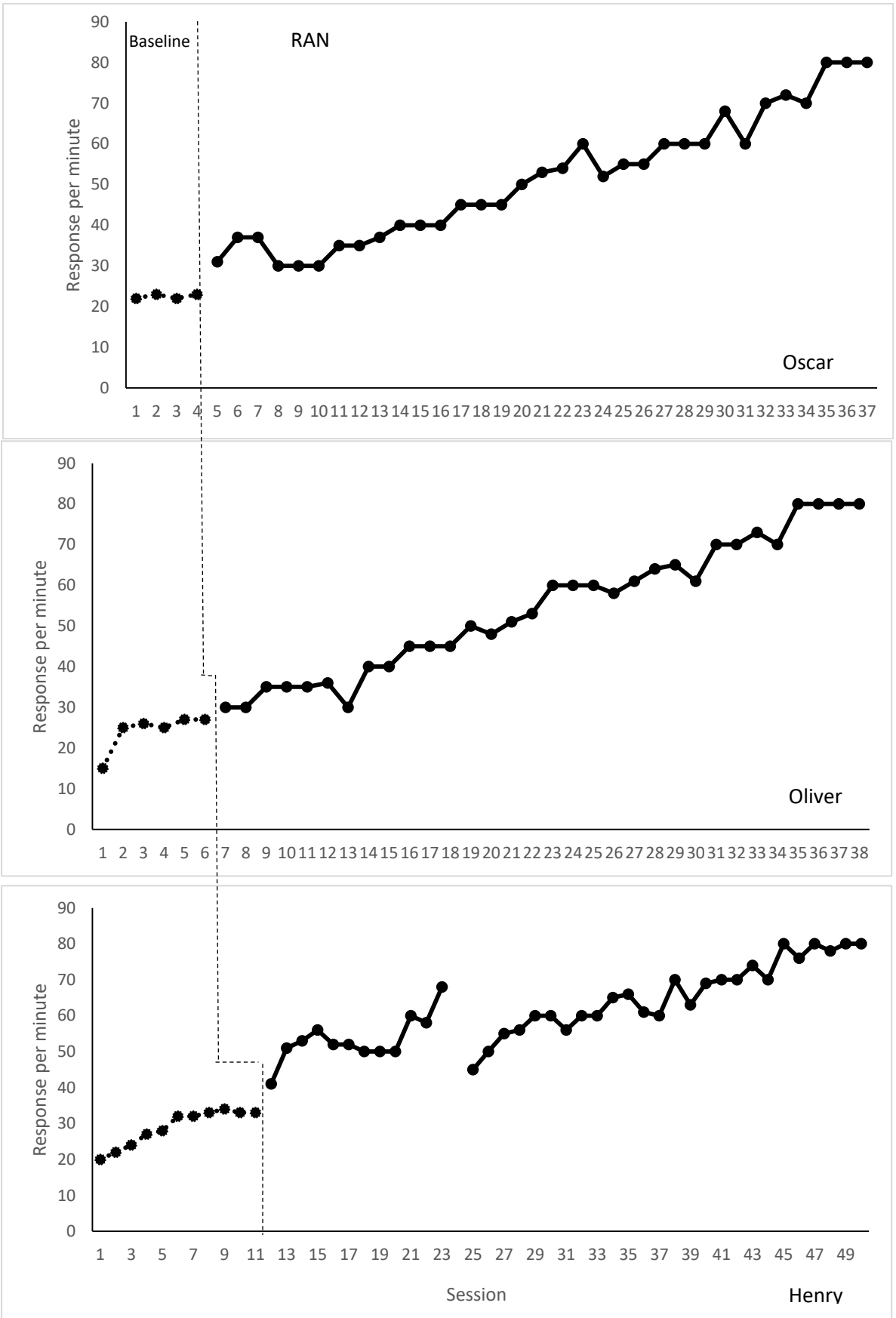


Figure 23: Accuracy (percentage correct) data for PEAK direct target Tacting numbers (9P) using RAN teaching procedure for 3 participants.

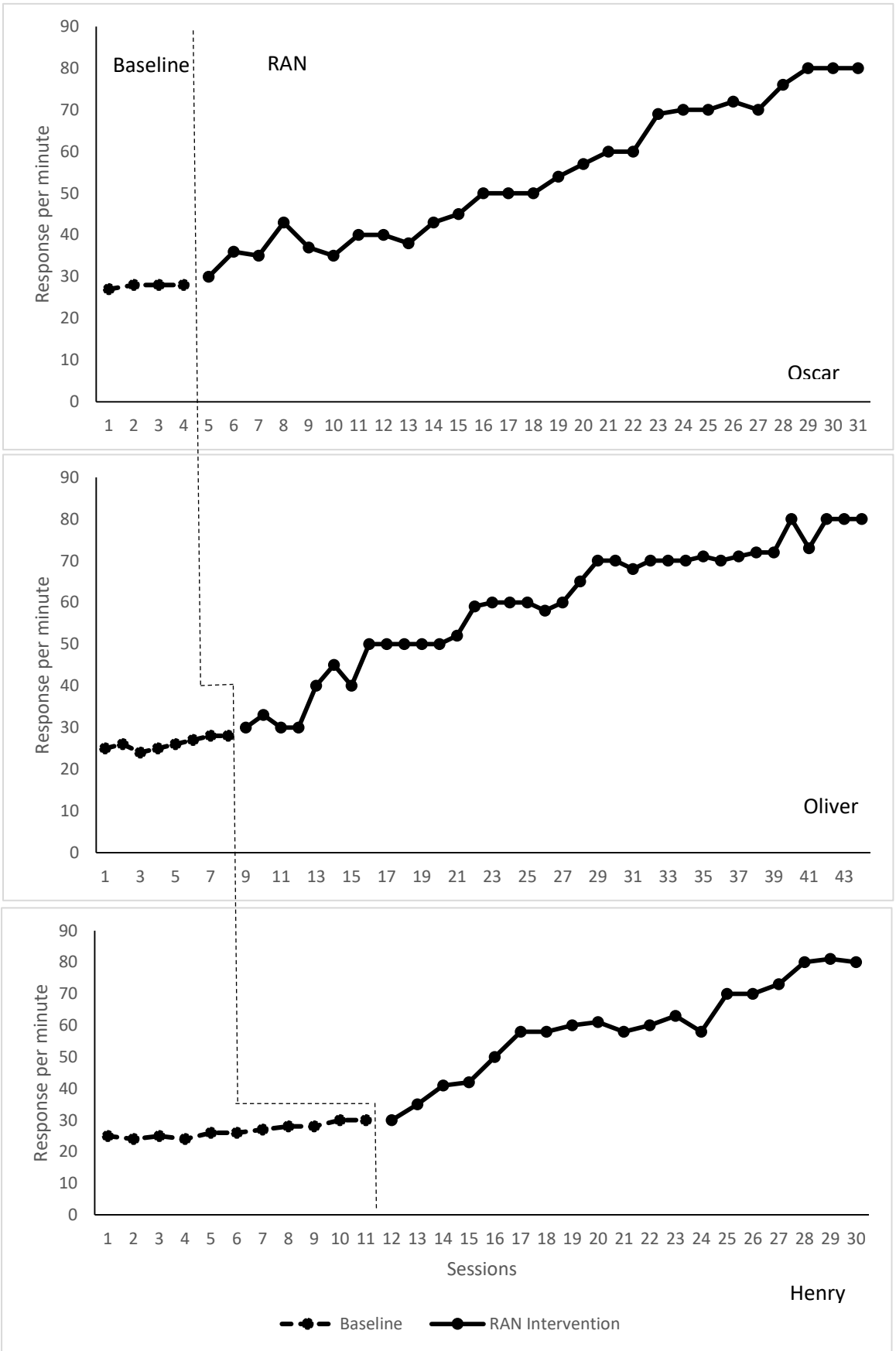


Figure 24: Accuracy (percentage correct) data for PEAK direct target Tacting objects (8K) using the RAN teaching method for 3 participants.

Follow up

The graphs below display the follow up results for the PEAK direct module targets taught to the three participants. The follow up assessment is designed to test the maintenance and generalisation of the skills taught. There are two graphs per participant; one displays the two PEAK Direct module targets taught using the PEAK train/test table top method alone and the other displays the three PEAK Direct module targets taught using PEAK train/test method and followed by fluency teaching using the RAN training.

The results seen in figure 25 and 26 show Oscar's performance on both the table top taught targets and the targets using RAN training at a follow up assessment. The first graph, figure 25, displays the four probe sessions carried out to test for maintenance and generalisation. Data show that Oscar kept a high level of responding for both shapes and letters ranging between 80% and 100% accuracy across the four sessions. However, the data in figure 8 for the RAN targets show a consistently higher level of accurate responding across all probes at follow up assessment. Oscar got 90% and 100% in all sessions with most overall scores being 100% showing excellent levels of generalisation to novel stimuli and environments alongside advantages of training skills to fluency.

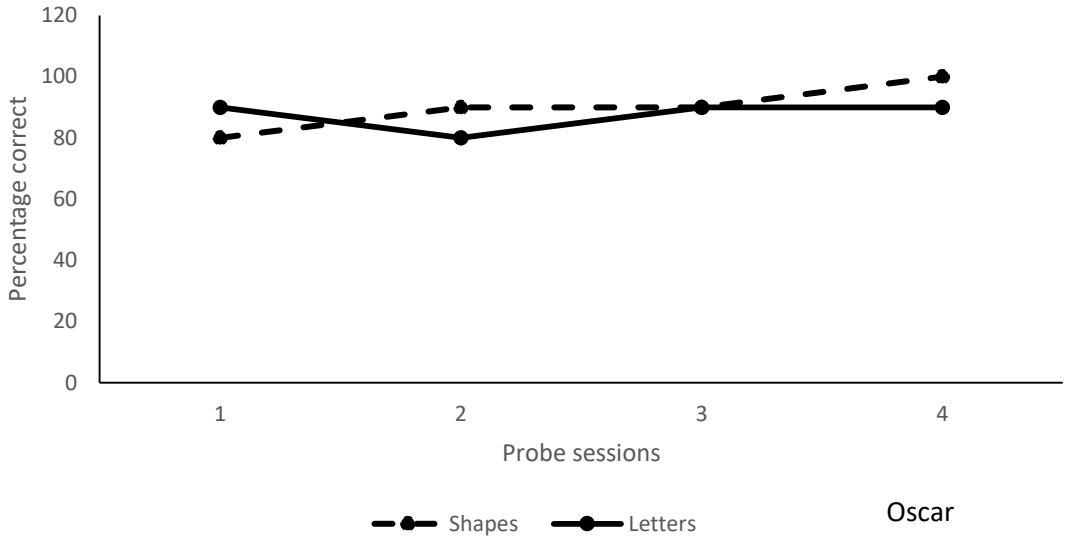


Figure 25: Generalisation data for Oscar tacting shapes and letters (PEAK direct targets 9K and 9O) in the natural environment subsequent to teaching table top. (novel format e.g. book or computer image as opposed to table top).

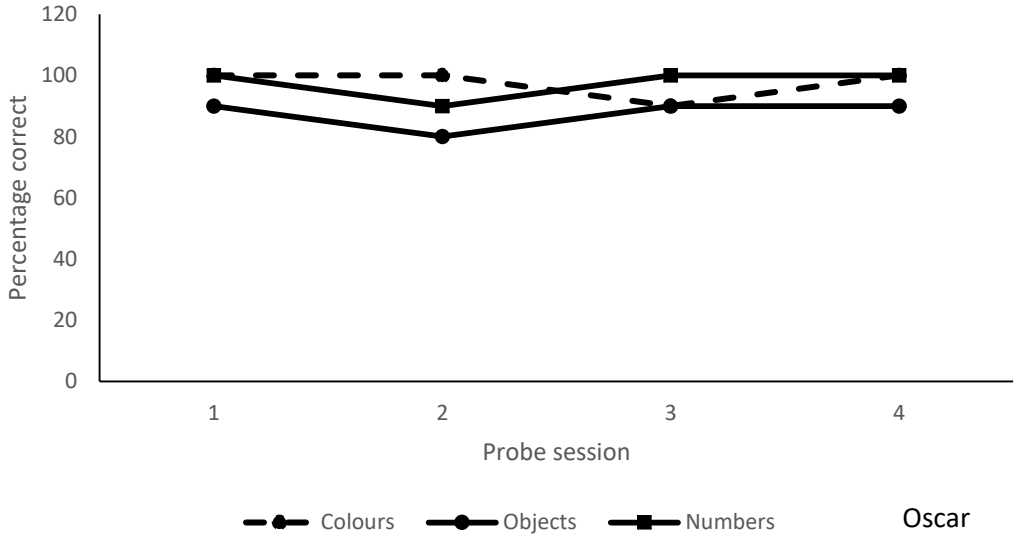


Figure 26: Generalisation data for Oscar tacting colours, objects and numbers (PEAK direct targets 9L, 8K and 9P) in the natural environment subsequent to RAN training. (novel format e.g. book or computer image as opposed to table top).

The following two graphs display the follow up data for Henry for both the table top taught targets and those taught using RAN training. Figure 27 displays the follow up assessment scores for both tacting shapes and tacting letters. The data shows a more variable trend for these two targets with accuracy scores ranging from 70% to 100% across the four sessions while figure 28 displays a higher level of accurate responding for the targets taught using RAN training with accuracy scores for these three targets ranging from 90%-100%. Responding remains both high and stable for the three targets taught using RAN. When compared to the ones taught at table top alone, the data seems to reflect better accuracy scores for these three targets.

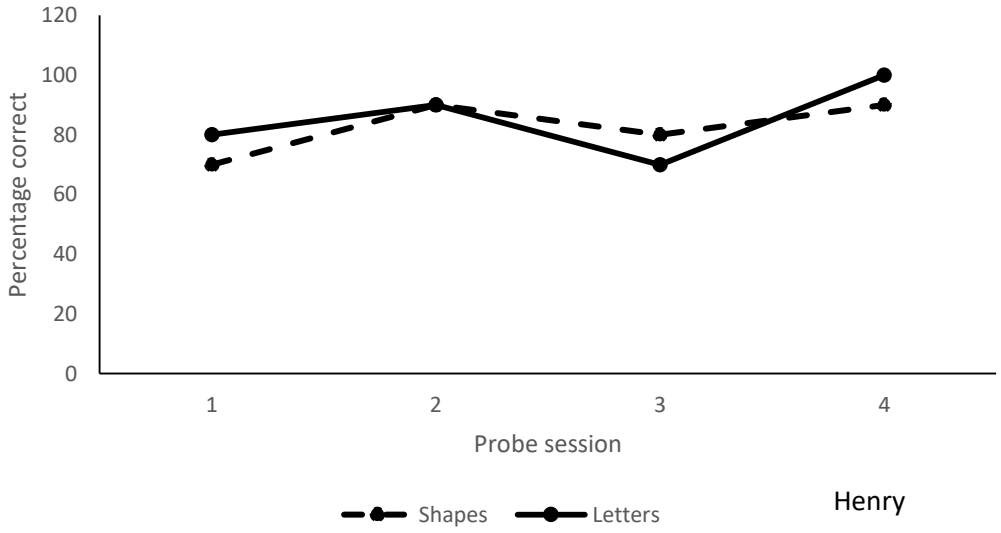


Figure 27: Generalisation data for Henry tacting shapes and letters (PEAK direct targets 9K and 9O) in the natural environment subsequent to teaching table top. (novel format e.g. book or computer image as opposed to table top).

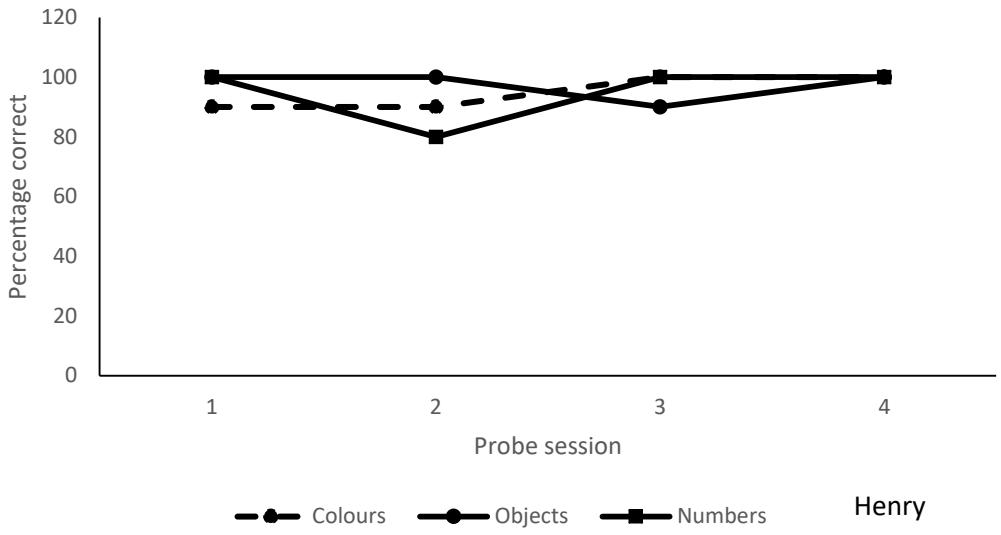


Figure 28: Generalisation data for Henry tacting colours, objects and numbers (PEAK direct targets 9L, 8K and 9P) in the natural environment subsequent to RAN training. (novel format e.g. book or computer image as opposed to table top).

The following graphs display the results for Oliver for both PEAK direct targets taught through table top methods alone and the PEAK targets taught using RAN. There is a difference to be seen within the data when comparing both graphs, figure 29 and 30. Accuracy score for the table top taught targets, tacting shapes and tacting letters are seen to range from 70% to 90% and show a more variable trend across the four sessions. The data from figure 30 show accuracy to remain high at 90% or 100% for all three targets at each probe session. The targets taught to fluency using the RAN show greater maintenance and generalisation for this participant than the ones taught using table top methods alone.

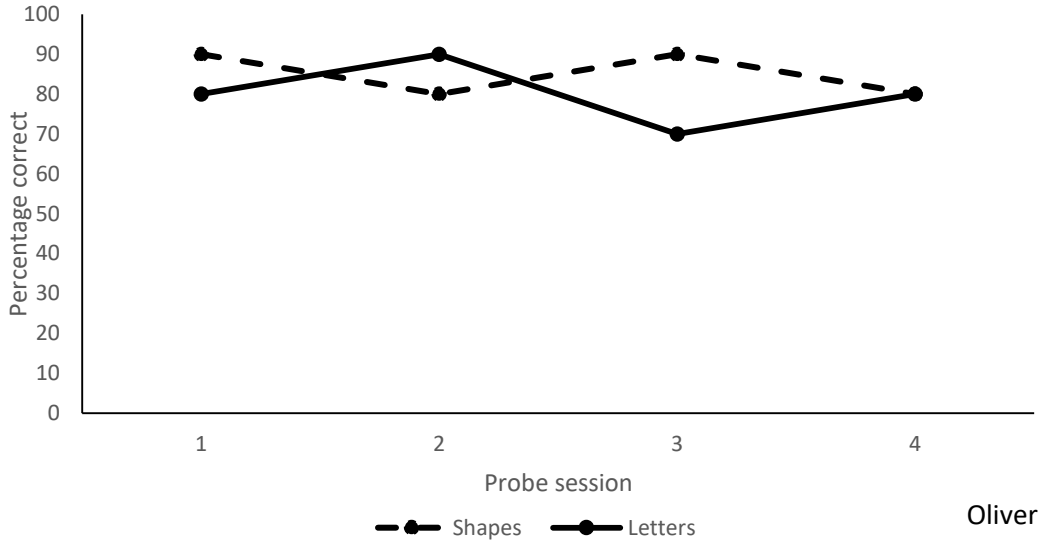


Figure 29: Generalisation data for Oliver tacting shapes and letters (PEAK direct targets 9K and 9O) in the natural environment subsequent to teaching table top. (novel format e.g. book or computer image as opposed to table top).

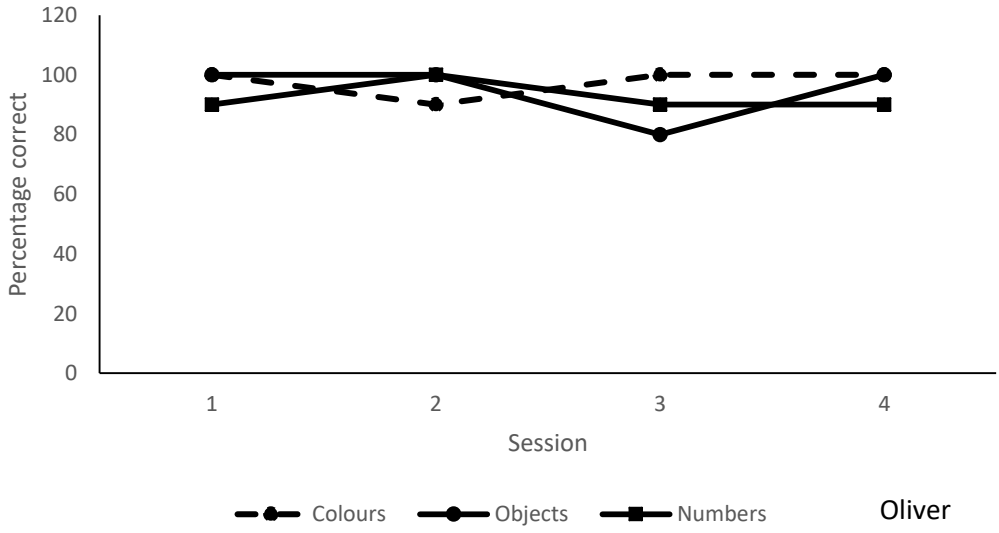


Figure 30: Generalisation data for Oliver tacting colours, objects and numbers (PEAK direct targets 9L, 8K and 9P) in the natural environment subsequent to RAN training. (novel format e.g. book or computer image as opposed to table top).

Post Assessment Data

The data below represents the post assessment tests done after the study was complete. Results show all targets taught to be marked (Y) representing the specific target as in the participants repertoire.

Table 12
PEAK results from the Direct Module assessments for 3 participants.

PEAK D	PEAK Target	Oliver		Henry		Oscar	
Number		Pre	Post	Pre	Post	Pre	Post
8K	Tact common objects	N	Y	N	Y	N	Y
9K	Tact shapes	N	Y	N	Y	N	Y
9L	Tact colours	N	Y	N	Y	N	Y
9O	Tact letters	N	Y	N	Y	N	Y
9P	Tact numbers	N	Y	N	Y	N	Y

Summary

The current study achieved its aims in teaching n=3 participants with speech and language delay five targets using PEAK table top teaching followed by further training with three of these targets using RAN. Comparison of the two table top teaching methods revealed the RAN produces slightly better results on generalisation and maintenance tests when assessed at a follow up for all three participants. It is also clear that the PEAK relational training system can be readily combined with other behavioural teaching methods such as the RAN which emphasises fluency as the outcome.

Discussion

The findings in Study 2 reveal n=3 participants, all diagnosed with a speech and language delay were taught five skills using the PEAK direct training module (Tacting Shapes, Letters, Numbers, Colours and Objects). Three of these skills (Objects, Numbers and Colours) were further taught to a fluent level of responding using an intervention based on precision teaching; Rapid Automatic Naming (RAN). Participants were exposed to the PEAK curriculum and teaching method and all succeeded in mastering the five targets relatively quickly. A multiple baseline design was implemented to show the teaching progression of the PEAK targets taught using RAN approach. Results provide further evidence to build on what was found in the previous study, that the PEAK assessment and curriculum is a versatile tool that can be used with different populations, all varying in ability, while also being combined with separate teaching methods, T-IRAP and RAN to successfully teach learning goals.

Results indicate that on comparison to the PEAK Direct module targets taught using table top methods alone, the targets taught using RAN were retained in the participants repertoire and participants showed faster and more accurate responding at a follow up assessment for generalisation and maintenance at one and three months. The participants graphed their own data using standard celeration charts as they had the ability to comprehend the process of the targeted words per minute each day and this was to enhance self-management by including goal-setting and self-monitoring. Generally, results show steadily increasing data paths for each participant. While the intervention proved successful with these three participants, due to them having only speech delay, results would need to be seen for the same intervention with a participant diagnosed with a developmental delay to see if the same findings were shown.

Study 2 assessed the participant's cognitive and verbal ability pre-post intervention. Results for the PPVT-IV assessment show two participants, Oscar and Oliver, increasing both

raw and standard scores from pre-post assessment while Henry does not show any increases in his ability score. The BSRA-3 reveals all three participants to increase their raw scores by at least 10 points. This is reflected in increases in their standard scores and percentage mastery of the overall assessment. It should be noted that the chosen PEAK Direct module targets did represent some of the aspects tested on the BSRA-3; colours, numbers etc. However, this provides evidence for successful use of PEAK training to increase scores on ability assessments pre-post intervention.

The results support findings in study 1 that teaching tools targeting fluency as the main desired outcome, show greater generalisation and maintenance on follow up assessments than those taught using DTT table top methods alone. Both the T-IRAP (computerised) and RAN (table top) show better outcome data when considering long term results than table top teaching. The findings also support the successful use of PEAK curriculum and teaching tool for different populations, with it being taught to students with speech delay in this study and participants with autism in the previous study. PEAK shows adaptability to different teaching tools and ease of manipulation to meet the requirements of the specific student.

Study 1 compared table top teaching using PEAK to a computerised teaching tool (T-IRAP), whereas study 2 compared teaching on two table top methods, one with rate of responding and self-management and one without these aspects. PEAK targets are taught using the train-test table top method while RAN are taught using worksheets/cards through table top also. Despite both being table top methods, RAN, having a fluency based goal as the target outcome, did show better outcome data for maintenance. As was seen in Study 1 also, table top teaching PEAK targets using DTT alone, for n=3 participants showed weaker results at a follow up assessment for n=3 participants.

-Chapter 4-

Comparing the T-IRAP and RAN as Methods of Teaching Skills to Fluency using the Retention, Endurance, Stability and Application (RESA) testing procedure.

Study 3 aimed to build on relational skills of same/different responding using the T-IRAP (Study 1b) while also assessing its ability, as a computerised teaching tool, to teach skills to fluency in comparison with the RAN method of teaching (Study 2), which proved a good indicator of fluent responding. This was done using follow up tests focusing on the RESA (Retention, Endurance, Stability and Application; Johnson & Layng, 1992) components. As seen in Study 1b, the T-IRAP was successfully combined to teach non-arbitrary relations to children with autism after exposure to PEAK training while also showing good generalisation and maintenance results on follow up assessments. The RAN training also taught skills to children with speech and language delay successfully by building up fluent responding, again after exposure to PEAK training.

The current study takes both methods of teaching; the T-IRAP, a computerised tool to teach relational responding alongside the RAN teaching method, a table top tool, to train same/different relational responding using arbitrary stimuli and further aims to test their efficacy as teaching methods using the RESA; retention, endurance, stability and application tests. This study focuses on arbitrary relational responding, indicated in previous studies to represent higher cognitive functioning and indicate a more flexible learning repertoire in participants (Hayes, et al. 2001). It is these relations that allow humans to understand complex constructions such as value of money; for example the knowledge that the worth of a coin bears no example to its physical size. This type of responding is extremely important in everyday life and often lacking in people with autism or other learning delays.

Study 3 focused on fluency and whether it is achieved when tested at follow up using two different teaching methods. Fluency is now considered one of the most highly desired outcomes for learners (Weiss, Pearson, Foley & Pahl, 2010). Research carried out in 1996

described fluency as the combination of accuracy and speed that leads to competent performance (Binder, 1996). As increasing amounts of children are being diagnosed with learning difficulties and developmental delays, fluency is often not a priority in their daily teaching. It is important to remediate this as fluency deficits can manifest in many different ways and affect different types of development, such as motor and social as well as academic.

This being said, there is not much research carried out in this specific area to report on the correct or successful teaching methods for fluency, especially when considering students with additional needs. Much of what is available has yet to be empirically validated and are as such based on assumptions (Heinicke, Carr & LeBlanc, 2010). The current study, hopes to give some empirical insight into teaching of skills to fluency using both table top and computerised methods with two participant's, one diagnosed with a speech and language delay who took part in study 2 and the second, a boy with diagnosed ASD from study 1. Both participants had previously been exposed to PEAK train test teaching prior to completing this study.

Study 3 commenced with testing the participant for arbitrary relational responding for same/different relations. Once it was established the participant understood the nature of same/different responding, the T-IRAP and RAN training began. An alternating treatments design was used to teach the participant's to respond to same/different stimuli on both teaching tools. Once mastery criteria was reached, the participants were assessed at a follow up of one and three months for RESA; Retention, Endurance, Stability and Application.

Method

Participant Recruitment

Two participant's, n=2, from the previous study took part in study 3. The first participant, Henry (4) from study 2 was diagnosed with speech and language delay and attending a mainstream playschool which offered services for children with additional needs. The second participant from study 1, Mark (4) was diagnosed with ASD and attending a specialised ABA preschool for children with autism. Both participants were exposed to ABA style teaching strategies in their daily schedule. Consent forms were sent out to recruit the participant's for the study via their schoolbag. An information sheet also accompanied this in which more details of the proposed research was given (Appendix 1 and 2). Parents were also asked to fully read all information sheets and consent forms prior to signing them therefore agreeing to participate in the research or declining to take part.

The participant's will be given a pseudonyms that will be used throughout. Henry is a 4 year old boy with a diagnosis of speech and language delay. His verbal ability was assessed using the Peabody Picture Vocabulary Test (PPVT-IV; Dunn & Dunn, 2007). He achieved a standard score of 101. His school readiness was assessed using the Bracken School Readiness Assessment (BSRA-3; Bracken, 2007) in which he received a standard score of 113.

Mark is a 4 year old boy with a diagnosis of autism spectrum disorder. His verbal ability was assessed using the PPVT-IV. He achieved a standard score of 89. He received a standard score of 95 on the BSRA. Mark displays some aggressive behaviours in order to access tangibles towards other children and staff. He has a DRO procedure in place to help with this.

Ethics

See Study 1 for ethical considerations.

Settings and Materials

All sessions took place in a classroom in each's Pre-School. The sessions did not interfere with the usual daily routine the child had in place and did not reduce the amount of academic work he did each day. The research was carried out during 1:1 sessions, usually 10 minutes, with the researcher and participant in a classroom with other tutors and children present. Most sessions were carried out at a table with two chairs. Often a third person; IOA data collector or BCBA sat at the table to observe the sessions.

Pre Training IQ Assessments. The participants were assessed using two tests of ability, the PPVT-IV and the BRSA-3. The assessments were carried out during the day or before school with the BCBA present to supervise. All PPVT-IV and BRSA-3 are administered using easels with various pictures on them and separate scoring sheets. The Vineland assessment was carried out by performing small tasks and asking parents/carers questions about the participant's ability. After the initial assessments, the research sessions took place daily. A more detailed description for each assessment used can be found mentioned above in the previous study.

Rapid Automatic Naming (RAN: Haughton Learning Centre, 2002): Refer to description in previous study (Study 2) for detailed outline.

The T-IRAP. Refer to previous study (Study 1) for detailed outline of the T-IRAP.

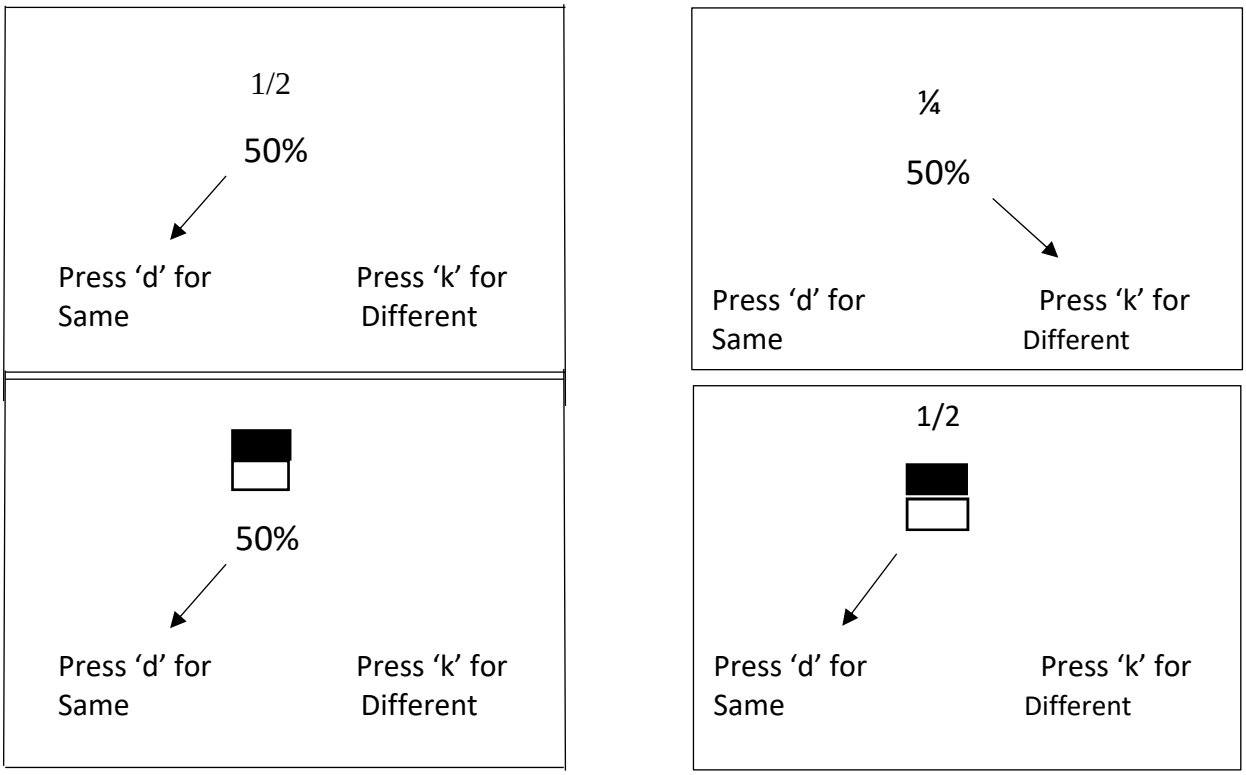


Figure 31: Example of the T-IRAP screens seen by participants when responding to same/different arbitrary responding for T-IRAP. Arrows do not appear on screen during trials.

Design

This study utilised an alternating treatments design with two subject's to compare the outcomes of two different teaching methods. Same/different relations using arbitrary stimuli were taught to participant's, one with a speech and language delay and one with ASD, after which both methods of teaching were subjected to follow up tests to assess their ability to teach skills to fluency. Pre training assessments were conducted using the PPVT-IV and the BSRA-3 and again repeated after the follow up tests were completed.

Procedure

Pre training IQ assessments. Baseline PPVT-IV and BSRA-2 assessments were carried out first with the participant's and scores were calculated before any IRAP or TT procedures took place. The assessments were conducted in the classroom with other children and staff present. Either the Head teacher or the BCBA were also present for each research session.

PPVT-IV was administered as per the instructions in the manual. The trials consisted of presenting the participant with four pictures on a flipchart page and requiring them to 'find x'. The BSRA-3 was administered using a flipchart with pictures displayed on each page. The participant was told to 'show me X' and they could point to the correct picture. Both assessments were accompanied by separate scoring sheets in which the researcher could fill in as they delivered the assessment.

T-IRAP format. Refer to previous study for T-IRAP teaching procedure (Study 1)

Rapid automatic naming: RAN worksheets were designed to match the targets chosen for the study. Each worksheet was cut into a small card shape with images on it of the same/different arbitrary stimuli chosen for the study. The participants were presented with the worksheets and given 3 attempts to complete it on order for the researcher to get an average score per minute for each participant. The timer was set to 1 minute and the following instructions were given to the participant, 'I am going to set the timer to 1 minute and you can work your way through the cards, saying the answer, either same or different, going as fast as you can'. Once the averages were established, a ceiling and floor were set, meaning the minimum score that could be recorded and the maximum score for each session. The sessions took place daily, with the participant being given one practice session and then the testing ones followed each day. A maximum of three attempts were done for each session. If the participant beat their score from the precious day, then the session was finished for that

day. If all three sessions were ran, the best of 3 attempts were chosen to graph for that day. If they got the same score or a decreasing trend for 3 days, an intervention was put in place in the form of a prompt or training errors using DTT prior to running daily sessions. The participants self-recorded their scores using a standard celeration chart which showed correct responses and errors per minute for each day. A personal aim was set for each student for each target and this was used as a mastery criterion for this study. The aims were decided on based on the learners ability, the average per minute ability of the corresponding age matched typically developing peers and previous research studies using targets reported in literature on aims for specific ages. Each session took 5-10 minutes per day for the participants

IOA

An independent observer who had training in ABA and worked in the setting with the researcher was trained to record the RAN data. The observer sat behind the researcher and did not participate in the session or speak to the participant at all. Approximately 43% of trials were observed and subjected to trial by trial analysis where inter observer agreement resulted in 100%.

Results

IQ Assessment Data (Pre-training)

Table 13 shows the pre and post-intervention standard and raw scores on the PPVT-IV for the two participant's. Henry, aged 4, had a diagnosis of speech and language delay and Mark, aged 4 had a diagnosis of ASD. The results indicate that while Henry did not see any large improvements from pre-post assessment, Mark did show an increase of 9 points on his standard score after the intervention.

Table 13
Standard score (S) and raw score (R) for participant's on the PPVT-IV pre and post intervention.

	Pre-Intervention		Post-Intervention	
Participant	PPVT-IV (S)	PPVT-IV (R)	PPVT-IV (S)	PPVT-IV (R)
Henry	101	59	101	60
Mark	89	63	97	67

Table 14 shows each participants pre and post-intervention results for the BSRA-3. In this assessment, Henry showed an increase from pre-post assessment on both his raw and standard score meaning he did not move categories, remained in the average bracket, but did display improvement on his results. Mark did not show any increase on his pre-post assessment scores however.

Table 14
BSRA results displaying the participant's raw score, percentage mastered and standard score for pre and post intervention.

	Pre-intervention			Post-intervention		
Participant	Raw Score	% mastered	Standard score	Raw score	% mastered	Standard score
Henry	52	61	113	65	76	120
Mark	48	56	96	49	58	96

Training

The following graph, figure 32, displays the results of the training carried out with Henry on the T-IRAP for arbitrary same/different relations. The data shows that at baseline, Henry was not displaying any correct responses. When the gestural prompt was introduced, Henry began to respond accurately showing a stable increase in percentage correct while the response latency is seen to decrease across the sessions with a decreasing yet variable trend seen. The gestural prompt assisted Henry in the correct key for responding, being the D or K key on the computer keyboard. When the prompt was faded back, independent responding showed an initial dip in accuracy and increase in response latency as Henry adjusts to the lack of prompting. A variable trend can be seen for both data paths with accuracy slowly increasing and speed showing a downward trend. Both the accuracy data and the response latency did reach mastery criteria by the end of the intervention with accuracy at 100% and response latency under 2000 milliseconds.

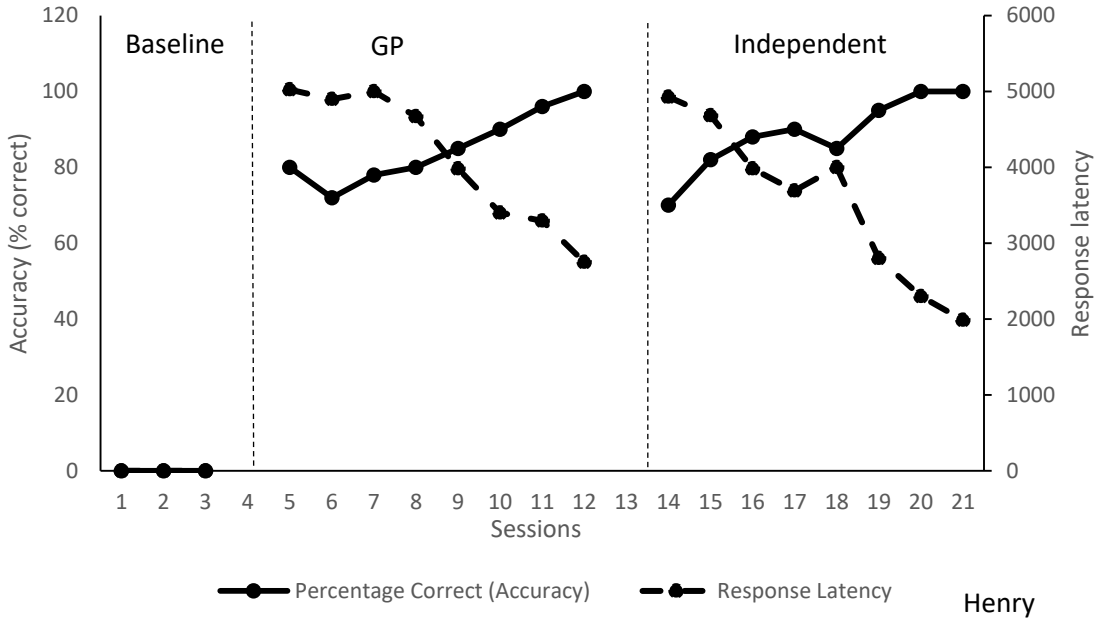


Figure 32: T-IRAP Data for Henry showing accuracy and response latency for arbitrary same/different relations.

The graph below, figure 33, displays the T-IRAP training carried out with Mark for teaching same/different arbitrary relational responding. The graphs shows at baseline, no accurate responding was seen. After this, the gestural prompt was introduced to assist with responding. Data shows a decreasing trend for response latency across 10 sessions and while accuracy is increasing foe five data points before dipping and rising again to meet criteria. A less variable trend is seen when independent responding is introduced. An increasing trend for accuracy is seen corresponding to a steadily decreasing data path for response latency across the final six sessions to reach mastery criterion of 100% and responding under 2000milliseconds.

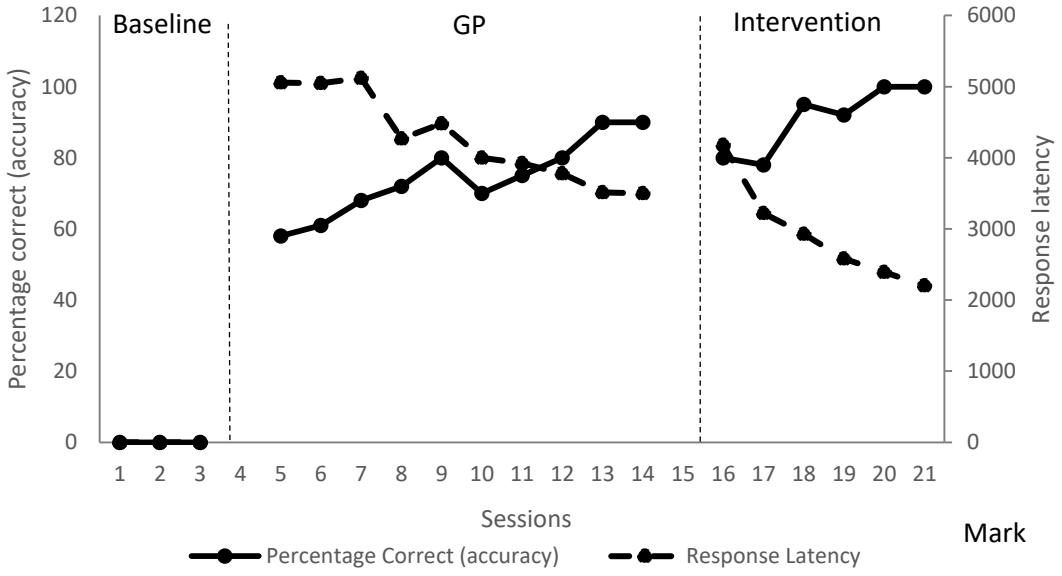


Figure 33: T-IRAP Data for Mark showing accuracy and response latency for arbitrary same/different relations.

The graph below, figure 34, shows the data for Henry using the RAN method to teach arbitrary same different relations. Initial responding at baseline shows error rates to be variable between 1 and 2 and words per minute, accuracy data, to range from 20 -25. Once

stable responding was seen, the intervention was introduced. The results show a steadily increasing trend for accuracy (words per minute) with some dips throughput the intervention. The error data shows a more variable trend while remaining low towards the end of the intervention with 1 or 0 errors seen for most sessions. Criteria of 80 words per minute was reached alongside 0 errors which ended the intervention.

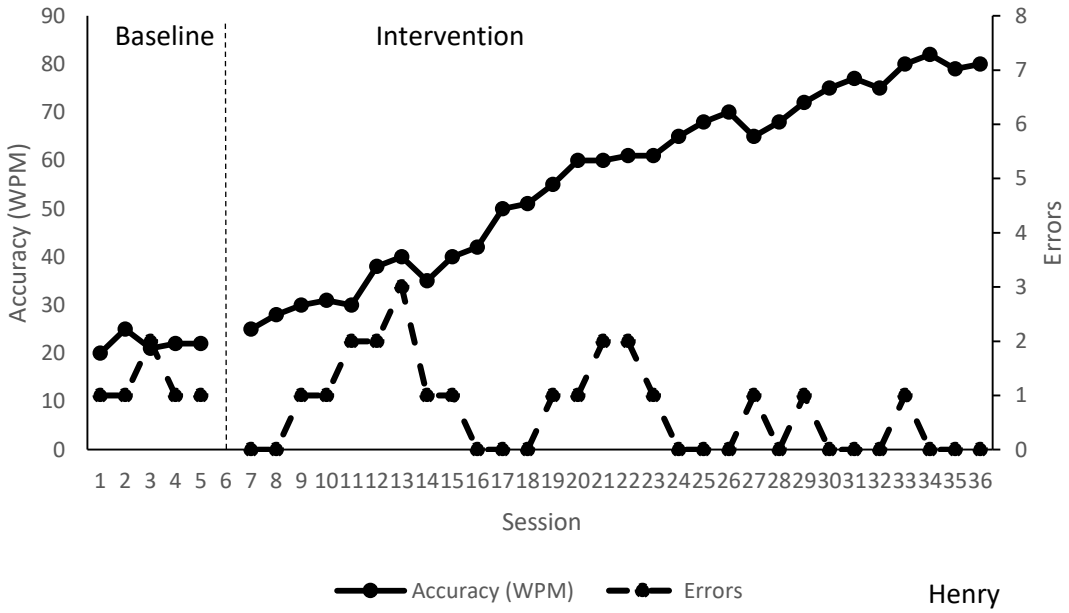


Figure 34: RAN data for Henry showing accuracy in words per minute alongside errors for teaching target same/different using arbitrary stimuli.

The following graph, figure 35, displays the results for Mark using RAN to teach same/different relational responding using arbitrary stimuli. Initial responding at baseline shows error rates between 2 and 4 while words per minute vary from18-22. Once the intervention is introduced after stable responding is seen, the results show a steadily increasing trend for accurate responding, measured in words per minute, with one or two dips and rises seen in the data path. The errors show initially high rates which decrease throughout the intervention yet remain very variable until the end of the sessions. Mastery criteria was reached after 40 or more sessions.

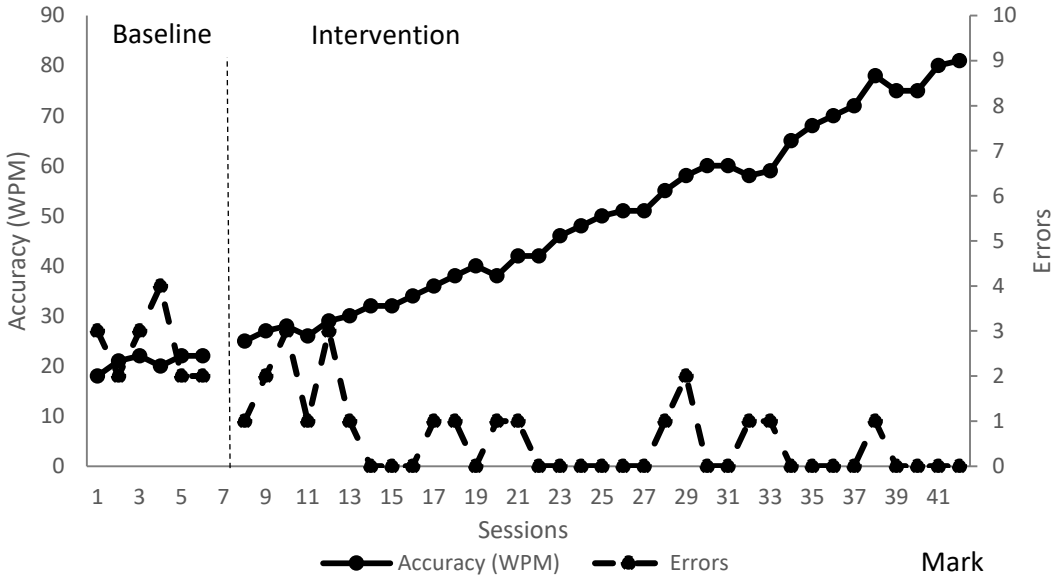


Figure 35: RAN data for Mark showing accuracy in words per minute alongside errors for teaching target same/different using arbitrary stimuli.

RESA Tests

The following graph, figure 36, represents the RESA tests done for the T-IRAP method of teaching same/different responding using arbitrary stimuli. The graph shows the results of the testing done for the following four components; retention, endurance, stability and application at a one month and three month follow up assessment post training. The retention test was designed exactly as the training tests had been carried out. Henry shows high levels of accurate responding at both one month and three month testing, scoring 90% and 93% respectively with response latency remaining at the 2000ms point for both tests. The endurance tests were done by doubling the trial blocks that the original training was conducted with. At the first test, one month later, Henry scored 100% accuracy with response latency remaining low at 2180ms. At the three month follow up he scored 92% correct, slightly lower than previous responding with response latency also increasing to 2256ms.

Results show overall good levels of accurate responding with response latency remaining around the 2000ms criteria.

The third test was for stability and was carried out in a classroom setting with other children present and background music playing. Henry showed accuracy to be 82% at the first follow up test with response latency being 2367ms which is higher than previous conditions. At three months he scored 90% accuracy with response latency being 2218ms, meaning the second follow up showed better results than the initial one. The final condition was application whereby testing was done in a new environment, for this study that was a room the participant hadn't used before, with a new tester, a second member of staff and different stimuli used. Henry scored 90% for accurate responding with a response latency of 1998ms at the one month follow up and 95% accuracy at the three month follow up with response latency being 2088ms. Responding here was higher than the previous condition and results for accuracy were close to the mastery level of 100% while response latency reached criteria of 2000ms or less.

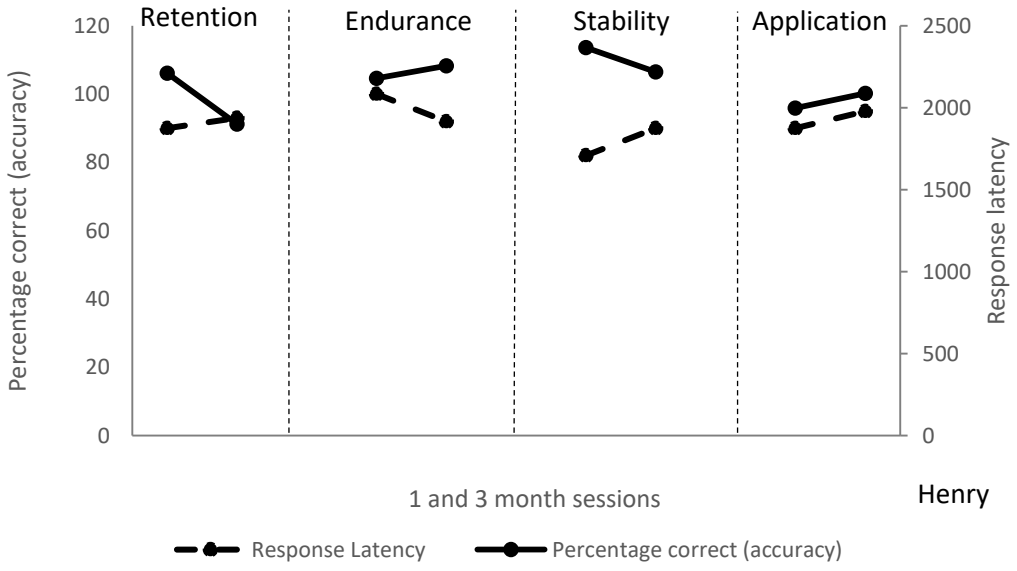


Figure 36: RESA testing results for target same/different responding (arbitrary) taught using T-IRAP.

The following graph, figure 37, represents the RESA tests done for the T-IRAP method of teaching same/different responding using arbitrary stimuli. The graph shows the results of the testing done for the following four components; retention, endurance, stability and application at a one month and three month follow up assessment post training. The retention test was designed exactly as the training tests had been carried out. Mark shows relatively high levels of accurate responding at both one month and three month testing, scoring 88% and 94% respectively with response latency rising slightly to 2308ms and falling again to 2100ms for the second follow up assessment. The endurance tests were done by doubling the trial blocks that the original training was conducted with. At the first follow up test, Mark scored 99% accuracy with response latency remaining low at 2008ms. At the three month follow up he scored 90% correct, slightly lower than previous responding with response latency also increasing to 2195ms. Results show overall good levels of accurate responding with response latency varying slightly around the 2000ms criteria.

The third test was for stability and was carried out in a classroom setting with other children present and background music playing. Mark showed accuracy to be 78% at the first follow up test, much lower than previous responding with response latency being 2801ms which is higher than previous conditions. At three months he scored 85% accuracy which is higher than his previous assessment with response latency remaining high at 2672ms. Despite this, the second follow up showed better results than the initial one. The final condition was application whereby testing was done in a new environment, for this study that was a room the participant hadn't used before, with a new tester, a second member of staff and different stimuli used. Mark scored 91% for accurate responding with a response latency of 2018ms at the one month follow up and 94% accuracy at the three month follow up with response latency being 2100ms. Responding here was higher than the previous condition and results

for accuracy were close to the mastery level of 100% while response latency dropped and stabled around the mastery criterion of 2000ms or less.

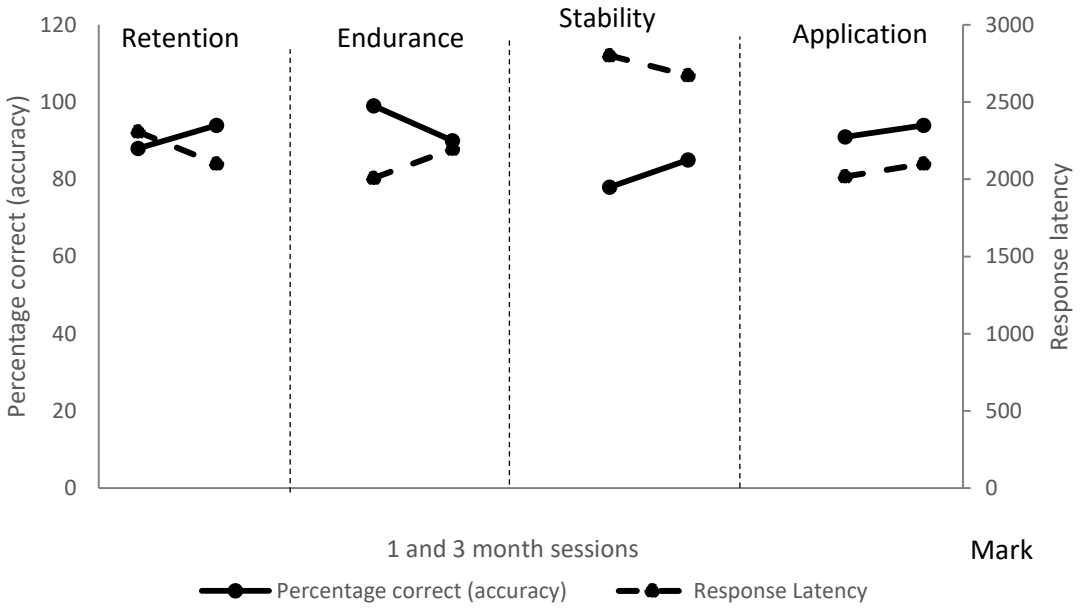


Figure 37: RESA testing results for target same/different responding (arbitrary) taught using T-IRAP.

The following graph, figure 38, represents the RESA tests done for the RAN method of teaching same/different responding using arbitrary stimuli. The graph shows the results of the testing done for the following four components; retention, endurance, stability and application at a one month and three month follow up assessment post training. The retention test was designed exactly as the training tests had been carried out. Henry shows high levels of accurate responding at both one month and three month testing, scoring 85 and 82 respectively with no errors for either test. The endurance tests were done by doubling the time the original training was carried out at. This was a two minute interval as training was done for one minute sessions. At the first test, one month later, Henry scored 79 with one error for that session and at the three month follow up he scored 81 with one errors. Results

show good levels of accurate responding with words per minute still reaching the mastery criteria.

The third test was for stability and was carried out in a classroom setting with other children present and background music playing. Henry scored 78 per minute at the first follow up test with two errors and at three months he scored 77 with one errors. Responding was slightly lower here than in the previous two conditions. The final condition was application whereby testing was done in a new environment, for this study that was a room the participant hadn't used before, with a new tester, a second member of staff and different stimuli used. Henry scored 72 and one month follow up with two errors and 76 at the three month follow up with no errors. While responding here was lower than the previous conditions and was not at the mastery level of 80wpm with no errors, it still remained high with relatively little errors seen.

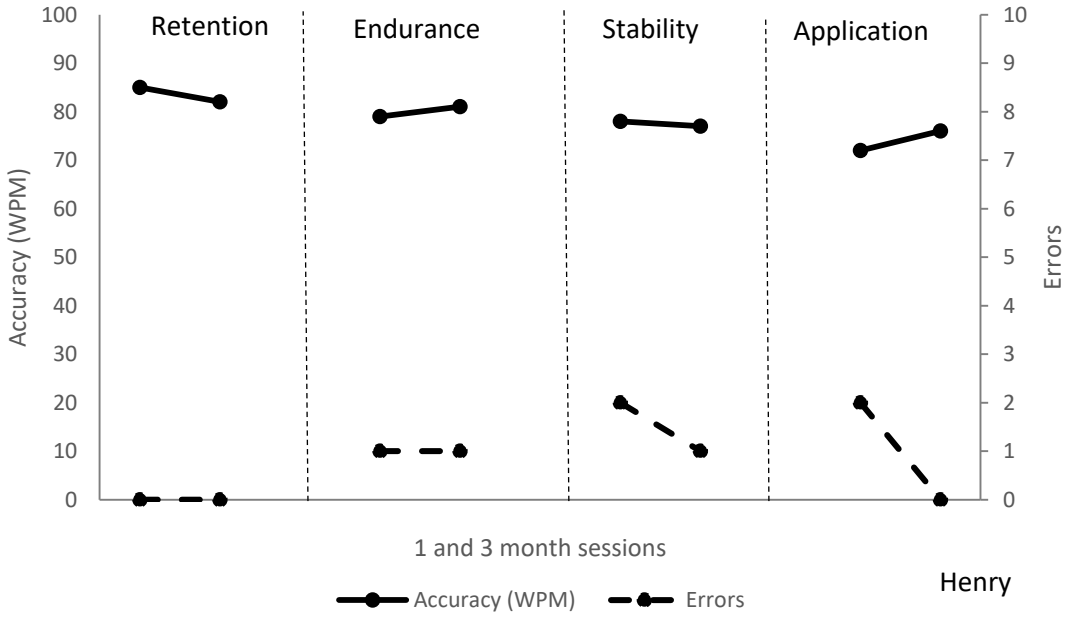


Figure 38: RESA testing for same/different (arbitrary) responding taught using the RAN teaching method at a one month and three month follow up session.

The following graph, figure 39, represents the RESA tests done for the RAN method of teaching same/different responding using arbitrary stimuli. The graph shows the results of the testing done for the following four components; retention, endurance, stability and application at a one month and three month follow up assessment post training. The retention test was designed exactly as the training tests had been carried out. Mark shows high levels of accurate responding at both one month and three month testing, scoring 81 and 78 respectively with one error for the first follow up and no errors for the next. The endurance tests were done by doubling the time the original training was carried out at. This was a two minute interval as training was done for one minute sessions. At the first test, Mark scored 78 with one error and at the three month follow up he scored 75, slightly lower, with one error. Results show good levels of accurate responding with words per minute still remaining high around the mastery criterion.

The third test was for stability and was carried out in a classroom setting with other children present and background music playing. Mark scored 70 words per minute at the first follow up test with one error and at three months he scored 72 with three errors. The error rates were slightly higher in this test than previous conditions, while words per minute also seen a dip in levels of responding. The final condition was application whereby testing was done in a new environment, for this study that was a room the participant hadn't used before, with a new tester, a second member of staff and different stimuli used. Mark scored 69 with two errors for the first follow up session and 75 words per minute with no errors at the three month follow up. Responding here was lower than the first two conditions and was not at the mastery level of 80wpm with no errors, it still remained high with not too many errors.

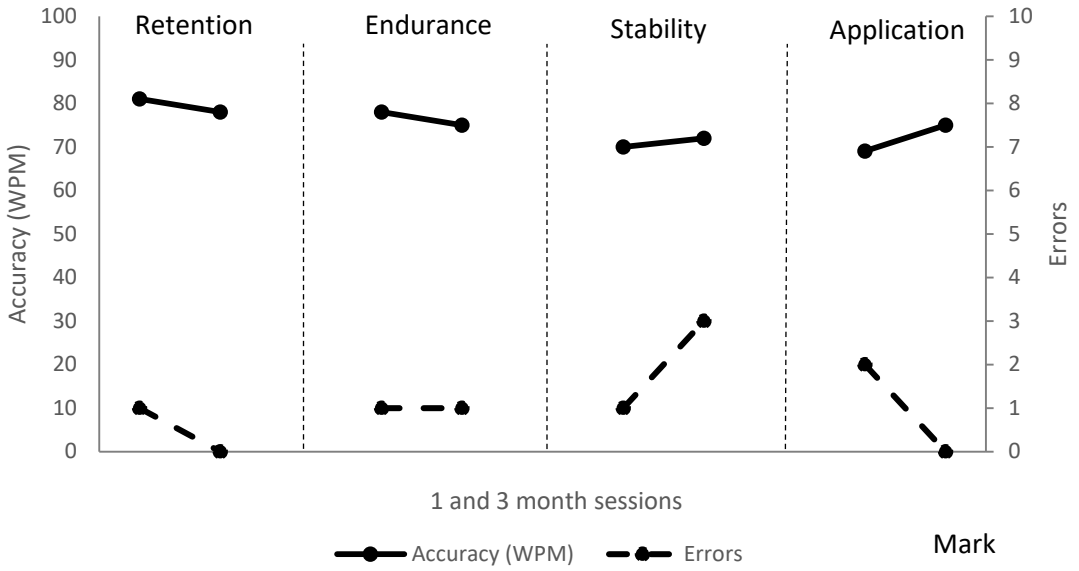


Figure 39: RESA testing for same/different (arbitrary) responding taught using the RAN teaching method at a one month and three month follow up session.

Summary

The current study achieved its aims in using an alternating treatment design to teach n=2 participants arbitrary relational responding using both the T-IRAP and the RAN teaching method. Both participants, one with ASD and one with speech delay, successfully learned to respond to the arbitrary relation ‘same/different’ without any formal pre-training. RESA tests were carried out at 1 and 3 months to compare both teaching methods for retention, endurance, stability and application. Results indicate that each method successfully taught skills to maintenance and both revealed strengths in different areas of the test yet neither was more favourable than the other.

Discussion

The results from study 3 build upon the findings in the previous two studies combining advanced ABA methods e.g. PEAK, T-IRAP and RAN to assess the level of fluency and retention taught to participants with varying additional needs using different teaching tools. The RAN method and the T-IRAP were chosen to teach same/different relational responding (arbitrary) to two participant's, one with a speech and language delay and a second participant with ASD. Both methods have been in the previous studies readily combined to the PEAK training modules and seen good outcome data for skill acquisition. Initially, the teaching was done using an alternating treatments design for the two teaching methods in question. The follow up assessments for generalisation and maintenance were done at one month and three months post-intervention. The study succeeded in teaching both participants to respond to arbitrary relations indicating flexible responding repertoires and higher cognitive functioning skills, often not seen or difficult to establish in children with learning delays. One participant, ASD, had been taught non-arbitrary relational responding prior to completing this study in Study 1.

The data for both participants show that while the T-IRAP displays a quicker acquisition of the skills in terms of sessions needed to be carried out with the participant, the RAN graph shows a more stable increasing trend line for overall skill acquisition. The participant's did meet mastery criterion for both teaching methods, the T-IRAP being 100% accuracy and responding in under 2000ms and for RAN, the target was 80 words per minute with no errors. The relatively quick teaching process for Henry could be linked to the child's ability prior to intervening, to understand both arbitrary and non-arbitrary responding. However, the second participant, Mark, only received pre-training on same/different relational responding using non-arbitrary stimuli in study 1 and derived his ability to respond accurately to arbitrary stimuli in the current study relatively quickly.

When the graphs for the two participants are compared, it would seem that for initial training, both participants did well on the T-IRAP with a similar amount of sessions seen to be needed to train up correct responding. The RAN training data reveal that Mark required more sessions than Henry in order to complete the intervention however his graph shows a more stable increasing trend of acquisition than Henrys. Both participants did show variable trends for error rates throughout the intervention. The follow up assessments for the T-IRAP reveal higher overall accurate responding for Henry in comparison to Mark, however, not by much. The average accuracy for Henry for follow up assessments was 92% while Mark scored 90%. Henry's average duration to response was 2152ms and Mark's was 2275ms While the RAN follow ups show higher levels of errors for Mark and lower accuracy scores, again, not dramatically different. Henry displays an average of 2 errors per minute as does Mark. Henrys average words per minute count for both follow ups was 79 in comparison to Marks which was 75.

The RESA tests (Johnson & Layng, 1992) were used to assess the level of fluency achieved by the participant after being taught the same skill using both teaching methods. Retention, endurance, stability and application are all important and defining features of what is considered a fluent skill. For this study, the four separate conditions were tested at the two follow up sessions and it would appear from the data that neither of the two teaching methods were considered to better than the other. It was the case that the two methods had strengths and weaknesses in certain follow up assessments. The RAN outperformed the T-IRAP in terms of endurance and application whereas when assessing stability, both methods were matched in their effects on participant responding. It is interesting in comparison to the previous two studies to note that both these two teaching methods compared favourably to the table top teaching and yet when alternated in the current study, they show mixed results on the best predictor of fluent performance.

-Chapter 5-

General Discussion

Study 1 utilised pre-post ability assessments for eight participants (4 with diagnosed ASD, 4 typically developing). The Bracken School Readiness Assessment (BRSA-3; Bracken, 2007), the Vineland Adaptive Behaviour Rating Scales (Vineland-II; Sparrow & Cicchetti, 2005) and the Peabody Picture Vocabulary Test (PPVT-IV; Dunn & Dunn, 2007) were carried out with all eight participants prior to any training being conducted and post intervention tests were administered at a six month follow up session. The aim was to examine if using the PEAK relational training system as a teaching tool alongside the T-IRAP to teach flexible relational responding would result in gains on any of the ability assessments. At a group level, no substantial gains were found pre-post assessment. However, individual gains were seen and represent improvement in specific abilities. For the PPVT-IV, four out of the eight participants; two with ASD and two typically developing, were placed in the low average category prior to intervention and moved into the average bracket post assessment. Two participants, one typically developing and one in the ASD class moved from moderately low to low average after the intervention and the two final participants, one typically developing participant and one with ASD did not change categories from pre to post assessment. Both population samples had varied outcomes on the assessment which was interesting to note.

Results from the Vineland and the BSRA-3 assessments are not as clear with only one participant (ASD) increasing his standard score from pre to post assessment. The other participants, while increasing their raw scores across the intervention did not do so significantly in order to display any changes on their overall standard score or movement between categories. The Vineland revealed similar results in that the raw scores did increase within the 6 months, however, no change was seen on the participants adaptive level of

functioning or percentile ranks. The typically developing participants did score higher in general on this assessment than the participants with ASD for both pre and post assessment.

The findings in Study 1a revealed that the participants (N=8 pre-schoolers, 4 with diagnosed learning disability, 4 typically-developing) learned to derive previously unknown target skills from the PEAK Direct Module subsequent to being taught corresponding targets from the PEAK Generalisation Module. Assessments were first conducted for PEAK-D and PEAK-G modules, and a number of learning targets that were absent from the participants' repertoires were selected on the basis that they appeared to be similar (e.g., Generalised imitation (PEAK-G) to fine motor, gross motor, object imitation (PEAK-D). Twenty target skills selected from the PEAK-G module were taught to the eight participants after subsequently using the PEAK-G curriculum training methods. After the table top training was complete and participants had mastered the 20 skills from the PEAK-G Module, a second assessment was conducted for 34 learning targets selected from the PEAK-D Module. Results revealed that all participants successfully demonstrated the 34 skills that were previously recorded as absent in their repertoires prior to having learned the PEAK-G corresponding skills. Thus, it would appear from Study 1 that participants could derive these previously absent skills from being taught similar ones and that learning the PEAK-G targets negated the necessity of teaching similar skills targeted in the PEAK-D Module. Of course, it will be necessary to replicate findings with participants of varying ages and learning abilities before such interpretation can be confirmed. This preliminary and exploratory study discerned no notable differences in the learning of children with and without learning disability.

The second part of this study, study 1b was that PEAK-G relational responding (non-arbitrary) was taught with n=8 participants (4 with diagnosed learning disability and 4 typically developing) using the T-IRAP interactive computerised teaching programme,

similar to the study carried out by Kilroe et al. (2011). Two of the PEAK targets chosen and taught through table top methods were identical matching and exclusion skills. With the exception of the table top work using the PEAK targets, the participants were not exposed to any other pre-training for the T-IRAP. Each of the eight participants readily acquired the correspondence of the response options on the keyboard to the on screen response options without specific pre-training on how to use the T-IRAP. Future research in this area may want to examine this same process in children with varying levels of severity within the autism diagnoses. None of the participants in the current research had a severe diagnosis and majority of them would all be very familiar with computerised games and activities, with many choosing them as preferred reinforcers. This would provide an alternative explanation for the speedy acquisition of the T-IRAP.

Overall, the results highlight the ability to utilise the T-IRAP as a teaching tool for same/different relational responding (non-arbitrary) with different population samples of preschool age, with developmental delay, after only initial exposure to PEAK table top training which included both matching and exclusion targets. Baseline data were taken prior to teaching the PEAK targets same/different using the table top methods and results show no accurate responding for any of the participants. The maintenance and generalisation results post intervention reveal that after exposure to the PEAK training, accurate responding on the T-IRAP to a similar stimuli set was readily seen. The results indicate that participants derived same/different relational responding on the T-IRAP with very little prior training or exposure to that relation. Similar to work done by Kilroe et al. (2011) where flexible relational responding was seen in a population with autism and taught more efficiently than table top methods would do.

Study 2 also utilised ability assessments both pre and post intervention with the three participants. The PPVT-IV and the BRSA-3 were administered to the participants to assess

for language and cognitive ability. A comparison of pre and post PPVT-IV assessment data did not indicate any increase in standard scores for any participant, and only small changes were seen in raw scores for the participants. Specifically, the BRSA-3 revealed increases for all three participants from pre-post assessment with one moving up a descriptive category from very-delayed to average. The other two participants remained in the same category but did see overall increases in raw scores.

Study 2 extended on the work done in Study 1 by examining PEAK targets trained through table top methods in comparison to yet another ABA fluency-based training method, Rapid Automatic Naming (RAN). The study taught n=3 participants diagnosed with a speech and language delay fluency skills using PEAK targets. Five PEAK targets from the direct training module were taught using the PEAK train/test strategy (Tacting Colours, Numbers, Objects, Letters and Shapes). As these targets reached mastery level, three of them (Tacting Colours, Numbers and Objects) were maintained using RAN as the teaching tool. A multiple baseline design procedure was implemented to display levels of speed (words per minute) and accuracy (errors per minute) for each of the participants. Self-management skills were also targeted during Study 2 and the three learning targets chosen for the training were also graphed by the participants themselves using standard celeration charts, which is best practice when using precision teaching methods.

Follow up assessments were conducted to test participants' maintenance and ability to generalise skills learned. Both the two targets taught using PEAK table top methods and the three targets taught to fluency using RAN were subjected to these follow up assessments. While all participants retained the skills taught using both methods, the three targets followed up with the RAN revealed greater retention for both maintenance and generalisation of the skills. In terms of sessions to teach before reaching mastery level, the fluency training, RAN, took longer to teach than the table top work, however, the daily teaching time is greatly

reduced with only 1 minute sessions needed at most 3 times daily. Future research might need to examine this finding in terms of larger sample size and amount of targets taught, including examining the results with respect to different populations. That being said, previous research does support the above findings, although not using PEAK relational training system, in that skills taught using fluency measure show greater retention and generalisation at follow up performance. This is especially interesting for applied settings were generalisation and skill maintenance are often problematic, yet teaching time is always a resource to be considered.

Study 3 also conducted pre-post assessments to comparing participant data from either Study 1 or 2 and following up 6 months after the final intervention session of Study 3. One participant with diagnosed ASD displayed increases in his results in the PPVT-IV however none were seen on his results from the BSRA-3 assessment. The participant with the speech and language delay revealed opposite results with improvement seen on his BSRA-3 test scores and no increases on the PPVT-IV test when comparing pre and post assessment data. Study 3 built upon the findings of the previous two studies by comparing different teaching methods to teach arbitrary relational responding skills with n=2 participants with and without a diagnosis of autism, and assessing participants at follow-up of one and three months for Retention, Endurance, Stability and Application (RESA; Johnson & Layng, 1992) to evaluate their success at achieving fluent responding. Two participants were included in this study, one with ASD who also took part in study 1 and the other had a diagnosis of speech and language delay and completed study 2. Both participants learned to respond to same/different arbitrary relations using the T-IRAP and RAN. An alternating treatment design revealed the RAN method to be a better indicator of endurance and application whereas in terms of stability, both the RAN and T-IRAP were matched for responding effects in participants at a one and three month follow up. Despite being labelled differently, both

measures recorded speed; words per minute for RAN and milliseconds for T-IRAP as well as accuracy, errors per minute for RAN and percentage correct for T-IRAP.

Both of the teaching tools, T-IRAP and RAN proved more effective than table top teaching alone. In line with previous studies, the T-IRAP was the fastest teaching tool in terms of daily sessions which is useful for applied settings similar to where this study was done as time is always valuable. While both participants did acquire arbitrary relational responding and retain it to follow up, it is interesting to note that mixed results were seen for overall skill acquisition and follow up with both methods have strengths and weaknesses in certain RESA tests meaning not one particular method can be said to be preferable over another.

In summary, a total of 11 participants (4 with diagnosed ASD, 4 typically developing and 3 with speech and language delay) were exposed to the PEAK-Generalisation Module and PEAK-Direct Module relational training system and taught using both table top and computerised methods for non-arbitrary and arbitrary relational responding for the target same/different. All teaching methods were compared and tested for long term gains on fluent performance as well as the generalisation of the newly acquired skills with three different population samples. The research highlights how the principles of RFT in the form of PEAK and the T-IRAP can be combined to traditional ABA methods such as DTT and precision teaching using prompting, fading and positive reinforcement to develop contemporary teaching approaches that target language based skills.

As stated above, pre and post intervention ability assessments were carried out with all eleven participants for each study they took part in. The aim was to see if using the PEAK curriculum alongside teaching flexible relational responding to participants with different additional needs or learning delays would impact on cognitive and language ability scores.

No substantial gains were recorded from pre to post assessment however, individual gains were detected across the studies. As previously mentioned, some participants did move from lower categories pre-test to higher ones post testing, however, the majority of tests displayed increases in raw scores for each participant which reflects improvement, but not enough to move them from one test category to another. For example, moving up 5 points in a raw score will not be reflected in moving from 'low average' to 'average' on descriptive categories. The above findings provide further evidence for PEAK as an assessment that may result in potential gains on cognitive and language ability tests, as is seen in previous PEAK research (Dixon, et al. 2014; Dixon, Whiting, Rowsey & Belisly, 2014).

It should also be noted that gains seen on these measures can also be attributed to other factors. Each of these participants, with the exception of the typically developing ones, n=4 were receiving 1:1 ABA tuition on a daily basis throughout the course of the study which could coincide with natural improvements and this method has also been seen to show benefits with regard to IQ scores (Lovass, 2009). One issue needing further examination in regards to ability assessments is that of test sensitivity to people with developmental disabilities and whether or not the tests are sensitive enough to detect smaller changes in the lower extremities of the tests where this population may score. There can be difficulty saying for certain that the test is assessing the correct skills or abilities in populations with learning delay. In the context of the current study, it is however interesting to note that the one test that showed positive changes repeatedly throughout each study from pre-post assessment was the PPVT-IV which is the language based assessment. This could be examined in future research in relation to both PEAK and T-IRAP studies revealing results such as these and both also having a foundation in the analysis of verbal behaviour. Results are consistent with findings reported by Cassidy, et al. (2011).

As emphasised throughout, the current research builds on the use of teaching techniques in applied settings that are mainly founded in RFT to teach participants with varying degrees of educational needs. RFT has had implications in the field of education and language as well as developing skills for relational responding, allowing for cognitive gains which correlate to academic achievement (Barnes-Holmes, Barnes-Holmes & Murphy, 2004). Often, multiple exemplar training is described in the literature as good practice for achieving and extending on flexible responding repertoires (Barnes-Holmes, Barnes-Holmes & Murphy, 2004). However, extensive training with multiple exemplars, used commonly in the field of ABA, does not result in the acquired ability to show flexible responding. One study attempting to teach derived relations through multiple exemplar training did not succeed in teaching new relational repertoires but activating previously established symmetrical responding (Barnes-Holmes, Barnes-Holmes & Roche, 2001). However, a second study carried out with children diagnosed with developmental delay teaching derived manding did succeed in showing a derived transfer effect (Barnes-Holmes et al, 2004). This provides more evidence for RFT as a successful method of teaching derived relational responding when focused on verbal behaviour which is especially important in educational settings for children with additional needs.

In establishing derived relational responding, a generative component can be added to the teaching practice that reduces the need for each skill to be taught individually (Murphy, Barnes-Holmes & Barnes-Holmes, 2005). The current study built up the complexity of relational responding using PEAK table top methods first and extending this work to the computerised T-IRAP to show relational responding successfully taught to both typically developing children and those with ASD. While the current study did use both Table top and T-IRAP teaching, it did not aim to compare the performance of the two as previous research carried out by Kilroe et al (2011) and Lyons & Murphy (Under Submission) established the

T-IRAP as a more effective and efficient method of teaching. However, this study adds support to the suggestion that the T-IRAP may be a very useful supplementary teaching tool alongside more traditional ABA methods and can be seen to show positive findings when used alongside the novel PEAK relational training system.

The complexity of the relational responding was increased by adding arbitrary relational responding for two participants in the third study. It is proven that arbitrary relational responding is more advanced than relational skills that are taught based on their physical properties (non-arbitrary). It is also thought that these may be a pre-requisite skill for the more advanced arbitrary responding. The current study supports these findings in that the participant, Mark (ASD), was taught to respond to non-arbitrary relations prior to successfully mastering arbitrary ones in the third study. However, a second participant, Henry, showed arbitrary relational responding without being formally taught to respond to non-arbitrary stimuli. Arbitrary responding is also seen to promote more intelligent flexible behaviour which can be very important for these particular populations and their language development, for example, naming objects. Increased scores in ability tests for Mark post intervention also provide further evidence for the ideas promoted through RFT studies that derived relational responding can be seen to effect and encourage intelligent behaviour and higher cognitive functioning (Cassidy, Roche & Hayes, 2001).

The current research, as stated above, provides interesting findings on the ability of one participant with autism to display responding to arbitrary relations after only exposure to the T-IRAP to train non-arbitrary responding. No instructions or hierarchy of training can be found for teaching relational responding to children, however, it is generally assumed that non-arbitrary responding is a pre-requisite to arbitrary responding (Barnes-Holmes, Barnes-Holmes & Smeets, 2004). This is mainly assumed as arbitrary responding is seen to produce rapid learning and generalisation of skills that neither direct operant training nor non-arbitrary

responding can be seen to show (Stewart & Roche, 2013). This would be an interesting development on the findings of the current study; at what point should one begin teaching relational responding and where should they begin when it comes to developmental disabilities?

The current studies highlight the ability to adapt modern teaching techniques to more traditional ABA methods of teaching. This is very relevant to the teaching of relational responding and higher cognitive skills. Although very successful in teaching specific concepts, DTT approaches do not focus as much on relational comparisons within teaching, for example, majority of ABA assessments place focus on teaching the concept of 'same' yet do not explicitly teach 'different' and assume it is derived, when this is likely not the case, especially when considering learners with developmental delay. However, research in the field of cognitive, educational and developmental psychology has identified the ability to differentiate one stimuli in relation to another extremely important in relation to cognition and higher human functioning (Addyman & Mareschal, 2010). The reoccurring problem in the field of ABA is that program based on the analysis of verbal behaviour do not place any emphasis on teaching difference and explain no way of doing so. It is commonly thought of as too difficult for very early language interventions, however, the current study and many similar previous ones highlight the ability to teach same/different relational responding to pre-school aged typically developing children and ones with a developmental delay (Kilroe et al, 2011; Lyons & Murphy, Under Submission).

Interesting preliminary findings were reported for PEAK; Promoting the Emergence of Advanced Knowledge relational training system (Dixon 2014a, 2014b). This study provides further evidence for the PEAK program as an assessment and training system which can be seen to promote intelligent behaviour, reflected in increased ability scores pre-post interventions (BSRA-3 and PPVT-IV). Participants in these current studies, as in previous

research (Dixon, Whiting, Rowsey & Belisly 2014), show advances on scores after exposure to the PEAK teaching intervention. These findings are in line with previous research examining the effect of DRR on IQ measures in children with learning delays (Cassidy, Roche & Hayes, 2011; O'Toole et al. 2009). The current research also utilises a small n design in comparison to previous work carried out using PEAK which focuses on group comparisons.

As a relatively novel assessment and training procedure, PEAK has not seen much research into patterns of learning and sequence effects to date. The current research provides findings that teaching specific skills within the PEAK Generalisation Module, negate the need to teach all simpler level skills from the PEAK Direct Training Module. These findings could have implications for using PEAK within applied settings where time is valuable and often practitioners need to know where specifically within a training guide they should begin. The results show positive effects for the relationship of targets between PEAK modules and could potentially reduce the need to teach too many lower level targets before moving to more general ones. Further research is needed on these findings with larger sample sizes and possibly using the other PEAK modules to examine for similar effects with the higher cognitive skills. Unfortunately, at the time of the current research, these modules were not available for that research to be conducted. This research highlights the ability of PEAK to be combined with other teaching methods such as fluency teaching tools and the T-IRAP. It has proven to be a flexible behaviour analytic approach to teaching complex skills, such as DRR while focusing on cognition and verbal ability.

In the field of ABA, numerous studies have previously shown that fluent and fast responding are correlated to increased scores on IQ assessments and ability tests (Hayes, 2001, O'Toole et al, 2009). This remains consistent with findings that high performance on IQ tests have been correlated with equally high abilities to show relational responding skills.

One particular study examined the effect of fluent responding of relational skills to see if it impacted participant's performance on IQ measures (Cassidy, Roche & Hayes, 2011). The study carried out relational training with four of eight participants and tested IQ at a follow up assessment of two years later to avoid practice effects, results indicated that those who received relational training had a significant increase in the IQ test in comparison to those who did not and showed no such increase on the IQ test. Similar results have been seen recently for PEAK training, again reiterating the importance of DRR as a skill which impacts and increases IQ and cognitive ability (Dixon, Whiting, Rowsey & Belisly, 2014). Results such as these are very important to the field of ABA as they reveal some of the more core skills can be enhanced by fluency training in relational responding which may result in a more widespread general effect on other skills. Especially when considering the common practice in ABA to teach very specific skills, it may be beneficial to widen the focus to include more generic cognitive skills such as those seen in IQ testing.

In line with previous findings, current results show that the T-IRAP produces faster and more accurate results than table top work can do, especially when considering follow up generalisation and maintenance results (Kilroe et al 2011; Lyons & Murphy, Under Submission). Interestingly, this study also utilised a Precision Teaching approach, RAN, whereby speed of responding and accuracy were seen as necessary components of advanced skills. The findings from this study highlight RAN as more effective in producing fluent responding than traditional DTT. PEAK targets were used for both teaching methods being assessed using RESA; Retention, Endurance, Stability and Application tests (Johnson & Layng, 1996). Despite RAN being taught through table top teaching and T-IRAP through computerised methods, both of these teaching tools focus on fluent responding in terms of speed and accuracy and both show greater maintenance and performance for targets taught at both one month and three month follow up assessments.

This evidence supports previous work on fluency based teaching techniques using RESA tests to assess taught skills. A skill is thought to be fluent when it can be retained without practice, endured over an extended period of time and done so in novel environments (Binder, 1996). One study taught a large group of learners with autism numerous skills to fluency and found at follow up RESA tests were satisfactory with excellent retention seen (Weiss, Fabrizio & Bamond, 2010). Similarly to these results, the current study found that skills taught using the T-IRAP or RAN, both of which prioritise fluency as an overall aim, did show better results on follow up assessment than those taught using table top methods alone. However, in relation to PEAK research, the findings show that PEAK targets and training is readily adaptable to other relational training and fluency teaching tools.

One aspect of the current study worth mentioning was that the participants in study 1 received training on the PEAK table top train/test teaching system prior to using the T-IRAP to teach same/different non-arbitrary relations. While this was the aim for the study in relation to combining PEAK with the T-IRAP as a teaching tool, a direct comparison between the two cannot be established. Future research may teach in the reverse order or two groups separately to control for this. It would enable researchers to determine if PEAK alone, T-IRAP alone or a combination of both is what allowed for relational responding to generalise to the natural environment. With regards to the T-IRAP as a comparison to other measures, such as the RAN in study 3, it should be noted that the IRAP being a computerised tool facilitates faster responding as no manual manipulation of the stimuli are required as is needed for table top work. As table top work requires the researcher to physically move the stimuli, fast response times are limited for the learner.

Future research may also want to consider using bigger sample sizes alongside a wider variety of population samples for novel research such as this. Time constraints within the current study meant that only the small sample size could be used and not all findings

could be followed through thoroughly. A final note would be in relation to the ability scores, the current study utilised two cognitive assessments that would reliably provide an accurate score for the participants with ASD. However, mixed results were seen and as such, future studies could test only using one, more specific IQ assessment or use a control participant with no intervention for pre-post ability testing.

Overall, the findings provide insight into the PEAK relational training program as a method of assessment and teaching for children with and without learning delays. It highlights the successful combination of novel and modern behavioural teaching tools such as PEAK and T-IRAP to more traditional methods of teaching in ABA to achieve more advanced teaching programs that target a more complete range of skills. The current research has provided new and interesting means of teaching PEAK targets and relational responding skills to children with varying learning delays using numerous teaching tools. Future research may expand on this by increasing sample sizes, target numbers and manipulating the order of teaching tools for further insights into addressing complex needs of students with learning delays, an area very advantageous to the field of ABA.

References

Addyman, C., & Mareschal, D. (2010). The perceptual origins of the abstract same/different concept in human infants. *Animal Cognition*, 13, 817-833. DOI:10.1007/s10071-010-0330-0

American Psychiatric Association (2013). *Diagnostic and Statistical Manual of Mental Disorders*. *Fifth Edition*. Washington DC: Author.

Baer, D. M., Wolf, M.M., & Risley, T.R. (1968) Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 1*, 91-97.

Barnes-Holmes, D., Barnes-Holmes, Y., & Cullinan, V. (2000). Relational Frame Theory and Skinner's Verbal Behaviour: A possible synthesis. *The Behaviour Analyst, 23*, 66-84

Barnes, D., McCullagh, P., & Keenan, M. (1990). Equivalence class formation in non-hearing impaired children and hearing impaired children. *Analysis of Verbal Behaviour, 8*, 1-11.

Barthold, CH & Egel, AL. (2001). Stimulus Over-selectivity and Generative Language Instruction for students with autism: an issue that needs to be revisited. *The Behaviour Analyst Today, 2* (1).

Bijou, S.W & Baer, D.M. (1978). Behavior Analysts of Child Development. In Stokes, T.F.& Osnes, P.G. (1989). An Operant Pursuit of Generalisation. *Behaviour Therapy, 20*: 337-335.

Binder, C (1996) Behavioural Fluency: Evolution of a new Paradigm. *The Behaviour Analyst, 19*(2), 163-197.

Binder, C. (1988). Precision teaching: Measuring and attaining exemplary academic achievement. *Education*, July, 12–15

Bishop, S.L., Guthrie, W., Coffing, M., & Lord, C. (2011) Convergent validity of the Mullen Scales of Early Learning and the differential ability scales in children with autism spectrum disorders. *American Journal of Intellectual Disability*. *116* (5), 331-43.

Blumberg, S. J., Bramlett, M. D., Kogan, M. D., Schieve, L. A., Jones, J. R., & Lu, M. C. (2013). Changes in prevalence of parent-reported autism spectrum disorder in school-aged U.S. children: 2007 to 2011–2012. *National Health Statistics Reports*, *65*,1 –7.

Boyle, C.A.,Boulet,S., Schieve, L.A.,Cohen,R.A., Blumberg,S.J., Yeargin-Allsopp, M., & Kogan, M. D. (2011). Trends in the prevalence of developmental disabilities in US children, 1997–2008. In Blumberg, S. J., Bramlett, M. D., Kogan, M. D., Schieve, L. A., Jones, J. R., & Lu, M. C. (2013). Changes in prevalence of parent-reported autism spectrum disorder in school-aged U.S. children: 2007 to 2011–2012. *National Health Statistics Reports*, *65*,1 –7.

Bracken, B. A. (2007) *Bracken School Readiness Assessment, Third Edition*. BSRA-3. Pearson.

Brown, W.H., & Odom, S.L (1994) Strategies and Tactics for promoting generalisation and maintenance of young child's social behaviour. *Research in Developmental Disabilities*, *15* (2), 99-118.

Carrow-Woolfolk, E. (1999). *Comprehensive Assessment of Spoken Language*; *CASL*. Pearson.

Cassidy, S., Roche, B. & Hayes, S.C. (2011). A relational frame intervention to raise intelligence quotients: A pilot study. *The Psychological Record, 61,* 1-26

Cohen, H., Amerine-Dickens, M., & Smith, T. (2006). Early intensive behavioral treatment: replication of the UCLA model in a community setting. *Journal of Development Behaviour Pediatrics*. *27* (2) 145-55

Cowan, R.J., & Allen, K.D. (2007). Using Naturalistic Procedures To Enhance Learning In Individuals With Autism: A Focus On Generalized Teaching Within The School Setting. *Psychology in the Schools*, *44*: 7.

Denckla, M.B & Rudel, R.G. (1976b). Rapid Automatized Naming (R.A.N): dyslexia different from other learning disabilities. *Neuropsychologia*, *14*, 471-79.

Delprato, D.J. (2001). Comparisons of discrete-trial and normalized behavioral language intervention for young children with autism. *Journal of Autism and Developmental Disorders, 31,* 315–325

Dixon, M. R., Belisle, J., Whiting, S. W., & Rowsey, K. E. (2014a). Normative sample of the PEAK relational training system: Direct training module and subsequent comparisons to individuals with autism. *Research in Autism Spectrum Disorders, 8*(11), 1597–1606.

Dixon, M. R. (2014a). *The PEAK Relational Training System module 1: Direct Training*. Carbondale: Shawnee Scientific Press.

Dixon, M. R. (2014b). *The PEAK Relational Training System: Generalization Module*. Carbondale: Shawnee Scientific Press.

Dixon, M.R, Peach, J., & Daar, J. (2014). Using the PEAK Generalisation Module to Teach Skinners Complex Verbal Operants to Children With Autism. *Journal of Applied Behaviour Analysis*, DOI: 10.1002/.373.

Dixon, M. R., Whiting, S. W., Rowsey, K. E., & Belisle, J. (2014) Assessing the Relationship between intelligence and the PEAK relational training system. *Research in Autism Spectrum Disorders*, *8*; 1208-1213.

Dixon, M. R., Carman, J., Tyler, P. A., Whiting, S. W., Enoch, M., & Daar, J. H. (2014b). PEAK relational training system for children with autism and developmental disabilities:

correlations with Peabody picture vocabulary test and assessment reliability. *Journal of Developmental and Physical Disabilities, 26*(5), 603–614.

Dixon, M.R., Belisle, J., Stanley, C., Rowsey, S.W., Daar, J.H., & Szekely, S. (2014). Toward a behavior analysis of complex language: Evaluating the Relationship between PEAK and the VB-MAPP. *Journal of Developmental Physical Disabilities*. DOI: 10.1007/s10882-014-9410-4.

Dunn, L.M., & Dunn, D.M. (2007). *Peabody Picture Vocabulary Test, Fourth edition; PPVT-IV*. Pearson.

Edelstein, B.A. (1989). Generalisation: Terminological, Methodological and Conceptual Issues. *Behaviour Therapy, 20*, 311-324.

Eikeseth, S., Smith, T., Jahr, E., & Eldevik, S. (2007). Outcome for children with autism who began intensive behavioral treatment between ages 4 and 7: A comparison controlled study. *Behavior Modification, 31*, 264–278.

Fabrizio, M. & Moors, A. (2003). Evaluating mastery: Measuring instructional outcomes for children with autism. *European Journal of Behavior Analysis, 4,* 23-26.

Foxx, R. M. (2008). Applied behavior analysis treatment of autism: the state of the art. *Child and Adolescent Psychiatric Clinics of America*, *17*(4), 821–834.

Fowler, S.A. & Baer, D.M. (1981) "Do I have to be good all day?" The timing of delayed rein-forcement as a factor in generalization. *Journal of Applied Behavior Analysis*, *14*, 13-24.

Gamby, T.E. (2007) Remediating generalisation deficits in children with autism. In Edelstein, B.A (1989) Generalisation: Terminological, Methodological and Conceptual Issues. *Behaviour Therapy, 20*, 311-324.

Gould, E., Dixon, D.R., Najdowski, A.C., Smith, M.N & Tarbox, J. (2011) A review of assessments for determining the content of early intensive behavioral intervention programs for autism spectrum disorders. *Research in Autism Spectrum Disorders*, *5*: 990-1002.

Greer, J. (2002) *Designing Teaching Strategies: an Applied Behaviour Analysis systems approach*. San Diego: Academic Press.

Hancock, M. A., Cautilli, J. D., Rosenwasser, B., & Clark, K. (2000). Four tactics for improving behavior analytic services. *The Behavior Analyst Today*, *1*, 35–38.

Haring, T. G., & Breen, C. G. (1992). A peer-mediated social network intervention to enhance the social integration of persons with moderate and severe disabilities. *Journal of Applied Behavior Analysis, 25*, 319-333.

Hayes, S.C., Barnes-Holmes, D., & Roche, B. (2001). *Relational Frame Theory: A Post Skinnerian account of human language and cognition.* New York: Kluwer Academic/Plenum Press.

Heinicke, M.,Carr, J., LeBlanc, L., & Severtson, J. (2010). On the use of fluency training in the behavioral treatment of autism: A commentary. *The Behavior Analyst*, *33*, 53-60

Howlin, P. (1997) Prognosis in Autism: Do specialist treatments affect long term outcomes? *European Child and Adolescent Psychiatry*. *6*, 55-72.

Ivarie, J.J. (1986) Effects of Proficiency rates on later performance of a recall and writing behaviour. *Remedial and special education; 7 (5)*, 25-30.

Johnson, K. (1997). Morningside Academy. *Behavior and Social Issues, 7*, 31 –35. Retrieved from: www./morningsideacademy./org.

Johnson, K. & Layng, T. (1992). Breaking the structuralist barrier: Literacy and numeracy with fluency. *American Psychologist*, *47*, 1475-1490.

Johnson, K. R., & Layng, T. V. J. (1996). On terms and procedures: Fluency. *The Behavior Analyst, 19,* 281-2

Johnson, K & Street, E.M. (2004) *The Morningside Model of Generative Instruction: What It Means to Leave No Child Behind*. Concord, MA: Cambridge Center for Behavioral Studies.

Kanner, L. (1943) Autistic disturbances of affective contact. *Nervous Child 2*: 217–50

Keller, E.S & Schoenfeld, W.N (1950). Principles of Psychology: A systematic text in the science of behavior. In Edelstein, B.A (1989) Generalisation: Terminological, Methodological and Conceptual Issues. *Behaviour Therapy, 20,* 311-324.

Kilroe, H., Murphy, C., & Barnes-Holmes, D. (2011) Using the IRAP computer program and applied behaviour analysis to teach relational responding to children diagnosed with autism. *Unpublished Doctoral Thesis.*

Koegel, L.K., Koegel, R.L., & Carter, C.M. (1998) Pivotal responses and the natural language teaching paradigm. *Seminars in Speech and Language, 19(4),* 355-372.

Keogel, L.K., Keogel R.L., & Ingham, J.S (1986) Programming rapid generalization of correct articulation through self-monitoring procedures. *Journal of Speech and Hearing Disorders, 51*, 24-32

Koegel, L.K., Carter, C.M., & Koegel, R.L. (2003). Teaching children with autism self-initiations as a pivotal response. *Topics in Language Disorders, 23,* 134–145.

Lindsley, O.R. (1971a) Precision Teahcing in Perspective: An Interview. *TEACHING Exceptional Children, 3,* 114-119.

Lindsley, O. R. (1990). Precision teaching: by teachers for children. *Teaching Exceptional Children*, *22*(3), 10–51

Lovass, O. (1977) *The Autistic Child: Language Development through behaviour modification*. New York: Irvington.

Lovaas, O. I., Koegel, R. L., & Schreibman, L. (1979) Stimulus overselectivity in autism: A review of research. *Psychological Bulletin, 86*(6), 1236-1254

Lovas, O.I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. *Journal of Consulting and Clinical Psychology, 55,* 3–9.

Lovaas, O.I (2003) Teaching individuals with developmental delays: Basic intervention techniques. In Love, J. R., Carr, J. E., Almason, S. M., & Petursdottir, A. I. (2009). Early and intensive behavioral intervention for autism: A survey of clinical practices. *Research in Autism Spectrum Disorders, 3,* 421–428.

Love, J. R., Carr, J. E., Almason, S. M., & Petursdottir, A. I. (2009). Early and intensive behavioral intervention for autism: A survey of clinical practices. *Research in Autism Spectrum Disorders, 3,* 421–428.

Lyons, K & Murphy, C (Under submission) Comparing the interactive computerised T-IRAP with Table top procedures in teaching flexibility in relational responding. Does increased relationsal flexibility correspond with a rise in IQ scores in children diagnosed with autism or developmental delay? *Doctoral Thesis*.

Mackay, H. A., Soraci, S. A., Carlin, M. T., Dennis, N. A., & Strawbridge, C. P. (2002). Guiding visual attention during acquisition of matching to-sample. *American Journal on Mental Retardation, 107,* 445-454. Retrieved from http://aaiddjournals. org/loi/ajmr.1

Magiati, I., Charman, T., & Howlin, P. (2007). A two-year prospective follow-up study of community-based early intensive behavioural intervention and specialist nursery provision

for children with autism spectrum disorders. *Journal of Child Psychology and Psychiatry*, *48*, 803–812.

McGee, G.G., Krantz, P.J., Mason, D., & McClannahan, L.E. (1983).A modified incidental-teaching procedure for autistic youth: Acquisition and generalization of receptive object labels. *Journal of Applied Behavior Analysis, 6,* 329–338.

Ming, S. & Stewart, I. (2017). When things are the not the same: A review of research into relations. *Journal of Applied Behaviour Analysis, 9999*.

Murphy, C., Barnes-Holmes, D., & Barnes-Holmes, Y. (2005). Derived manding in children with Autism: Synthesising Skinners Verbal Behaviour and Relational Frame Theory. *Journal of Applied Behaviour Analysis, 38,* 445-462.

Murphy, C., & Barnes-Holmes, D. (2009). Derived more/less relational mands in children diagnosed with autism. *Journal of Applied Behaviour Analysis*, *42*, 253-268.

Myers, S.M. & Johnson, C.P. (2007). Management of children with autism spectrum disorders, *The American Academy of Pediatrics Council on Children With Disabilities*, *120*, 1162-1182

Norton, E.S., & Wolf, M. (2012). Rapid Automatic Naming (RAN) and reading Fluency: Implications for understanding and treatment of reading difficulties. *Annual Review of Psychology, 63;* 427-52.

O‟Toole, C., Barnes-Holmes, D., Murphy, C., O‟Connor, J. & Barnes-Holmes, Y. (2009). Relational Flexibility and Human Intelligence: Extending the remit of Skinner‟s Verbal Behavior. *International Journal of Psychology and Psychological Therapy*, *9*, 1-17

Parsonson, D.S & Baer, D.M (1978) Training generalised improvisation of tools by preschool children. *Journal of Applied Behaviour Analysis, 11,* 363-380.

Partington, J. W. (2008). The Assessment of Basics Language and Learning Skills-Revised: Scoring instructions and IEP development guide. Pleasant Hill, CA: Behavior Analysts

Reed, S.R, Stahmer, A.C, Suhrheinrich, J., & Schreibman, L. (2013) Stimulus Overselectivity in typical development: implications for teaching children with autism. *Journal of Autism Developmental Disorder, 43*(6), 1249-57.

Rehfeldt, R., & Root, S. (2007) Contriving transitive conditioned establishing operations to established derived manding skills in adults with severe developmental disabilities. *Journal of Applied Behaviour Analysis, 40(1),* 105-121.

Reichow, B., & Wolery, M. (2009). Comprehensive synthesis of early intensive behavioral interventions for young children with autism based on the UCLA young autism project model. *Journal of Autism and Developmental Disorders, 39*, 23–41.

Richdale, A.L.,& Schreck, K.A.(2008).Assessment and intervention in autism: A historical perspective. In Gould, E., Dixon, D.R., Najdowski, A.C., Smith, M.N & Tarbox, J. (2011) A review of assessments for determining the content of early intensive behavioral intervention programs for autism spectrum disorders. *Research in Autism Spectrum Disorders*, *5*: 990-1002.

Rosales Ruiz, J.,& Baer, D.M.(1997). Behavioral cusps: A developmental and pragmatic concept for behaviour analysis. *Journal of Applied Behavior Analysis, 30*,533– 544.

Rowsey, K.E., Belisle, J., & Dixon, M.R. (2014) Principal Component Analysis of the PEAK Relational Training System. *Journal of Physical Disabilities.* In Publication.

Sallows, G.O., & Graupner, T.D. (2006) Intensive Behavioural Treatment for children with autism: Four year outcome and predictors. *American Journal of Mental Retardation, 110*, 417-438.

Savage, R., & Frederickson, N. (2005). Evidence of a highly specific relationship between rapid automatic naming of digits and text-reading speed. *Brain and Language, 93*, 152-159.

Sidman, M. (1971). Reading and auditory-visual equivalences. *Journal of Speech and Hearing Research, 14,* 5-13.

Sidman, M. (1994). Equivalence Relations and Behaviour: An Introductory Tutorial. *The Analysis of Verbal Behaviour, 25(1),* 5-17.

Sigafoos, J., Schlosser, R. W., Green, V. A., O'Reilly, M., & Lancioni, G. E. (2008). Communication and social skills assessment. In Gould, E., Dixon, D.R., Najdowski, A.C., Smith, M.N & Tarbox, J. (2011) A review of assessments for determining the content of early intensive behavioral intervention programs for autism spectrum disorders. *Research in Autism Spectrum Disorders, 5*: 990-1002.

Skinner, B.F. (1938). *The Behavior of Organisms*. New York: Appleton-Century

Crofts.

Skinner, B.F (1953). *Science and human behavior*. New York: MacMillan

Skinner, B.F (1957). *Verbal behavior*. New York: Appleton-Century-Crofts.

Sparrow, S.S., & Cicchetti, D, V. (2005). *Vineland Adaptive Behaviour Scales, Second Edition*. Vineland-II. Pearson.

Stokes, T.E & Osnes, P.G (1996) Programming the generalization of children's social behavior. In

Stokes, T.F & Baer, D.M (1977) An implicit technology of generalization. *Journal of Applied Behavior Analysis, 10*, 349-367.

Stokes, T.E. & Osnes, P.G (1989) An Operant Pursuit of Generalisation. *Behaviour Therapy, 20*: 337-335.

Stokes, T.F & Baer, D.M (1977). An implicit technology of generalization. *Journal of Applied Behavior Analysis, 10*, 349-367.

Sundberg, M. L. (2008). *Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP).* Concord, CA: AVB Press.

Sundberg, M. L., & Michael, J. (2001). The value of Skinner's analysis of verbal behavior for teaching children with autism. *Behavior Modification, 25,* 698-724.

Turner, M. A. (1999). Generating novel ideas: Fluency performance in high-functioning and learning-disabled individuals with autism. *The Journal of Child Psychology and Psychiatry and Allied Disciplines, 40,* 189-201

Weiss, M. J., Fabrizio, M. A., & Bamond, M. (2010). Skill Maintenance and Frequency Building: Archival Data from Individuals with Autism Spectrum Disorders. *Journal of Precision Teaching, 5:* 87-99.

Weiss, M.J., Pearson, N., Foley, K. & Pahl, S. (2010) The Importance of Fluency Outcomes in Learners with Autism. *The Behaviour Analyst Today, 11 (4),* 245-252.

Williams, K.T. (2001) *Group Reading Assessment and Diagnostic Evaluation; GRADE*. Pearson.

Williams, K.T. (2007). *Expressive Vocab Test; EVT-2*. Pearson.

Zimmerman, I.L., Steiner, V.G., & Pond, R.E. (2002) *Preschool Language Scales, Fourth Edition; PLS-4*. Pearson.

Appendix 1

Informed Parental Consent Form for Participation in Doctoral Research.

Title: Combining PEAK (Promoting the Emergence of Advanced Knowledge) with Other Teaching Methodologies with Children with and without Learning Delays.

The current research will be conducted by Emma Fawcett, B.A (Hons) Psychology, who is a doctoral student at the Department of Psychology, National University of Ireland, Maynooth, Co. Kildare and can be contacted at emma.fawcett.2012@mumail.ie. The research carried out will be supervised by Dr. Carol Murphy, B.A., Ph.D., B.C.B.A-D. Dr. Murphy is course manager on the Doctorate in Psychological Science at the Department of Psychology, NUI Maynooth, and can be contacted via 01-7086723 or Carol.A.Murphy@nuim.ie.

In agreeing that my child participates in research carried out by a Doctoral student at the National University of Ireland, Maynooth, I, _____, understand the following:

- While conducting the research, both the researcher and the supervisor are responsible for adhering to ethical guidelines that are set by the Psychological Society of Ireland and the Behaviour Analyst Certification Board in any dealings with a child.
- The attached information sheet will provide specific details for me about the procedures to be completed with my child.
- My child's identity will be protected and not provided for any subsequent publication or presentation of the data. The data will be given false names and stored in an encrypted file on the researcher's computer for 5 years, after which it will be permanently deleted.
- My child will have their ability tested using the Bracken School Readiness Assessment; Peabody Picture Vocabulary Test and The Vineland Adaptive Behaviour Rating Scales. The results of these assessments will not be made available to the parents or the school. Should I (parent/carer) request access to the results, I will be asked to make a formal written request and then access will be granted. It will include a formal written letter of advice from both the researcher and the supervisor stating that the test scores should not be used for clinical or important decisions, as the researcher is not qualified to interpret the results for that purpose.
- If I have concerns about my child's participation in the research, I understand that I may refuse consent to participate or I may withdraw consent at any stage throughout the research without any negative consequences for my child or myself.
- Continued consent will be signed by me throughout the research and I can withdraw my child then if I wish to.
- The research study will use table top exercises to run the PEAK program and a computer to run the T-IRAP. The aim is to increase my child's ability to generalise

their learning and perform it fluently. It will be done in line with my child's folder and existing programs.

- If I plan to have my child's IQ tested in the next 6 months for clinical reasons, the assessment for IQ in this research may affect that score for that period only.

I confirm that I have read and understand the accompanying information sheet and that I give permission for my child to participate in this research.

I understand that this research should not be considered as treatment of any description.

Signed:

_____ Participant/Parent

_____ Participant/Parent

_____ Researcher

_____ Date

Please note:

If you have any further questions, please do not hesitate to contact either the researcher or the supervisor on the above contact information.

If during your participation in this study you feel the information and guidelines you were given have been neglected or discarded in any way, or if you are unhappy about the process, please contact the Head of Psychology Department, Andrew Coogan. Email: Andrew.Coogan@nuim.ie. Please be assured that your concerns will be dealt with in a sensitive manner.

Appendix 2

Parent Information Sheet.

Details of researcher

Name: Emma Fawcett B.A Psych;
Doctoral student.

Address: Dublin 15 .

Email: emma.fawcett.2012@mumail.ie

Details of supervisor.

Name: Dr. Carol Murphy B.A., Ph.D., B.C.B.A-D.

Address: Dept. Psychology, NUI Maynooth.

Email: Carol.a.Murphy@nuim.ie

Phone: 01-7086723

Please note that this research should not be considered to be a treatment of any description.

What is the purpose of the research?

Generalisation and fluent responding are important skills for children to develop. It involves being able to expand on skills or information that were taught without being taught again to the child every time at a fast pace that remains stable over time. For example, a child may learn the colour red using balls, but he/she needs to be able to generalise so that 'red' is not just this ball, but a colour – a red car, a red crayon. This skill is often not seen in children diagnosed with Autism. This study aims to answer the following questions:

1: Is the ability of a child to respond in a certain way, which will be measured using a new assessment called PEAK, connected to scores on ability tests for preschool children and children diagnosed autism.

2. Does teaching skills in one PEAK assessment reduce the need to teach ones in another part of the same assessment?

3. Can PEAK assessment programmes be presented in an interactive computerised teaching programme such as the T-IRAP and combined with fluency training in the form of the RAN (Rapid Automatic Naming).

4. Does the skills learned from the PEAK program "transfer" to a fluent level when skills are tested with children with autism in naturalistic or everyday more realistic settings at a follow up stage?

What will the research involve for my child?

Firstly the researcher will carry out an assessments on the child's general cognitive and language ability. The researcher will also do an assessment of the skills the child already has using the PEAK assessment scales. They will assess where the child is on their ability to generalise the skills they know from school. The ability assessments take 20 minutes to run and the PEAK assessments should also take approximately 20-30 minutes. After the assessment the child will be taught the skills they do not already have from the assessment using the PEAK training system and curriculum. The teaching will be done using methods and materials used in the child's everyday learning. After table top training has finished, the T-IRAP and other fluency teaching methods using precision teaching

approach will be carried out on relational skills. After this, final assessments will be done; again repeating the ability assessments and the PEAK assessment scores to see if they change as a result of teaching the child new skills.
Positive reinforcement will be used throughout and frequent breaks will be provided.

When will the research be conducted?

Research will be conducted starting from October 2015 and running no later than February 2017. Assessment and teaching sessions will take place in the school setting in normal school hours with the head teacher present in the room. The sessions will only last 30 minutes and assessment expected to take up to 1 hour, once before the research begins and once after it is done. The session work will be incorporated into the child's already existing folder programs. It is expected that the child will receive up to 35 hours teaching throughout the research.

Where will the research be conducted?

The research will be carried out in the current educational setting classrooms with children diagnosed with Autism. The room will be quiet and suitable for the research to be carried out. Sessions will be conducted during regular program hours (school hours) and will coincide with their current academic or therapeutic routine. No sessions outside of these times or additional services will be provided.
A signed agreement allowing this research has been obtained from the organisation.

What if I don't want my child to participate?

There will be no penalty for not taking part in the research, nor will there be any obligation to do so. If you do consent, your child will be monitored throughout to ensure that he/she is participating voluntarily. They will be asked if they would like to work with the researcher and if they answer 'no', they will not take part that day. The children will be monitored based on their attention and behaviours and will be allowed to stop if they seem bored or distressed at any stage. Please note that you are free to withdraw your consent at any stage of the research. Please contact the researcher on the above details at any stage to do so.

How will my child's data be kept safe?

All data gathered will be stored using pseudonyms. The data will be entered into an encrypted hard drive on Microsoft 'encryption file system'. The data will also be stored on a USB which will be kept under lock and key on the university campus. A Back up of all data will be made weekly and this back up drive will be securely stored by the researcher. This offers a great deal of security to the Hope and the parents of the participants. The collection of the data each day during sessions will be done using pseudonyms and no identifiable information will be provided. It will then be entered into the computer and stored on the encrypted file. The data will be stored for the appropriate amount of time, 5 years, and then be destroyed. The researcher will be the only person with access to the data. The results of the IQ test will not be given to the parents or the school and results are just for research purposes of the current study. They are not for the purpose of clinical or important decisions and should not be interpreted in that way.

Thank you for taking the time to read this information sheet.

Appendix 3

Continued Parental Consent Form

Details of researcher

Name: Emma Fawcett B.A Psych;
Doctoral student.

Address: Dublin 15.

Email: emma.fawcett.2012@mumail.ie

Details of supervisor.

Name: Dr. Carol Murphy B.A., Ph.D., B.C.B.A-D.

Address: Dept. Psychology, NUI Maynooth.
Email: Carol.a.Murphy@nuim.ie
Phone: 01-7086723

We would like to thank you for your cooperation with the research for which you have provided consent for your child to take part in. at this point, we are approximately halfway through the research and would like to make sure you are still comfortable with your child taking part. If you have any concerns please do not hesitate to contact the researcher on the above details. The researcher will do her best to answer any questions or concerns you have and will try to address any issues that may have arisen since the research commenced. Given your child's progress on the research so far, we estimate a further 10 weeks of session will be the time commitment needed to complete the research. As it is difficult to predict each child's actual performance and timeframe, this is an estimation of when we will finish.

If you wish to withdraw consent for your child's participation, please sign below and return this form immediately to the researcher. If you wish to allow your child to continue in the study, you do not need to do anything further.

Please only sign if you wish to WITHDRAW your child from the study.

_____ Participant/Parent

_____ Participant/Parent

_____ Researcher

_____ Date