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Analysing Relational Responding Skills and Verbal Ability in Children with Autism, and Typically-developing Children

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It often takes another's love for us to realise what it is we live for

…I may never have made it here without you

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Abstract

Skinner's (1957) pioneering behavioural account of language identified verbal behaviour as fundamentally functional. This account of language has been the basis for effective teaching programmes for children with developmental disabilities (Sundberg & Michael, 2001). However, despite the well documented efficacy of language-training in applied settings, these programmes have been criticised for producing language that is rigid in nature and not readily generative (McEachin, Smith, & Loovas, 1993). It has been postulated that the reason for this inflexibility of language is due to the lack of focus on 'emergent' (i.e., untrained or derived) language responding (Luciano, et al., 2009). To address this issue, recent research has seen the integration of Skinner's Verbal Behaviour theory with Relational Frame Theory (Hayes, Barnes-Holmes & Roche, 2001), a modern behavioural language theory. A body of research now demonstrates the effective facilitation of derived relational responding in children with developmental disabilities (e.g. Barnes-Holmes & Murphy, 2007). The current research sought to add to RFT literature on the relational responding skills of children with developmental disabilities.

The studies reported in the current thesis were concerned with testing and training relational responding skills using protocol based on RFT (Rehfeldt & Barnes-Holmes, 2009), with two groups of children. Study 1, presented in Chapter 2 of the current thesis, sought to test and train relational responding in accordance with co-ordination and distinction with seven children with autism. Studies 2, 3 and 4, presented in Chapter 3, were concerned with testing the relational responding skills of five typically-developing children. Specifically, Study 2 tested relational responding in accordance with co-ordination and distinction; Study 3 tested

relational responding in accordance with comparison; and Study 4 tested relational responding in accordance with opposition.

A secondary objective of the current research was to assess the potential relationship between relational responding skills and verbal ability, as measured by two standard verbal assessments. Thus, the study assessed each participant's expressive and receptive verbal abilities through the administration of two standardised verbal assessments; the Peabody Picture Vocabulary Test (PPVT-4; Dunn & Dunn, 1997) and the Kaufman Brief Intelligence Test (K-BIT; Kaufman & Kaufman, 2004), respectively. The verbal assessments were conducted with both groups of participants both before and after relational responding testing/training.

The overall aim of the research was thus to, 1) test and train relational responding skills using protocol based on RFT (Rehfeldt & Barnes-Holmes, 2009), with children with autism and typically developing children; 2) to investigate whether higher verbal ability scores correlate with higher relational responding skills; 3) to compare the verbal ability and relational responding skill of children with autism to those of typically developing children, and 4) to investigate whether relational responding training resulted in enhanced verbal ability scores.

The findings of these studies demonstrate the diversity in verbal ability and relational responding skills among typically-developing children and those with autism. Specifically, participants with autism produced very weak performances on both verbal assessments. While all the children with autism reached criterion during co-ordination relations, only one of the seven participants reached criterion for relational responding in accordance with distinction. In comparison, all of the typically developing participants produced average performances on both verbal assessments and reached criterion for all relational frames tested; co-ordination,

distinction, comparison and opposition. These findings, in line with RFT predictions, suggest, that higher verbal ability is correlated with higher relational responding skills. Overall, no significant changes in verbal ability were detected post relational testing/training for any of the participants in the current research. Chapter 4 of the current thesis synthesises the empirical work presented in the preceding chapters and addresses a number of theoretical and clinical issues that arise from this work.

Chapter 1

General Introduction

Human language is typically the bedrock of learning opportunities for most children (Koegel, Koegel, & Carter, 1998). Because language skills are often deficient in individuals with autism, language acquisition and training is a primary aim of relevant educational and learning programmes (Sundberg & Michael, 2001). Applied Behaviour Analysis (ABA) and the underpinning science have contributed substantively to educational programmes for children with autism, including Skinner's *Verbal Behavior* (1957). This contribution has been recognised by organisations outside of behaviour analysis, including: the New York State Department of Health Early Intervention Program (1999); the American Academy of Pediatrics (2001); the Maine Administrators of Services for Children with Disabilities (2000); and Barbaresi, Katusic and Voigt (2006). (For a comprehensive account of the impartial independent reviews of ABA and EIBI treatments for children with autism, see Larsson, 2013).

Skinner's approach to language development was based on relations among behaviour, motivative and discriminative variables, and consequences. In essence, this constituted a 'functional units' approach to language, in which operants (e.g., mands, tacts, interverbals) are explicitly trained in many contexts (Barnes-Holmes & Murphy, 2007). It is not surprising, therefore, that ABA considers functional communication and language as pivotal skills, and the key to reducing undesired behaviour, while enhancing social and academic competencies (Koegel, et al., 1998). The long-term aim of such intensive training is that the child's language should ultimately resemble that of typically-developing peers. With explicit use of reinforcement, children are taught a wide range of communication skills, from reacting to verbal stimuli by following simple instructions, to correct pronunciation, correct grammar and appropriate tone of voice (Sundberg & Michael, 2001). While

there are several versions of this general approach to language training (e.g. Taylor & McDonough, 1996), they share most of the same basic behavioural features from Skinner's theory of language (Sundberg & Michael, 2001).

The set of basic behavioural principles identified in Skinner's early work on language thus proved to have widespread application. However, an approach that involves explicitly training every response could be extremely time consuming and labour intensive (Hernandez, Hanley, Ingvarsson & Tiger, 2007). Overall, the theory did not seem to provide a comprehensive empirical analysis of complex language and cognition (Sundberg & Michael, 2001). Two of the most commonly cited limitations of Skinner's approach include limited generalisation of learned repertoires (McEachin et al., 1993), and little attention to derived learning or the emergence of novel behaviours (Luciano, et al., 2009). An ensuing body of research, pioneered by Sidman (1971), sought to ameliorate these analytic difficulties.

A Three-term Contingency Analysis of Language Generativity

Sidman's (1971) account of stimulus equivalence was first researched and developed through work with individuals with developmental disabilities. His seminal work attempted to establish equivalence relations between written words and pictures, in an effort to train an individual with a developmental delay to read. Sidman (1971, 1977, Sidman & Cresson, 1973) found that, after individuals with developmental disorders and limited language skills were explicitly trained to match dictated names to the corresponding pictures and the pictures to their corresponding printed words, the individuals proved capable of naming the pictures, orally reading the text, and matching words to pictures and pictures to words. These responses were produced in the absence of explicit training, a phenomenon for which a behavioural

explanation had previously been lacking. Sidman (1971, 1977) termed these novel or emergent relations, *equivalence relations,* as the untrained skills seemed to represent symbolic or referential behaviour.

A major difference between Skinner's theory of language and that of Sidman's is encapsulated in the difference between a two- and three-term behavioural relation contingency. The typical two-term contingency as described by Skinner (1957) involves a relation between two events. It specifies either, the antecedent and behaviour (e.g. if the telephone rings then you answer it), or the behaviour and the consequence (e.g. if you answer the phone then you can talk to your friend) in a contingency. However, the three-term contingency offers a slightly more complex relation with respect to three events, in that it specifies all three terms of the contingency: the antecedent, behaviour, and consequence. For example, if the telephone rings (antecedent), and you answer it (behaviour), then you can talk to your friend (consequence). This was the critical advancement from Skinner's approach that Sidman's (1971) work uncovered and expanded on.

According to Sidman et al. (1982), equivalence relations occurs with stimuli that are reflexive, symmetrical and transitive. *Reflexivity* involves the identity matching of a stimulus to itself (e.g. A=A, B=B, C=C). For a relation to be reflexive, it must hold true for each individual stimulus, without differential reinforcement. For example, matching a red block with another red block. *Symmetry* involves the reciprocal relation between a sample stimulus and a comparison. When a sample and a comparison are interchanged, each relation must hold true without explicit training, for the relation to be considered symmetric (e.g. A=B, B=A). For example, saying the word 'car' when a toy car is present. When two relations are directly trained (e.g. A=B and B=C), and a new relation emerges as a result of this training (e.g. A=C),

the emergent relation is called *transitive* (if A=B, and B=C, then A=C). For example, if the spoken word ‘car’ is the same as a toy car, and a toy car is the same as the written word ‘car’, then the spoken word ‘car’ is the same as the written word ‘car’. For equivalence to be demonstrated, it is essential that the three properties of reflexivity, symmetry and transitive are present and that these emerged without a history of direct reinforcement (Sidman, et al., 1982).

Sidman was the first to employ the match-to-sample methodology to establish derived stimulus relations. The match-to-sample task typically consists of training a series of conditional discriminations between arbitrary stimuli. Consider the following equivalence trial. Participants are explicitly trained that stimulus A (reflexivity) is equal to stimulus B (symmetry), then a relation between B and A may also be derived (e.g. if A = B then B = A; transitivity). For Sidman (1994), equivalence relations are stimulus-stimulus relations that arise from contingencies of reinforcement.

However, this explanation of the derived nature of equivalence relations could not readily be explained through the traditional concept of language, which involves explicit reinforcement (Barnes, 1994). That is, unlike traditional methods of teaching new behaviour, explicit reinforcement is not involved in equivalence; hence the emergent nature of this behaviour remains to be explained. In short, the phenomenon of equivalence does not readily emerge from a direct contingency analysis. In response, Sidman (1994) suggested that equivalence is probably a basic stimulus function that is not derivable from more fundamental processes.

Although Sidman (1971) provided the first behavioural account of derived relations, his approach was primarily descriptive. Sidman himself concluded as much: "My own theorizing has been directed not so much at an explanation of

equivalence relations but rather, at the formulation of a descriptive system - a consistent, coherent, and parsimonious way of defining and talking about the observed phenomena" (1994, p. 536). While a precise, coherent description of an empirical phenomenon is important, it is not the same as a functional, behavioral explanation. Attempts to offer the latter have, in behaviour analysis, more recently been driven by Relational Frame Theory, a modern behavioural account of language and cognition (RFT; Hayes, Barnes-Holmes, & Roche, 2001).

RFT: A Modern Behavioural Account of Language

RFT centres fundamentally around the concept of derived relational responding and its role in practically all aspects of human language and cognition. In giving a comprehensive account of how humans can also respond to *arbitrary* stimuli relations as well as non-arbitrary, RFT attempts to provide a contextual, functional and behavioural account of human language and cognition (Hayes, et al., 2001). The theory draws mainly on the concept of derived multiple stimulus relations and a process called *arbitrarily applicable relational responding* (also known as relational framing; see Barnes, 1994). This process, as argued by RFT, underlies many of the basic phenomena that comprise human language and cognition, and is an important basis for linguistic generativity (Barnes-Holmes, McHugh, & Barnes Holmes, 2004).

As demonstrated in Sidman's (1971) early research on stimulus equivalence, most living organisms, when trained, can respond to relations among the physical properties of two or more types of stimuli; the most fundamental type of derived relation. This behaviour is referred to as derived responding (Hayes, et al., 2001) and has been readily demonstrated with different species of animals and birds (e.g.

Kastak & Schusterman, 1994; Wasserman & DeVolder 1993), as well as human participants (Cowley, Green, & Braunling-McMorrow, 1992). According to RFT, this type of relational response is controlled entirely by the non-arbitrary or formal properties of the stimuli (i.e., one stimulus is actually physically different/similar to another), and as such it is not a verbal process. In contrast, RFT argues that arbitrarily applicable relational responding is a *verbal* process, because it is under the control of contextual features beyond the formal properties of the related stimuli or events. Such relations are arbitrarily applied because they are not based on physical features of the related stimuli.

RFT suggest that human verbal abilities allow them to respond to relations among stimuli based on contextual cues. Such relational instructional control is more commonly known as rule-governed behaviour. According to RFT, rule following, like all other relational framing, is built upon generalised classes of operant behaviour. In particular, rule following depends upon an individual's ability to respond in accordance with the relation between the words stated in a rule, and the relation between those words and other stimuli in the environment (Rehfeldt & Barnes-Holmes, 2009). The simplest form of rule-governed behaviour involves behaving with respect to a rule that contains a single if-then relation (Barnes-Holmes, O'Hora, et al., 2001).

According to RFT, relational instructional control is acquired by teaching many examples of particular instructions, each of which is different, but where each includes the same relational cues. That is, across many different instances of reinforced instruction following, the particular antecedents, consequences, and behaviours described in the rules change, but the contextual cues remain constant and the contingencies that the rules describe are always followed through. For

example, one might teach compliance with rules such as “If the red light is on, then it’s time for work,” “If the green light is on, then it’s time to play”. On each occasion, the antecedent and behaviour may change, but the if-then contextual cues remain constant.

Initially, acquired behaviours are under direct discriminative control (i.e. they are not relational). However, after sufficient exemplars have been trained, a generalised class forms. Moreover, this contextual control is likely to occur with combinations of antecedents and behaviours that have never before been presented (Rehfeldt & Barnes-Holmes, 2009). For RFT, this contextually controlled relational responding results from a history of multiple exemplars from early natural language interactions (Luciano et al., 2009). The important feature of rule-governed behaviour is that it is *relational* (i.e. not directly trained), and requires the skill of generalisation in order to follow novel instructions. Therefore, when training relational instructional control, the goal is not for the learner to acquire or memorise many individual instructions. Rather, the goal is for the learner to acquire a generalised ability to follow novel instructions.

Similar to Sidman’s stimulus equivalence, there are three defining properties of relational framing: mutual entailment, combinatorial entailment and the transfer/transformation of stimulus functions (Hayes, et al., 2001). *Mutual entailment* describes the relations that occur between two stimuli or events. For example, if stimulus A is explicitly established as equal to stimulus B, then a language-able human may also derive a relation between B and A (e.g. if A = B then B = A). However, not all mutual entailed relations are equivalent, or co-ordinated. Consider a trained relation in which A>B, then the correct derivation of the B-A relation is B<A (not B=A). *Combinatorial entailment* describes relations that occur among three or

more stimuli. For example, if a language-able human is explicitly trained in the relations A≥B and B≥C, then the relations A≥C and C≤A can be derived. The final defining feature of a relational frame is the transfer or *transformation of stimulus functions*. Briefly, if humans are taught that stimulus A, B and C are co-ordinated (i.e. the same), functions taught for one of the stimuli will emerge for the other stimuli without direct reinforcement.

What is crucial for RFT is the fact that stimulus functions can be changed on the basis of derived relations (Barnes & Keenan, 1993; Dymond & Barnes, 1995, 1996). Consider the following real life example. If an individual is explicitly taught to relate B as opposite to A, and A is then given a conditioned punishing function, RFT would predict that B would acquire a derived reinforcing function, based on the opposition relation with A. Numerous RTF studies have demonstrated transformation of stimulus functions (e.g., Barnes & Keenan, 1993; Dymond & Barnes, 1995, 1996). This very specific transformation of stimulus functions based upon derived stimulus relations is a critical feature of relational framing, and lies at the very heart of RFT.

Hayes (1989) argued that equivalence is only one of a number of different types of derived stimulus relations. RFT extends Sidman's concept of derived equivalence by identifying other types of derived relations, often referred to collectively as multiple stimulus relations. RFT thus suggests that an understanding of these other types of relations, and their impact on the psychological functions of stimuli, is also vitally important to a comprehensive theory of language and cognition (Hayes & Barnes, 1997). It is through this extensive analysis of derived relations that RFT is now leading to empirical work on such phenomena as analogy, storytelling, metaphor, deception, humour and perspective-taking (Barnes-Holmes,

McHugh, & Barnes Holmes, 2004). The existing empirical evidence on RFT has identified many different relational frames including co-ordination, distinction, comparison and opposition (Rehfeldt & Barnes-Holmes, 2009).

The Relational Frames of Co-ordination, Distinction, Comparison and Opposition

Co-ordination. The relational frame of co-ordination is the most basic frame that infants come into contact with through natural early language interactions. Responding in accordance with the frame of co-ordination is believed to form the basis of all other relational frames (Hayes, Fox, et al., 2001). Frames of co-ordination establish what are otherwise known as equivalence classes (A is the same as B) and include other derived relations of similarity and sameness. The following example of co-ordination was described by Luciano and colleagues (2009); if a learner is told 'A is the same as B, and B is the same as C', the result of this instruction is that the learner should be able to derive the mutually entailed but untrained relations; 'B is the same as A' and 'C is the same as B'. Additionally, the following relations known as combinatorial entailed relations should emerge, 'A is the same as C' and 'C is the same as A'.

Consider the following real life example of a young child's establishment of co-ordination relations through language interactions with their primary caregiver. If the caregiver shows the learner a toy such as a car, the caregiver will apply the label or word "car" (object-sound relation), and later the learner's responses to the car (such as pointing) when the object is named will be reinforced (sound-object). Similar explicit reinforcement will occur across multiple examples of different types of objects in the learner's environment on a day to day basis. If the learner is then

asked, “What is it?” while the caregiver holds up the car, and the learner and the learner says “car”, this will then be reinforced by the caregiver through verbal praise, clapping etc. Such a history of MET establishes that in certain contexts the training of object-name relations will result in the derivation of name-objects relations (and vice versa). That is, the MET history results in the emergence of a type of generalised bi-directional responding that can be applied to any new object and name, and it is controlled by the presence of specific contextual cues (e.g. “What is it?”).

There are numerous studies that demonstrate the establishment of co-ordination relations in developmentally delayed populations (e.g. Carr, Wilkinson, Blackman, & McIlvane, 2000; O’Connor, Rafferty, Barnes-Holmes, & Barnes, 2009). There has been further evidence to suggest that not only are co-ordination relations the basis of more advanced relational responding, but that they correlate with verbal ability. For example, Devany and colleagues (1986) compared the co-ordination performances of typically developing preschoolers, developmentally delayed children with age-appropriate verbal abilities and developmentally delayed children with limited verbal abilities.

The results of their study indicated that all of the verbally-able children (both typically developing and developmentally delayed) readily demonstrated co-ordination relations. In comparison, none of the children with limited verbal abilities readily demonstrated co-ordination relations. Furthermore, O’Connor, et al. (2009) conducted research involving 15 participants with a diagnosis of ASD and varying levels of verbal ability and three typically developing children. The results of their work indicated that the co-ordination performances of both groups of participants were influenced by verbal ability.

Distinction. Once co-ordination relations are established, the next relational frame believed to emerge is distinction (Hayes, Fox, et al., 2001). Responding in accordance with distinction involves applying this relational frame along a particular dimension by arbitrarily applying the relational cue 'is different from'. Although the relevant dimension of differentiation is not directly specified, one can conclude that two stimuli are somehow different (Luciano et al., 2009). For example, if A is different to B, B must be different to A, although you do not know how or what differs between them.

Comparison. Comparative relations involve responding to one event in terms of a quantitative or qualitative relation along a specified dimension with another event. Comparative frames can be divided into specific sub-types, such as bigger-smaller, brightest-darkest and so on. The different types are, in part, defined by the dimension along which the relation applies (e.g. size, colour or speed). Comparative frames can also involve quantification of the dimension, for the example 'A is worth twice as much as B, and B is worth twice as much as C' (Hayes et al., 2001).

In a study by Barnes-Holmes, Barnes-Holmes, Smeets, Strand and Friman (2004), comparison relations were established as more-than and less-then with three young children. The children were presented with a basic problem solving task that involved two or three identically sized coins. On each trial, the experimenter described how the coins compared to one another in terms of their value, and the child was asked to pick the coin that would "buy as many sweets as possible". All the participants failed the baseline test. Following interventions of testing and training based on RFT across multiple stimulus sets, the participants successfully

passed tests across increasingly complex patterns of relational responding. All generalisation tests were also passed (Barnes-Holmes et al., 2004).

In a follow up study (Berens & Hayes, 2007) the efficacy of MET training in relation to forming comparative relations in the form of arbitrary relational responding to more-than and less-than was demonstrated. The researchers found that comparative relations were established in all participants, and it was successfully demonstrated that these skills generalised across stimuli and trial types. Developmentally, frames of co-ordination are most likely established, at least to some extent, prior to the emergence of opposition relations (Lipkens, Hayes, & Hayes, 1993).

Opposition. The relational frame of opposition involves applying the relational cue 'is the opposite of' or equivalent along a contextual cue that specifies a specific dimension (e.g. temperature, size, value). For example, if A is opposite to B and B is opposite to C, then A and C are the same. The relational frame of opposition was established in young children in research reported by Barnes-Holmes, Barnes-Holmes, and Smeets (2004). This study was the first ever attempt to generate repertoires of relational responding in accordance with opposite, as generalised operant behaviour in three young children. All the children failed the baseline tests of a problem solving task. The tasks involved the researchers presenting the children with identically sized coins and giving instructions such as "This coin buys many sweets, and this is the opposite to this coin, which would you take to buy as many sweets as possible?" Following training interventions as suggested by RFT (including training across different examples of stimulus sets and testing with novel stimuli), specific patterns of relational responding in accordance to opposite were established among participants.

Application of RFT's Account of Language

As outlined above, RFT explains linguistic generativity in terms of learned contextually controlled relational responding across numerous relational frames, referred to as relational framing. Typically-developing children learn relational framing through natural language interactions during which they are exposed to contingencies that establish these response patterns (Lipkens, Hayes, & Hayes, 1993; Luciano, Gómez, & Rodríguez, 2007). However, children with ASD do not easily learn this key form of responding (e.g., Rehfeldt, Dillen, Ziomek, & Kowalchuk, 2007). In combining Skinner's work with RFT, researchers have sought to provide a means of building on effective existing tools to establish functional language skills by introducing a conceptual and practical framework for the establishment of more complex, generative properties of human language.

Such derived learning avoids the necessity to train learners in numerous contexts and reduce the need to use high levels of reinforcement across numerous training trials (O'Toole, Barnes-Holmes, Murphy, O'Connor, & Barnes-Holmes, 2009). Indeed, much recent research has demonstrated the efficacy of incorporating RFT into early language training for children with developmental disabilities, such as autism (e.g. Murphy & Barnes-Holmes, 2009; Murphy & Barnes-Holmes 2006; Rosales & Rehfeldt, 2007). A number of studies have successfully used RFT to teach various language skills to individuals with developmental disabilities.

Specifically, recent behavioural research has sought to develop procedures for establishing generative manding with children with autism and with adults with learning impairments. Results of a study by Murphy, Barnes-Holmes and Barnes-Holmes (2005) showed that all seven participants with diagnoses of autism successfully demonstrated derived manding. This study was the first clear

demonstration of a derived or generative form of one of Skinner's (1957) verbal operants with children with autism. A number of studies have built upon this work, highlighting the utility of RFT and its potential in training derived learning (e.g. Murphy & Barnes-Holmes, 2009; Murphy & Barnes-Holmes 2006; Rosales & Rehfeldt, 2007).

Alongside this applied research, Rehfeldt and Barnes-Holmes (2009) were the first to outline a comprehensive set of applied behaviour analytic training approaches for language and cognition that directly target the establishment of derived learning in individuals with autism. This work represents a significant advancement within behaviour analysis, bringing together research that is reasonably well-known (e.g., Barnes, 1994; Hayes, Barnes-Holmes, & Roche, 2001) and advancements in the psychology of language (e.g., Murphy & Barnes-Holmes, 2006). Such research has clear implications for the design and implementation of RFT-based educational programmes that seek to facilitate derived learning in children with developmental disabilities. This approach to teaching language appears to provide a means to establish a broader more flexible repertoire of language with children who typically show rigidity in verbal responding (Barnes-Holmes & Murphy, 2007). As behavioural researchers add to the traditional ABA approach to teaching functional language, it has become a reasonable possibility that behavioural psychology could successfully and empirically begin to explain the complexities of human language and cognition.

More recently, it has become apparent that flexibility and generativity in language skills is vital to a more fluent and comprehensive understanding of human language. Flexibility and generativity are developed through a focus on 'emergent' (i.e., untrained or derived) language responding (Barnes-Holmes & Murphy, 2007).

Ideally, therefore, language training programs should seek to develop more advanced techniques that serve to establish appropriate responses in the absence of explicit training (Barnes-Holmes & Murphy, 2007). Luciano et al. (2009) have argued that language interventions programmes should incorporate training in bi-directional stimulus relations, MET and testing on novel stimulus sets, because these comprise the roots of verbal behaviour and the basic repertoires for generalisation. This view has been gaining momentum among behaviour analytic researchers inspiring much research in the area (e.g. Berens & Hayes, 2007; Murphy & Barnes-Holmes, 2009; O'Connor, et al., 2009).

Link Between RFT And Verbal Ability

As mentioned previously in this chapter, a number of researchers have demonstrated a correlation between relational responding and verbal ability (e.g. Devany et al., 1986; O'Connor, et al., 2009). A subsequent replication of the study by Devany and colleagues (1986) provided further evidence of the importance of conditional discrimination abilities to relational responding and verbal ability. In research by Peláez, Gewirtz, Sanchez, and Mahabir (2000), nine normally developing infants, aged twenty-one to twenty-five months, were assessed on the Receptive-Expressive Emergent Language Scale (REEL-2) and then exposed to a series of visual-visual conditional discriminations. These involved matching animal-like figures presented in a match-to-sample (MTS) training format.

There were four conditional discriminations involved in the study: if A then B; if A then C; if D then E; and if D then F. The trained relations were A-B, A-C, D-E, and D-F. All of the children readily demonstrated the target conditional discriminations and eight of the children demonstrated transitivity (B-C and E-F);

however, five performed below chance on the symmetry tests (for example, B-A and F-D). As expected, there was a significant negative correlation between the number of training trials and the children's language competence (i.e., higher verbal ability means less relational training). These findings highlighted the relationship between the level of explicit training necessary for relational responding and verbal competence. Furthermore, these findings suggested some degree of difference between the various component skills; reflexivity, symmetry and transitivity, within co-ordination relations.

We know from the RFT research to date that establishing a history of derived relational responding in individuals with a variety of learning challenges is an effective and efficient means of establishing the prerequisites of such educationally relevant skills as reading and spelling (Hanna, de Souza, de Rose, & Fonseca, 2004), recognising names and faces of caregivers (Cowley, Green, & Braunling-McMorrow, 1992), requesting preferred items (Rosales & Rehfeldt, 2007), and understanding basic numerical concepts (Lynch & Cuvo, 1995), to name a few. Thus, the incorporation of a programme based on derived stimulus relations into the learning curriculum of individuals with developmental disabilities would seem to hold great promise in helping such individuals acquire functional and meaningful goals.

The Current Research

While many assessments of verbal behaviour, such as those that look for novel responding and response generalisation, imply that participants require the ability to derive relations among stimuli (e.g., Sundberg, 2008), direct testing of relational responding abilities is not yet typical in applied behaviour analytic

educational programmes. As a result, many questions are still to be empirically answered. The current study questioned the relationship between existing verbal skills and the ability to relationally respond, and the impact of subsequent relational training on verbal ability.

Specifically, the research sought to assess the relationship between verbal ability and relational responding skills with two groups of children; children with autism and typically developing children. Participant's verbal ability was assessed on two standardised verbal assessment tests; the Peabody Picture Vocabulary Test (PPVT-4; Dunn & Dunn, 1997) and the Kaufman Brief Intelligence Test (K-BIT; Kaufman & Kaufman, 2004). Relational responding was then assessed and trained using published standardised protocols (Rehfeldt & Barnes-Holmes, 2009) for the relational frames of co-ordination and distinction. The additional relational frames of comparison and opposition were assessed with the group of typically developing children. The relationship between participants' verbal ability (as measured by the verbal assessments) and relational responding skills (as measured by protocol based on RFT) was investigated and compared within and between participants. The study also assessed the potential impact of subsequent testing/training of relational responding on participant's verbal ability. Putative changes in verbal ability were investigated by re-administering the verbal assessments, post relational responding training.

The aim of the research was thus to, 1) test and train relational responding skills using protocol based on RFT (Rehfeldt & Barnes-Holmes, 2009), with children with autism and typically developing children; 2) to investigate whether higher verbal ability scores (as measured by two standard verbal assessments) correlate with higher relational responding skills; 3) to compare the verbal ability and relational

responding skills of children with autism to those of typically developing children, and 4) to investigate whether relational responding testing/training resulted in enhanced verbal ability scores (as measured by re-administration of the verbal assessments).

Chapter 2: Study 1

Testing and Training Relational Responding in Accordance with Co-ordination and Distinction in Children with Autism

Method

Participants

A total of seven male children, all independently diagnosed with moderate autism by an independent psychologist, participated in Study 1. All were enrolled full-time in a special needs school in Dublin, Ireland. Their ages ranged from 10 years, 5 months to 13 years. Four of the boys were non-vocal, while the remaining three children displayed very limited vocal abilities.

Table 1

Details of participants involved in Study 1

Participant	Age (Years/Months)	Vocal/Non-vocal
1	10/5	Vocal
2	13/0	Non-vocal
3	9/5	Non-vocal
4	11/8	Vocal
5	12/9	Non-vocal
6	12/10	Vocal
7	11/6	Non-vocal

Ethical Considerations

All behavioural procedures and assessments were conducted by the researcher, under the supervision of a fully qualified Board Certified Behaviour Analyst (BCBA). Assessments were conducted with due regard for Responsibility for Competence and related recommendations listed (p.2) in the Code of Good Practice for Psychological Testing (British Psychological Association [BPS], 2010; and in accordance with Principles for the use of Published Psychological Testing in Research (BPS, 2005). In addition, all aspects of the administration of the PPVT and the K-BIT adhered to the recommendations of the individual assessment tool. In general, strong ethical consideration was given to the fact that all participants were

under the age of 18 years and had a diagnosis of autism. The primary ethical issues of concern to Study 1 are outlined below.

Informed Voluntary Consent. An information sheet (see Appendix 1) and an informed consent form (Appendix 2) were delivered to the parents/guardian of all potential participants. Only those children whose parents/guardian returned a signed consent form were selected to participate. The parent/guardian of each participant was also provided with an information sheet explaining the background, rationale and objectives of the research, a copy of which they retained for their records. Parents/guardians were informed via the informed consent form and information sheet that if they wished to contact the researcher with regard to any concerns they may have about their child's participation they may do this at any stage. Parents/guardians were also assured that all information relating to their children acquired throughout the research would not be shared with a third party and that the identity of each participant would remain confidential. Pseudonyms were used in all aspects of the research to protect the identity of participants and their parents/guardians.

Continued Participant Assent. Bearing in mind possible constraints pertaining to minors with autism, direct assent was sought from each participant before the commencement of each session, using an appropriate mode of communication for each participant (i.e. sign language, Picture Exchange Communication System; PECS, or appropriate vocals familiar to the participant). If the participant expressed a wish or otherwise indicated that he did not want to work with the researcher, the planned session did not occur. Participants' behaviours were monitored for signs of distress or boredom (e.g. crying, excessive yawning, or increased problem behaviour) and all trials were terminated at once if distress was

evident. If a participant indicated that he did not want to work with the researcher on three consecutive occasions, participation was terminated.

Parent-Researcher Communication. On-going correspondence with parents/guardians kept them informed of their child's participation status, and on each correspondence parents were encouraged to contact the researcher with any questions or concerns relating to their child's participation. The verbal assessment scores were not made available to parties other than the researcher as they were collected for research purposes only and would not be used to direct clinical decisions regarding participants. In accordance with the guidelines set out by the APA (APA, 2000) individual results from the PPVT and the K-BIT were not made freely available to either the school or parents because doing so may result in clinical decisions being made based upon them. It was not the intention of this research project to guide any clinical or teaching decisions. If a parent requested access to the test results, a formal written request was required (in accordance with current Freedom of Information legislation). Access was always accompanied by formal written advice from the researcher and class supervisor that the test scores should not be used to guide clinical or other important decisions because the researcher was insufficiently experienced to interpret test results for this purpose.

Setting

All experimental trials occurred at each participant's desk in his usual classroom. All sessions were 20 minutes in length and spanned three to four days per week, in a manner that was similar to the teaching sessions of each participant's normal school work schedule.

Materials

Study 1 involved two types of materials. Two standardised measures were used to assess participants' verbal abilities. Specifically, the Peabody Picture Vocabulary Test (PPVT-4, Form A; Dunn & Dunn, 1997) was used to assess *receptive* verbal ability. For instance, participants were shown a page of four pictures (e.g. a baby, a car, a fish and sweets) and were asked: "Put your finger on the picture that shows the baby". The Kaufman Brief Intelligence Test (K-BIT; Kaufman & Kaufman, 2004) was used to assess *expressive* verbal ability. For example, participants were shown a picture of a bed and asked: "What is this?" Scoring of each measure was completed by pen and paper on standardised record sheets.

A series of 2x4 inch laminated colour and picture flashcards were specifically made to test and train relational responding in Study 1. There was a total of 28 colour flashcards; two duplicates of 14 different colours. There was a total of 60 picture flashcards; three duplicates of 20 different cards that presented a picture of a common item (e.g. a tractor, a car, a dog, a cat, a house, etc; see Figure 1). Scoring of correct and incorrect responding based on selection of the flashcards was recorded by pen and paper on tailor-made scoring sheets.

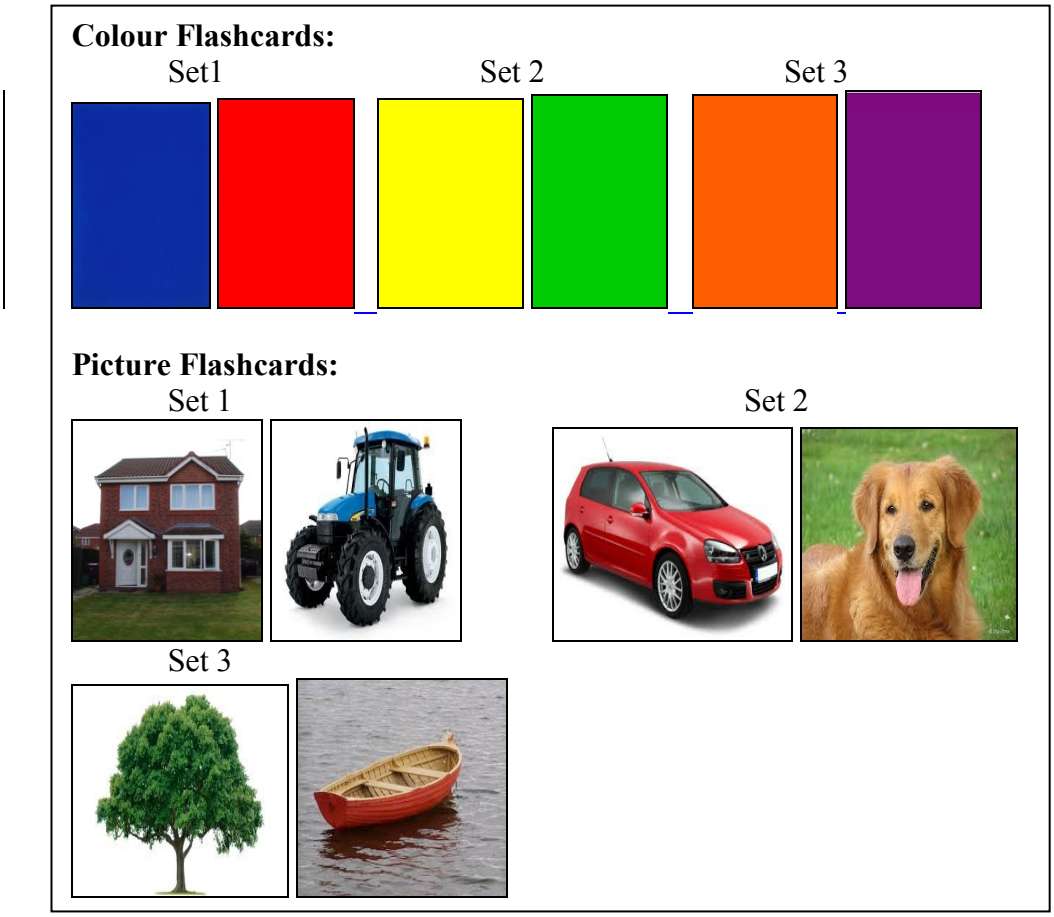

Figure 1: Example sets of colour and picture flashcards for testing/training co-ordination and distinction relations in Study 1.

Experimental Sequence

There were eight stages in Study 1 (see Figure 2). The basic sequence involved the administration of the verbal assessments in Stage 1. The relational testing and training occurred across Stages 2-7. Stage 2 focused on non-arbitrary co-ordination relations, while Stage 3 focused on non-arbitrary distinction relations. Stage 4 was a combination of the two previous stages with a joint test of non-arbitrary co-ordination and distinction relations. Stage 5 focused on arbitrary distinction relations. Stage 6 focused on non-arbitrary co-ordination relations and arbitrary distinction relations, while Stage 7 was largely similar but included

combinatorial entailment. The verbal assessments were re-administered in Stage 8 to determine the possible impact of the relational training and testing from pre to post. The number of stages completed by each participant depended upon his individual performance at each stage.

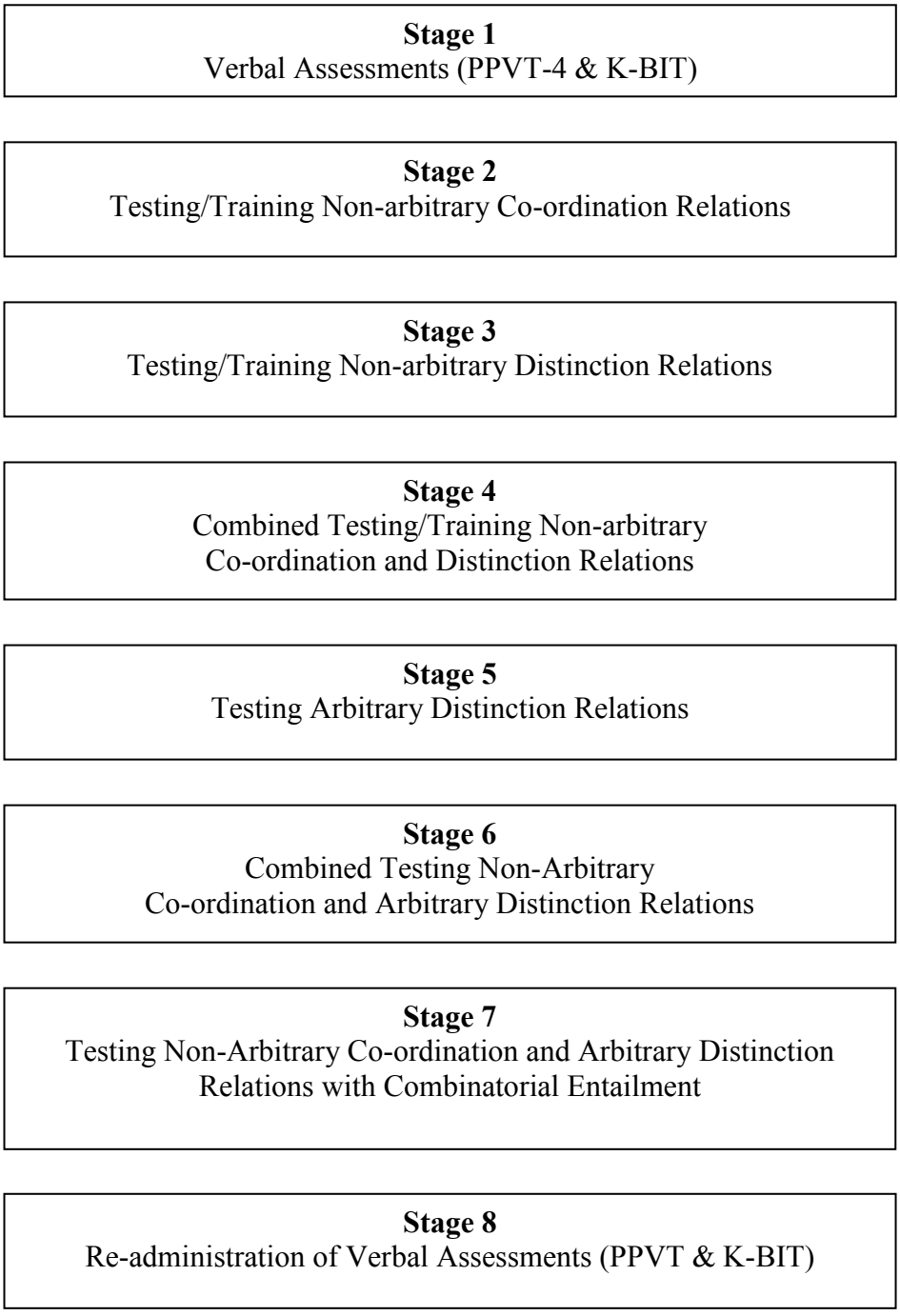

Figure 2: Experimental sequence employed in Study 1.

Corrective Feedback

No feedback was provided for correct or incorrect responding on either of the standardised verbal assessments, although all participants received intermittent reinforcement in the form of verbal praise for good attending. During the relational *test* trials, positive reinforcement (verbal praise) for good attending was provided consistently and non-contingently, but no corrective feedback was provided. During relational *training* trials, similar contingencies were in place for attending, but positive reinforcement in the form of verbal praise and a tangible item was also delivered for correct responding, along with corrective feedback, in the form of modelling the correct response for incorrect responding. The specific contingencies operated with each child were, as much as possible, aligned with that child's other learning programmes. These generally took the form of intermittent positive reinforcement for on-task behaviour.

Procedure

Stage 1: Verbal assessments. The PPVT was presented first as an assessment of receptive verbal ability. The measure is divided into 19 test sets of 12 test-trials, generating a total of 228 test-trials. The test sets are of consecutively increasing complexity. As standard practice, participants proceeded through the test sets until they scored 8 or more errors in any one test set, or until all 19 sets had been completed. The PPVT was always presented in a single first session.

In the following session of Stage 1, the K-BIT assessed participants' expressive verbal ability. The K-BIT is divided into three sections (expressive vocabulary, definitions and matrices). Each section is divided into sets of 5 trials. Participants engaged with each section, starting with expressive vocabulary, moving

on to definitions and finally matrices, until they scored 5 errors in any one set, or until the section was complete. This continued until all sections were complete or until no further progress could be made. The K-BIT was always completed in the second session.

Relational testing/training: Stages 2-7. Several recurrent patterns guided the testing/training of the frames of co-ordination and distinction. 1. Trials were always presented in blocks of 20. Consider the following mutually entailed test trial involving co-ordination relations. A flashcard of a house and one of a tractor were placed on the desk in front of the participant as two comparison stimuli. The participant was handed a third flashcard of an identical house (the sample stimulus) and instructed: "Match same". A correct response involved the participant placing the sample on top of the correct (i.e. same) comparison. The location of the correct comparison stimulus was counterbalanced across trials. 2. Each frame was first tested/trained in non-arbitrary form. Thereafter, only the frame of distinction was tested/trained in arbitrary form. 3. Non-arbitrary trials always tested mutual entailment, while arbitrary trials, at different stages, tested both mutual and combinatorial entailment (see experimental sequences). 4. Each frame was first tested with an 80% overall accuracy criterion**,** trained thereafter (if necessary) to 80% accuracy, re-tested (if training had been required), tested on a single novel stimulus set (whether or not the first test was passed), and finally tested in randomised fashion. Each randomised test involved presenting a novel set of flashcards, at random, on every trial (i.e. 20 novel stimuli sets). If a participant failed to pass a test, the next planned test (i.e. re-test, novel test, randomised test or next relational frame test, as appropriate) was not presented. Instead, the participant was provided with training until criterion was reached. While novel testing was primarily

in place for when training on the first stimulus set was required, it was used throughout testing as good practise, whether or not training was required. 5. Non-arbitrary trials were always first tested using the colour flashcards and tested again using the picture flashcards in order to test any increased complexity of responding. Arbitrary trials were tested using picture flashcards only. 6. Both colour and picture flashcards were presented in sets of two (see Figure 1). For example, non-arbitrary co-ordination was initially tested using colour set one (i.e. blue and red flashcards). If a novel test was presented, which only occurred if training was required; colour set two was used (i.e. yellow and green flashcards). Subsequent novel tests used colour Set 3, followed by Set 4, and so on until criterion was reached and no further novel tests were required. Thus, the number of stimulus sets presented was depended on how often a participant returned to novel testing. The same procedure was repeated with picture flashcards. 7. The number of stages completed by each participant depended upon his individual performance at each stage and was, in some cases, also constrained by the classroom teacher and the confines of the research time-frame.

Stage 2: Testing/training non-arbitrary co-ordination relations. Consistent with the general sequence noted above, non-arbitrary co-ordination relations were first tested and were only trained if necessary. Testing/training first occurred with colour flashcards, with the same procedure then repeated with picture flashcards. Non-arbitrary co-ordination trials involved the presentation of two non-identical flashcards (e.g. blue and red) as comparison stimuli. The participant was then handed a third sample flashcard that was identical to one of the comparisons and was asked to: “Match same” by placing the sample on top of the correct (i.e. same) comparison. A match was recorded as a correct response, while failure to match correctly or to respond within 10 secs of the instruction were both recorded as incorrect responses.

Participants who passed the non-arbitrary co-ordination test with colours were tested on a novel stimulus set, and then tested in randomised fashion. The procedure was then repeated with the picture flashcards. Participants who did not pass a test were immediately provided with training on the test stimulus set. Training trials were identical to test trials, except that corrective feedback in the form of correct response modelling was provided after each incorrect response. Training continued until the 80% criterion was reached and the failed test was repeated with a novel set. This testing-training pattern continued until participants had passed all non-arbitrary co-ordination tests with colour and picture flashcards.

Stage 3: Testing/training non-arbitrary distinction relations. Consistent with the general sequence noted above, non-arbitrary distinction relations were first tested and were only trained if necessary. Testing/training first occurred with colour flashcards, with the same procedure then repeated with picture flashcards. Similar to co-ordination trials, non-arbitrary distinction trials involved the presentation of two non-identical flashcards (e.g. red and blue) as comparison stimuli. A third sample flashcard that was identical to one of the comparisons was then presented and participants were asked: "Match different" by placing the sample on top of the correct (i.e. different) comparison. A match was recorded as a correct response, while failure to match correctly or to respond within 10 secs of the instruction were both recorded as incorrect responses. Participants who passed the non-arbitrary distinction test were tested on a novel stimulus set and then tested in randomised fashion, all involving colour cards. The procedure was then immediately replicated using the picture flashcards. Participants who did not pass a test were immediately provided with training. This testing-training pattern continued until participants had passed all non-arbitrary distinction tests with colour and picture flashcards.

Stage 4: Combined testing/training non-arbitrary co-ordination and distinction relations. Stage 4 involved an amalgamation of the co-ordination and distinction trials from Stages 2 and 3, respectively. Testing/training occurred with picture flashcards only. The combined test comprised a block of 20 mixed trials; 10 co-ordination trials and 10 distinction trials, each conducted in a manner that was identical to the previous stage. Participants who passed the combined test were then tested on a novel stimulus set, followed by a randomised test. Participants who did not pass a test were immediately exposed to training. This testing-training pattern continued until participants had passed the combined non-arbitrary co-ordination and distinction tests.

Stage 5: Testing arbitrary distinction relations. Arbitrary distinction trials involved the presentation of two identical flashcards (e.g. two buses) as comparison stimuli. The participant was then shown a third sample flashcard that was identical to both of the comparisons and instructed to pretend that it was the 'same' as one of the comparisons and 'different' to the other comparison. The participant was then handed the sample flashcard and was asked: "Match different" by placing the sample on top of the correct (i.e. 'different') comparison. Once participants passed the arbitrary distinction test were tested on a novel stimulus set, and then tested in randomised fashion. No participants required training at this stage.

Stage 6: Combined testing of non-arbitrary co-ordination and arbitrary distinction relations. Stage 6 involved an amalgamation of an adapted non-arbitrary co-ordination trial from Stage 4 and arbitrary distinction trials from Stage 5. The combined test comprised of a block of 20 randomly mixed trials; 10 non-arbitrary co-ordination trials and 10 arbitrary distinction trials. Both of these trial-types were identical to the trials presented in the two previous stages. Once participants passed

the combined test, a novel test and a randomised test, they proceeded immediately to Stage 7. No participants required training at this stage.

Stage 7: Combined testing of non-arbitrary co-ordination and arbitrary distinction relations with combinatorial entailment. Stage 7 was identical in part to Stage 6, except for the addition of a question that tested combinatorial entailment presented at the end of each trial. Thus the combined test with combinatorial entailment comprised of a block of 40 trails. All trials involved the presentation of three identical picture stimuli. During the non-arbitrary co-ordination trials, the participant was shown the third sample flashcard (that was identical to both of the comparisons). Pointing to one of the comparison stimuli, the participant was instructed that they were the 'Same'. Pointing to the other comparison stimuli, the participant was instructed that they were 'Different'. The participant was thus required to visually track the researcher's instruction, and was then asked to "Match same" by placing the sample on top of the correct (i.e. same) comparison. During the arbitrary distinction trials, the participant was shown the third sample flashcard (that was identical to both of the comparisons). The researcher pointed to one of the comparison stimuli and instructed that they were the 'Same', and pointed to the other comparison stimuli and instructed that they were 'Different'. The participant was thus required to visually track the researcher's instruction, and then asked to "Match different" by placing the sample on top of the correct (i.e. 'different') comparison. Both these trial-types tested mutual entailment only. Referring to the two comparisons on the desk, during half of the trials, the participant was then asked "Are these two same?" Responding "No" was recorded as a correct response. During the other half of trials, the participant was asked "Are these two different?" Responding "Yes" was recorded as correct. This tested combinatorial entailment.

Due to the time-frame of the current research, regardless of whether the participant passed or failed this stage, s/he proceeded immediately to Stage 8.

Stage 8: Verbal re-assessments. Potential changes in verbal ability following relational testing/training were measured by re-administering the PPVT and the K-BIT in a manner that was identical to Stage 1.

Inter-Observer Agreement (IOA)

Twenty-five percent of testing and training trials across all sessions were observed by an independent observer. The observer was informed of the target responses and how responding was recorded. The independent observer could not see the researcher's data sheet. Total count IOA was calculated by comparing the total number of correct responses recorded by each observer per session (see Cooper et al., 2007) and was recorded at 99%.

Results

The primary aim of Study 1 was to attempt to test and establish co-ordination and distinction relations, using a MTS procedure based on RFT protocol, with seven children with autism. The primary purpose of doing so was to explore the nature of performances inside and between each relational frame and to subsequently identify the potential deficits the children had in this regard and how these might be remediated using protocol based on RFT. The secondary aim of the study was to explore the relationship between relational responding and verbal ability. The study thus assessed each participant's expressive and receptive verbal abilities through the administration of two standardised verbal assessments (the PPVT-4; Dunn & Dunn, 1997; and the K-BIT; Kaufman & Kaufman, 2004, respectively). Overall, the aim of the work was to assess participant's performances on critical relations repertoires that might underpin more advanced relational responding skills and to assess the potential impact of these skills on verbal ability.

Data from Verbal Assessments: PPVT and K-BIT

In Stage 1, all seven participants produced very weak (i.e. <26/228) overall PPVT performances (see Table 3). Subscores for the three sections of the K-BIT were equally weak (vocabulary <8/45; definitions 0/37; and matricies <7/48). These performances indicated that all participants were of a low verbal ability, in both expressive and receptive domains, as measured by these scales.

In Stage 8, verbal assessments were re-administered to each participant. Again, all participants produced very weak (i.e. <22/228) overall PPVT performances (see Table 3). Subscores for the three sections of the K-BIT were equally weak (vocabulary <8/45; definitions 0/37; and matricies <7/48). These

performances indicated that all participants were of a low verbal ability, in both expressive and receptive domains, as measured by these scales. There were very minor changes in scores for both the PPVT (-8/+6), and the subscores for the three sections of the K-BIT (vocabulary +1; definitions 0; and matricies +4/-1) post relational testing/training. A comparison of the results on the verbal assessments therefore shows insignificant changes in verbal ability post relational responding testing/training across all participants in the current study.

Table 2

Participants' Overall Scores and Subscores on the PPVT and K-BIT, Pre- and Post-Relational Testing/Training, Study 1.

P	PPVT-4		K-BIT					
	Pre	Post	Expressive Vocabulary		Definitions		Matrices	
			Pre	Post	Pre	Post	Pre	Post
	Maximum Scores							
	228		45		37		48	
1	26	22 (-4)	7	7	0	0	2	1 (+1)
2	18	10 (-8)	6	6	0	0	6	6
3	12	9 (-3)	0	0	0	0	0	3 (+3)
4	11	4 (-7)	1	1	0	0	0	1 (+1)
5	4	2 (-2)	0	0	0	0	1	5 (+4)
6	12	12	0	1 (+1)	0	0	4	3 (-1)
7	10	16 (+6)	0	0	0	0	0	2 (+2)

(+ / -) indicates increase or decrease change in participants' PPVT-4 and K-BIT scores pre and post relational responding testing and training during Study 1

Data from Relational Responding

The results for each participant are presented in the tables below. Each table presents the following information: the relational frame, and colour or picture phase that was tested/trained; whether the trials were non-arbitrary or arbitrary; whether the trials were test, training, retest, novel test or randomised test; whether the participant passed or failed; the number of correct responses on a test, or the number of training

trials required; and whether or not the participant reached criterion for each relation that was tested/trained. Due to the volume of relational responding data for Participant 7, the data is divided across three tables; Table 9 presents data for Stages 2 and 3; Table 10 presents Stage 4; and Table 11 presents Stages 5, 6 and 7. All participants required training at some point during non-arbitrary relations, although the amount of training required varied considerably across participants.

Participant 1. The results for Participant 1 are presented in Table 3. Participant 1 required only 40 training trials to pass Non-arbitrary Co-ordination relations and 60 training trials to pass Non-arbitrary Distinction Stages of the relational responding. However despite extensive training (640 training trials) during Non-arbitrary Combined Co-ordination and Distinction Stage, Participant 1 failed to reach criterion.

Table 3

Total Number of Tests and Training Trials for Participant 1 during Study 1.

Relational Frame	Test/Train	Pass/Fail	No. Correct Test / No. Training trials	Criterion Reached
NON-ARBITRARY Trials				
Co-ordination - colours	Test	Fail	0/20	-
	Train	Pass	40	-
	Retest	Pass	17/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	-
- pictures	Test	Pass	20/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	**Yes**
Distinction - colours	Test	Fail	0/20	-
	Train	Pass	20	-
	Retest	Pass	19/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	-
- pictures	Test	Fail	0/20	-
	Train	Pass	40	-
	Retest	Pass	20/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	**Yes**
Combined Co-ordination and Distinction - pictures	Test	Fail	10/20	-
	Train	Pass	440	-
	Retest	Fail	13/20	-
	Train	Fail	200	**No**

Participant 2. The results for Participant 2 are presented in Table 4. Participant 2 passed the Non-arbitrary Co-ordination relational test without any training. While an extensive amount of training (780 training trials) was required, the participant passed Non-arbitrary Distinction testing. Despite a significant 1040 training trials Participant 2 did not reach criterion for Non-arbitrary Combined Co-ordination and Distinction relations.

Table 4

Total Number of Tests and Training Trials for Participant 2 during Study 1.

Relational Frame	Test/Train	Pass/Fail	No. Correct Test / No. Training trials	Criterion Reached
NON-ARBITRARY Trials				
Co-ordination - colours	Test	Pass	20/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	-
- pictures	Test	Pass	20/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	**Yes**
Distinction - colours	Test	Fail	0/20	-
	Train	Pass	400	-
	Retest	Pass	19/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	-
- pictures	Test	Fail	0/20	-
	Train	Pass	380	-
	Retest	Pass	20/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	**Yes**
Combined Co-ordination and Distinction - pictures	Test	Fail	10/20	-
	Train	Pass	280	-
	Retest	Fail	12/20	-
	Train	Fail	760	**No**

Participant 3. The results for Participant 3 are presented in Table 5. Participant 3 did not require training to pass the Non-arbitrary Co-ordination relational test. However, 520 training trials were required to pass the Non-arbitrary Distinction Stage. Interestingly, while the same number of training trials (260) were required for each Non-arbitrary Distinction phases; testing using colour flashcards, and testing using picture flashcards, training criterion was reached more often during

the Non-arbitrary Distinction testing using picture flashcards. Despite training (160 training trials), on Non-arbitrary Combined Co-ordination and Distinction trials, Participant 3 did not reach criterion for this stage.

Table 5

Total Number of Tests and Training Trials for Participant 3 during Study 1.

Relational Frame	Test/Train	Pass/Fail	No. Correct Test / No. Training trials	Criterion Reached
NON-ARBITRARY Trials				
Co-ordination - colours	Test	Pass	20/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	-
- pictures	Test	Pass	20/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	**Yes**
Distinction - colours	Test	Fail	0/20	-
	Train	Pass	160	-
	Retest	Fail	9/20	-
	Train	Pass	100	-
	Retest	Pass	16/20	-
	Novel	Pass	16/20	-
	Random	Pass	16/20	-
- pictures	Test	Fail	0/20	-
	Train	Pass	60	-
	Retest	Fail	15/20	-
	Train	Pass	20	-
	Retest	Fail	12/20	-
	Train	Pass	20	-
	Retest	Pass	20/10	-
	Novel	Fail	12/20	-
	Train	Pass	20	-
	Retest	Fail	13/10	-
	Train	Pass	40	-
	Retest	Fail	15/20	-
	Train	Pass	20	-
	Retest	Pass	18/20	-
	Novel	Fail	7/20	-
	Train	Pass	40	-
	Retest	Pass	20/20	-
	Novel	Pass	17/20	-
	Random	Fail	10/20	-
	Train	Pass	20	-
	Retest	Pass	20/20	-
	Novel	Pass	1820	-
	Random	Fail	13/20	-
	Train	Pass	20	-
	Retest	Pass	18/20	-
	Novel	Pass	20/20	-
	Random	Pass	18/20	**Yes**
Combined Co-ordination and Distinction - pictures	Test	Fail	0/20	-
	Train	Fail	160	**No**

Participants 4. The results for Participant 4 are presented in Table 6. Participant 4 passed the Non-arbitrary Co-ordination relational test without training. He was then provided with extensive training (880 training trials) for Non-arbitrary Distinction relations, using colour stimuli. Although he passed two of the novel tests, Participant 4 did not pass the randomised testing and so did not reach criterion for Non-arbitrary Distinction relations.

Table 6

Total Number of Tests and Training Trials for Participant 4 during Study 1.

Relational Frame	Test/Train	Pass/Fail	No. Correct Test / No. Training trials	Criterion Reached
NON-ARBITRARY Trials				
Co-ordination - colours	Test	Pass	20/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	-
- pictures	Test	Pass	20/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	**Yes**
Distinction - colours	Test	Fail	0/20	-
	Train	Pass	280	-
	Retest	Fail	14/20	-
	Train	Pass	400	-
	Retest	Pass	17/20	-
	Novel	Fail	15/20	-
	Train	Pass	20	-
	Retest	Fail	15/20	-
	Train	Pass	80	-
	Retest	Pass	19/20	-
	Novel	Fail	1/20	-
	Train	Pass	40	-
	Retest	Pass	17/20	-
	Novel	Pass	17/20	-
	Random	Fail	12/20	-
	Train	Pass	20	-
	Retest	Fail	14/20	-
	Train	Pass	20	-
	Retest	Fail	14/20	-
	Train	Pass	20	-
	Retest	Pass	18/20	-
	Novel	Pass	16/20	-
	Random	Fail	2/20	**No**

Participants 5. The results for Participant 5 are presented in Table 7. Participant 5 did not require training to pass the Non-arbitrary Co-ordination relations. However, despite extensive training (280 training trials) and reaching

novel testing stage 12 times, and passing 3 of these novel tests, Participant 5 did not reach criterion during randomised testing for Non-arbitrary Distinction relations using colour flashcards.

Table 7

Total Number of Tests and Training Trials for Participant 5 during Study 1.

Relational Frame	Test/Train	Pass/Fail	No. Correct Test / No. Training trials	Criterion Reached
NON-ARBITRARY Trials				
Co-ordination - colours	Test	Pass	20/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	-
- pictures	Test	Pass	20/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	**Yes**
Distinction - colours	Test	Fail	0/20	-
	Train	Pass	20	-
	Retest	Pass	20/20	-
	Novel	Fail	1/20	-
	Train	Pass	20	-
	Retest	Pass	20/20	-
	Novel	Fail	0/20	-
	Train	Pass	20	-
	Retest	Pass	20/20	-
	Novel	Fail	8/20	-
	Train	Pass	40	-
	Retest	Pass	16/20	-
	Novel	Fail	12/20	-
	Train	Pass	20	-
	Retest	Pass	20/20	-
	Novel	Fail	0/20	-
	Train	Pass	20	-
	Retest	Pass	18/20	-
	Novel	Fail	0/20	-
	Train	Pass	20	-
	Retest	Pass	19/20	-
	Novel	Fail	0/20	-
	Train	Pass	40	-
	Retest	Pass	19/20	-
	Novel	Fail	12/20	-
	Train	Pass	20	-
	Retest	Pass	20/20	-
	Novel	Fail	12/20	-
	Train	Pass	20	-
	Retest	Fail	14/20	-
	Train	Pass	20	-
	Retest	Pass	20/20	-
	Novel	Pass	20/20	-
	Random	Fail	15/20	-
	Train	Pass	20	-
	Retest	Pass	16/20	-
	Novel	Pass	16/20	-
	Train	Pass	17/20	-
	Retest	Pass	18/20	-
	Novel	Pass	19/20	-
	Random	Fail	8/20	**No**

Participants 6. The results for Participant 6 are presented in Table 8. Participant 6 passed the Non-arbitrary Co-ordination relations without training. After extensive training (360 training trials), particularly during the Non-arbitrary Distinction relational testing using colour flashcards (300 training trials), criterion for Non-arbitrary Distinction relations was not reached.

Table 8

Total Number of Tests and Training Trials for Participant 6 during Study 1.

Relational Frame	Test/Train	Pass/Fail	No. Correct Test / No. Training trials	Criterion Reached
NON-ARBITRARY Trials				
Co-ordination - colours	Test	Pass	20/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	-
- pictures	Test	Pass	20/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	**Yes**
Distinction - colours	Test	Fail	0/20	-
	Train	Pass	120	-
	Retest	Fail	8/20	-
	Train	pass	120	-
	Retest	Pass	16/20	-
	Novel	Fail	15/20	-
	Train	Pass	20	-
	Retest	Fail	13/20	-
	Train	Pass	20	-
	Retest	Pass	17/20	-
	Novel	Fail	15/20	-
	Train	Pass	20	-
	Retest	Pass	20/20	-
	Novel	Pass	20/20	-
	Random	Fail	12/20	-
	Train	Pass	20/20	-
	Retest	Pass	20/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	-
- pictures	Test	Fail	6/20	-
	Train	Fail	60	**No**

Participant 7. The results for Participant 7 are presented in Tables 9, 10 and 11. Participant 7 passed the Non-arbitrary Co-ordination relational test without any training. However, extensive training was required, particularly during the Non-

arbitrary Distinction relational testing using colour flashcards (200 training trials). Once this criterion was reached, very little training (20 training trials) was required to reach criterion during the Non-arbitrary Distinction relational testing using picture flashcards (see Table 9). Participant 7 required a significant amount of training (840 training trials) to pass the Non-arbitrary Combined Co-ordination and Distinction relations, with a number of novel testing being failed (se Table 10). Interestingly, Participant 7 then passed the Arbitrary Distinction Stage, and the Combined Non-arbitrary Co-ordination and Arbitrary Distinction Stage without training. Criterion was not reached however, once Combinatorial Entailment trials were introduced (see Table 11).

Table 9

Total Number of Tests and Training Trials for Participant 7 during Stages 2 and 3 of Study 1.

Relational Frame	Test/Train	Pass/Fail	No. Correct Test / No. Training trials	Criterion Reached
NON-ARBITRARY Trials				
Co-ordination - colours	Test	Pass	20/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	-
- pictures	Test	Pass	20/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	**Yes**
Distinction - colours	Test	Fail	0/20	-
	Train	Pass	60	-
	Retest	Fail	0/20	-
	Train	Pass	20	-
	Retest	Pass	20/20	-
	Novel	Pass	17/20	-
	Random	Fail	0/20	-
	Train	Pass	20	-
	Retest	Pass	20/20	-
	Novel	Fail	0/20	-
	Train	Pass	20	-
	Retest	Pass	20/20	-
	Novel	Fail	0/20	-
	Train	Pass	20	-
	Retest	Pass	20/20	-
	Novel	Fail	0/20	-
	Train	Pass	20	-
	Retest	Pass	19/20	-
	Novel	Pass	20/20	-
	Random	Fail	13/20	-
	Train	Pass	20	-
	Retest	Pass	20/20	-
	Novel	Pass	18/20	-
	Random	Fail	15/20	-
	Train	Pass	20	-
	Retest	Pass	20/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	-
- pictures	Test	Fail	2/20	-
	Train	Pass	20	-
	Retest	Pass	20/20	-
	Novel	Pass	19/20	-
	Random	Fail	11/20	-
	Train	Pass	20	-
	Retest	Pass	20/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	**Yes**

Table 10

Total Number of Tests and Training Trials for Participant 7 during Stage 4 of Study 1.

Relational Frame	Test/Train	Pass/Fail	No. Correct Test / No. Training trials	Criterion Reached
NON-ARBITRARY Trials				
Combined Co-ordination and Distinction - pictures	Test	Fail	10/20	-
	Train	Pass	220	-
	Retest	Fail	10/20	-
	Train	Pass	20	-
	Retest	Fail	14/20	-
	Train	Pass	20	-
	Retest	Fail	13/20	-
	Train	Pass	20	-
	Retest	Fail	15/20	-
	Train	Pass	20	-
	Retest	Fail	12/20	-
	Train	Pass	40	-
	Retest	Fail	12/20	-
	Train	Pass	60	-
	Retest	Pass	17/20	-
	Novel	Fail	6/20	-
	Train	Pass	20	-
	Retest	Fail	12/20	-
	Train	Pass	120	-
	Retest	Fail	13/20	-
	Train	Pass	40	-
	Retest	Fail	13/20	-
	Train	Pass	60	-
	Retest	Fail	15/20	-
	Train	Pass	20	-
	Retest	Fail	12/20	-
	Train	Pass	20	-
	Retest	Fail	11/20	-
	Train	Pass	20	-
	Retest	Pass	18/20	-
	Novel	Fail	12/20	-
	Train	Pass	20	-
	Retest	Pass	17/20	-
	Novel	Fail	14/20	-
	Train	Pass	20	-
	Retest	Pass	16/20	-
	Novel	Fail	13/20	-
	Train	Pass	20	-
	Retest	Fail	11/20	-
	Train	Pass	20	-
	Retest	Fail	13/20	-
	Train	Pass	20	-
	Retest	Fail	10/20	-
	Train	Pass	20	-
	Retest	Fail	15/20	-
	Train	Pass	20	-
	Retest	Pass	16/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	**Yes**

Table 11

Total Number of Tests and Training Trials for Participant 7 during Stage 5, 6 and 7 of Study 1.

Relational Frame	**Test/Train**	**Pass/Fail**	**No. Correct Test / No. Training trials**	**Criterion Reached**
ARBITRARY Trials				
Distinction - pictures	Test	Pass	19/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	**Yes**
Combined Co-ordination and Distinction - pictures	Test	Pass	20/20	-
	Novel	Pass	20/20	-
	Random	Pass	20/20	**Yes**
+ **Combinatorial Entailment** - pictures	Test	Fail	30/40 ME – 20/20 CE – 10/20	**No**

ME = Mutual Entailment; CM = Combinatorial Entailment

Summary of Results

In summary, all participants produced very weak performances on the PPVT (i.e. <26/228) and the K-BIT (vocabulary <8/45; definitions 0/37; and matricies <7/48), both pre and post relational training, with very little change in scores between the two administrations of each assessment (i.e. PPVT, -8/+6; K-BIT, vocabulary +1; definitions 0; and matricies +4/-1).

All participants passed relational responding Non-arbitrary Co-ordination, with little or no training (>41 training trials). While Participant 1 passed the Non-arbitrary Distinction relations, with very little training (60 training trials), Participants 2, 3 and 7 required extensive training (200-780 training trials), with half of participants not reaching criterion at this stage. Despite extensive training (640-840 training trials) for both Participant 1 and 7 who were tested on Non-arbitrary Combined Co-ordination and Distinction trials, only Participant 7 reach the criterion for this stage. Interestingly, while extensive training was required for participant 7 to pass the Non-arbitrary stages, once these criteria were reached, he required no training to pass the Arbitrary Distinction, or the Combined Non-arbitrary Co-ordination and Arbitrary Distinction Stages. Participant 7 then failed to reach criterion once Combinatorial Entailment trials were introduced.

On closer analysis of the data for Participants 1, 2 and 3, who did not reach criterion on mixed co-ordination and distinction trials, it was identified that a limitation in relational responding on distinction trials was responsible for the inaccurate responding on combined trials. However, when responding in accordance with distinction alone was later probed, training was not required to meet criterion. This suggests a deficit in the flexibility required to switch rapidly between co-ordination and distinction trials. See Chapter 4 for a more detailed discussion on the

role of flexibility in relational responding. A number of other theoretical and clinical issues arose from this study, however because the current study closely relates to the other studies in this thesis, all arising issues will be discussed in the general discussion in Chapter 4.

Chapter 3

Introduction

The studies presented in Chapter 3 sought to replicate and expand Study 1 with typically developing participants. As discussed in Chapter 1, derived relational responding is established among children, in large part, by an appropriate history of exemplar training (Barnes 1994, 1996; Barnes & Holmes, 1991; Barnes & Roche, 1996; Hayes, 1991, 1994; Hayes & Hayes, 1989) through a series of early naturally occurring language interactions between caregiver and child (Luciano et al., 2009). Therefore, RFT suggests that relational responding should not require the same extent of explicit training with typically developing children in the same way it would with children with developmental disabilities, such as autism. Studies 2, 3 and 4 sought to investigate this premise by analysing the relationship between the verbal ability (as measured by two standard verbal assessments) and the relational responding skills (as measured by protocol based on RFT) of typically developing children between the ages of four and eight years old.

The aim of Study 2 was to; 1) assess the verbal abilities of typically developing children as measured by two standard verbal assessments (the PPVT-4; Dunn & Dunn, 1997; and the K-BIT; Kaufman & Kaufman, 2004); 2) test relational responding skills in accordance with co-ordination and distinction with typically developing children using protocol based on RFT (Rehfeldt & Barnes-Holmes, 2009) identical to that used in Study 1; 3) to investigate whether higher verbal ability scores correlate with higher relational responding skills; and 4) to compare the verbal ability and relational responding skills of typically developing children to those of children with autism.

Study 3 sought to extend the findings of Study 2 by testing relational responding in accordance with comparison, using similar protocol based on RFT

(Rehfeldt & Barnes-Holmes, 2009) with the same participants. Study 4 aimed to expand on Study 3 by testing the relational frame of opposition, again using protocol based on RFT with the same participants. Study 4 also involved a re-administration of the verbal assessments (PPVT-4; Dunn & Dunn, 1997; and K-BIT; Kaufman & Kaufman, 2004) previously administered to these participants in Study 2. The aim of study 4 was thus to; 1) test relational responding skills in accordance with opposition with typically developing children using protocol based on RFT; and 2) to investigate whether relational responding testing affect verbal ability scores (as measured by re-administration of the verbal assessments).

Study 2

Testing and Training Relational Responding in Accordance with Co-ordination and Distinction with Typically-developing Children

Method

Participants

A total of five children, three female and two male, participated in Study 2 (see Table 2). The age of the participants ranged from 4 years and 1 month to 8 years and 9 months. All participants' were typically-developing and were enrolled full-time in a mainstream school. The children were recruited from an afterschool setting in Dublin, Ireland.

Table 12

Details of participants involved in Study 2

Participant	Gender	Age (Years/Months)
1	Female	4/4
2	Female	4/7
3	Male	8/9
4	Male	4/1
5	Female	4/10

Ethical Considerations

Ethical considerations for Study 2 were identical to that of Study 1, except that they applied to typically-developing children.

Setting

The study was carried out at a desk in a quiet room in the afterschool facility at which the participants attended. Research sessions were conducted in a 20-30 minute session, held one day a week, for approximately 12 weeks.

Materials

Study 2 involved identical materials to Study 1.

Experimental Sequence

There were five stages in Study two (see Figure 3). The basic sequence involved administration of verbal assessments in Stage 1. The relational testing and training occurred across Stages 2-5. Stage 2 focused on non-arbitrary co-ordination relations, while Stage 3 focused on non-arbitrary distinction relations. Stage 4 was a combination of the two previous stages with a joint test of non-arbitrary co-ordination and distinction relations. Stage 5 focused on non-arbitrary co-ordination relations and arbitrary distinction relations, including combinatorial entailment.

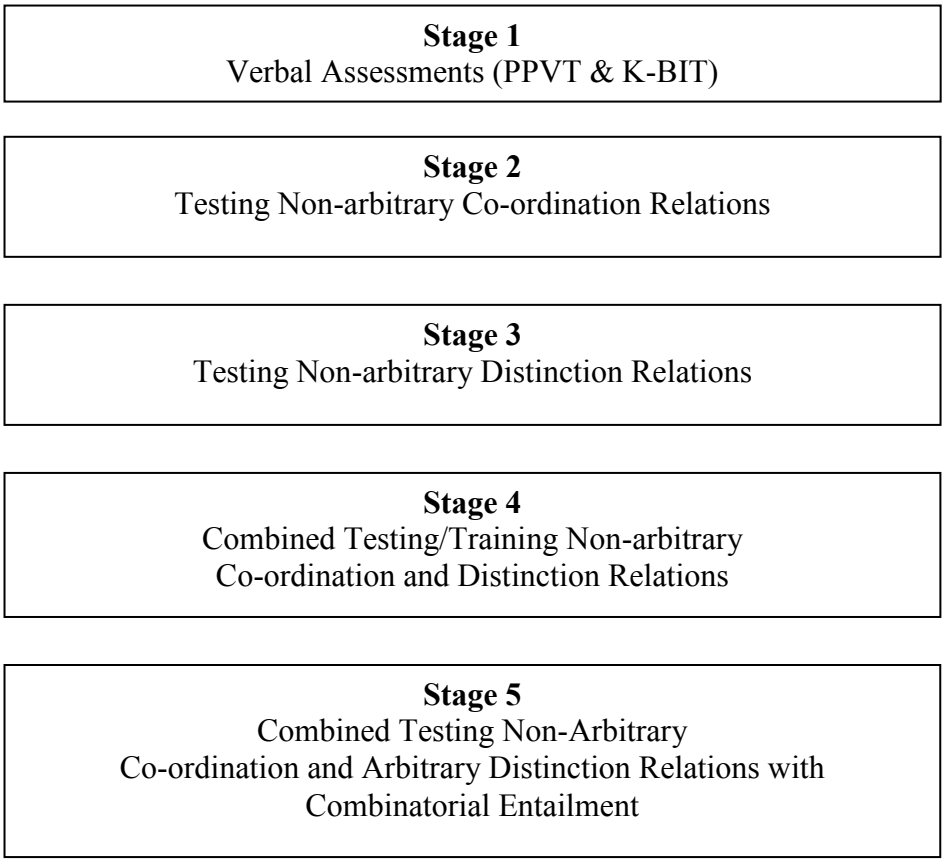

Figure 3: Experimental sequence employed in Study 2.

Corrective Feedback

No feedback was provided for correct or incorrect responding on either of the standardised verbal assessments, although all participants received intermittent reinforcement in the form of verbal praise for good attending. During the relational *test* trials, positive reinforcement (verbal praise) for good attending was provided consistently and non-contingently, but no corrective feedback was provided. During relational *training* trials, similar contingencies were in place for attending, but positive reinforcement in the form of verbal praise and a tangible item was also delivered for correct responding, along with corrective feedback, in the form of modelling the correct response, for incorrect responding.

Procedure

Stage 1: Verbal assessments. Verbal assessments involved an identical procedure to Stage 1, Study 1.

Stages 2-5: Relational testing/training. The recurrent patterns that guided the testing/training of all relational frames were identical to that in Study 1. The procedure for Stages 2-4 were identical to Stages 2-4, Study 1, respectively. The procedure for Stage 5 was identical to the procedure for Stage 7, Study 1.

Inter-Observer Agreement

Twenty-five percent of testing and training trials across all research sessions were observed by an independent observer. The observer was informed of the target responses, and trained in how to record the rate of correct and incorrect responses on the record sheet. The independent observer could not see the researchers' data sheet during research sessions. Total count inter-observer agreement (IOA) was calculated

by comparing the total number of correct responses recorded by each observer per session (see Cooper et al., 2007). Agreement between the observer's and researcher's recorded data was 100%.

Results

Study 2 sought to replicate Study 1 with typically-developing participants. The aim of Study 2 was thus to; 1) assess the verbal abilities of typically developing children as measured by two standard verbal assessments; 2) test relational responding skills in accordance with co-ordination and distinction using protocol based on RFT, identical to that used in Study 1; 3) to investigate whether higher verbal ability scores correlate with higher relational responding skills; and 4) to compare the verbal ability and relational responding skills of typically developing children to those of children with autism.

Data from Verbal Assessments: PPVT and K-BIT

In Stage 1, all five participants produced average (i.e. 90-130/228) overall PPVT performances (see Table 13). Subscores for the three sections of the K-BIT were mixed, with all five participants producing average performances on two of the sections (vocabulary 17-28/45; and matricies 12-32/48), and weak performances on the third section (definitions 0-4/37). These performances indicated that all participants were of average verbal ability in receptive language and slightly weak in some expressive domains, as measured by these scales.

Table 13

Participants' Overall Scores and Subscores on the PPVT and K-BIT, Pre-Relational Testing/Training, Study 2.

P	PPVT-4 (Form B)	K-BIT		
		Expressive Vocabulary	Definitions	Matrices
	Maximum Scores			
	228	45	37	48
1	130	28	0	12
2	106	20	0	15
3	90	17	0	14
4	125	28	3	32
5	110	26	0	18

Data from Relational Responding

The results from relational responding in Study 2 are presented in the tables below. Each table presents the following information: the relational frame, and colour or picture phase that was tested/trained; whether the trials were non-arbitrary or arbitrary; whether the trials were test, training, retest, novel test or randomised test; whether the participant passed or failed; the number of correct responses on a test, or the number of training trials required; and whether or not the participant reached criterion for each relation that was tested/trained.

Participants 1, 3, 4 and 5. The results for Participants 1, 3, 4 and 5 are presented in Table 14. All four participants passed each of the four stages of relational responding (Non-arbitrary Co-ordination, Non-arbitrary Distinction, Non-arbitrary Combined Co-ordination and Distinction, and Combined Non-arbitrary Co-ordination and Arbitrary Distinction with Combinatorial Entailment) without any training.

Table 14

Total Number of Tests and Training Trials for Participants 1, 3, 4 and 5 during Study 2.

Participants	Relational Frame	Test/Train	Pass/Fail	No. Correct Test/ No. Training trials	Reached Criterion
1, 3, 4, 5	**NON-ARBITRARY Trials**				
	Co-ordination - colours	Test	Pass	20/20	-
		Novel	Pass	20/20	-
		Random	Pass	20/20	-
	- pictures	Test	Pass	20/20	-
		Novel	Pass	20/20	-
		Random	Pass	20/20	**Yes**
	Distinction - colours	Test	Pass	20/20	-
		Novel	Pass	20/20	-
		Random	Pass	20/20	-
	- pictures	Test	Pass	20/20	-
		Novel	Pass	20/20	-
		Random	Pass	20/20	**Yes**
	Combined Co-ordination and Distinction - pictures	Test	Pass	20/20	-
		Novel	Pass	20/20	-
		Random	Pass	20/20	**Yes**
	ARBITRARY Trials				
	Combined Co-ordination and Distinction + Combinatorial Entailment - pictures	Test	Pass	40/40	-
		Novel	Pass	40/40	-
		Random	Pass	40/40	**Yes**

Participant 2. The results for Participant 2 are presented in Table 15. Participant 2 required minimal training (20 training trials) to reach criterion during the Non-arbitrary Combined Co-ordination and Distinction relational testing. However, all other relational testing was passed without training.

Table 15

Total Number of Tests and Training Trials for Participant 2 during Study 2.

Participant	Relational Frame	Test/Train	Pass/Fail	No. Correct Test/ No. Training trials	Reached Criterion
2	**NON-ARBITRARY Trials**				
	Co-ordination - colours	Test	Pass	20/20	-
		Novel	Pass	20/20	-
		Random	Pass	20/20	-
	- pictures	Test	Pass	20/20	-
		Novel	Pass	20/20	-
		Random	Pass	20/20	**Yes**
	Distinction - colours	Test	Pass	20/20	-
		Novel	Pass	20/20	-
		Random	Pass	20/20	-
	- pictures	Test	Pass	20/20	-
		Novel	Pass	20/20	-
		Random	Pass	20/20	**Yes**
	Combined Co-ordination and Distinction - pictures	Test	Fail	20/20	-
		Train	Pass	20	
		Retest	Pass	20/20	
		Novel	Pass	20/20	-
		Random	Pass	20/20	**Yes**
	ARBITRARY Trials				
	Combined Co-ordination and Distinction + Combinatorial Entailment - pictures	Test	Pass	40/40	-
		Novel	Pass	40/40	-
		Random	Pass	40/40	**Yes**

Summary of Results

All four participants passed each of the four stages of relational responding (Non-arbitrary Co-ordination, Non-arbitrary Distinction, Non-arbitrary Combined Co-ordination and Distinction, and Combined Non-arbitrary Co-ordination and Arbitrary Distinction with Combinatorial Entailment) with minimal (>21 training trials), or no training.

The results of Study 2 suggest that relational responding skills in accordance with co-ordination and distinction are established in typically-developing children between the ages of four and eight years old through early natural language interactions (Luciano, et al., 2009). Thus, as expected, Non-arbitrary and Arbitrary Co-ordination and Distinction relations were found to be already established among the participants of Study 2, with little or no training required. A number of theoretical and clinical issues arose from this study, however because the studies in both Chapter 2 and 3 are closely related, all issues will be discussed in the general discussion in Chapter 4.

Study 3:

Testing Relational Responding in Accordance with

Comparison with Typically-developing Children

Method

Participants

Study 3 employed the same participants as Study 2.

Ethical Considerations

Ethical considerations for Study 3 were identical to that of Study 1, except that they applied to typically-developing children.

Setting

The current study was carried out in the same setting as Study 2.

Materials

A series of laminated colour picture flashcards were specifically made to test relational responding in accordance with comparison for the purposes of Study 3. There was a total of 10 flashcards each depicting one, two or three brass coin(s) or one, two or three silver coins (see Figure 4). Each trial involved the presentation of three flashcards, one sample and two comparisons. Scoring of correct and incorrect responding based on selection of the flashcards was recorded by pen and paper on tailor-made scoring sheets.

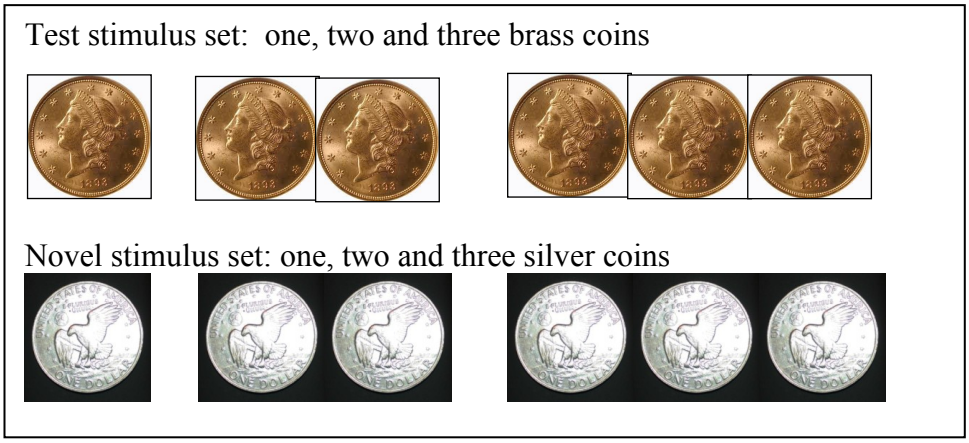

Figure 4: Example sets of picture flashcard for testing comparison relations in Study 3.

Experimental Sequence

Study 3 comprised of two short stages, which involved testing relational responding in accordance with comparison from non-arbitrary to arbitrary trials, with a focus on more-than and less-than relations. The frame was tested with an 80% overall accuracy criterion, then tested as before but on a single novel stimulus set (whether or not the first test was passed).

Stage 1
Testing Non-arbitrary Comparison Relations

Stage 2
Testing Arbitrary Comparison Relations

Figure 5: Experimental sequence employed in Study 3.

Corrective Feedback

No feedback was provided for correct or incorrect responding during the relational test trials, although all participants received intermittent reinforcement in the form of verbal praise for good attending.

Procedure

Stage 1: Testing non-arbitrary comparison relations. Testing non-arbitrary comparison relations involved six trial-types; A<B<C; A<C>B; B>A>C; B<C>A; C>A<B; C>B>A (see Figure 5). There were three trials per trial-type; two mutual entailment trials and one combinatorial entailment trial. This generated a total of 18 trials per test; 12 mutual entailment and six combinatorial entailment trials.

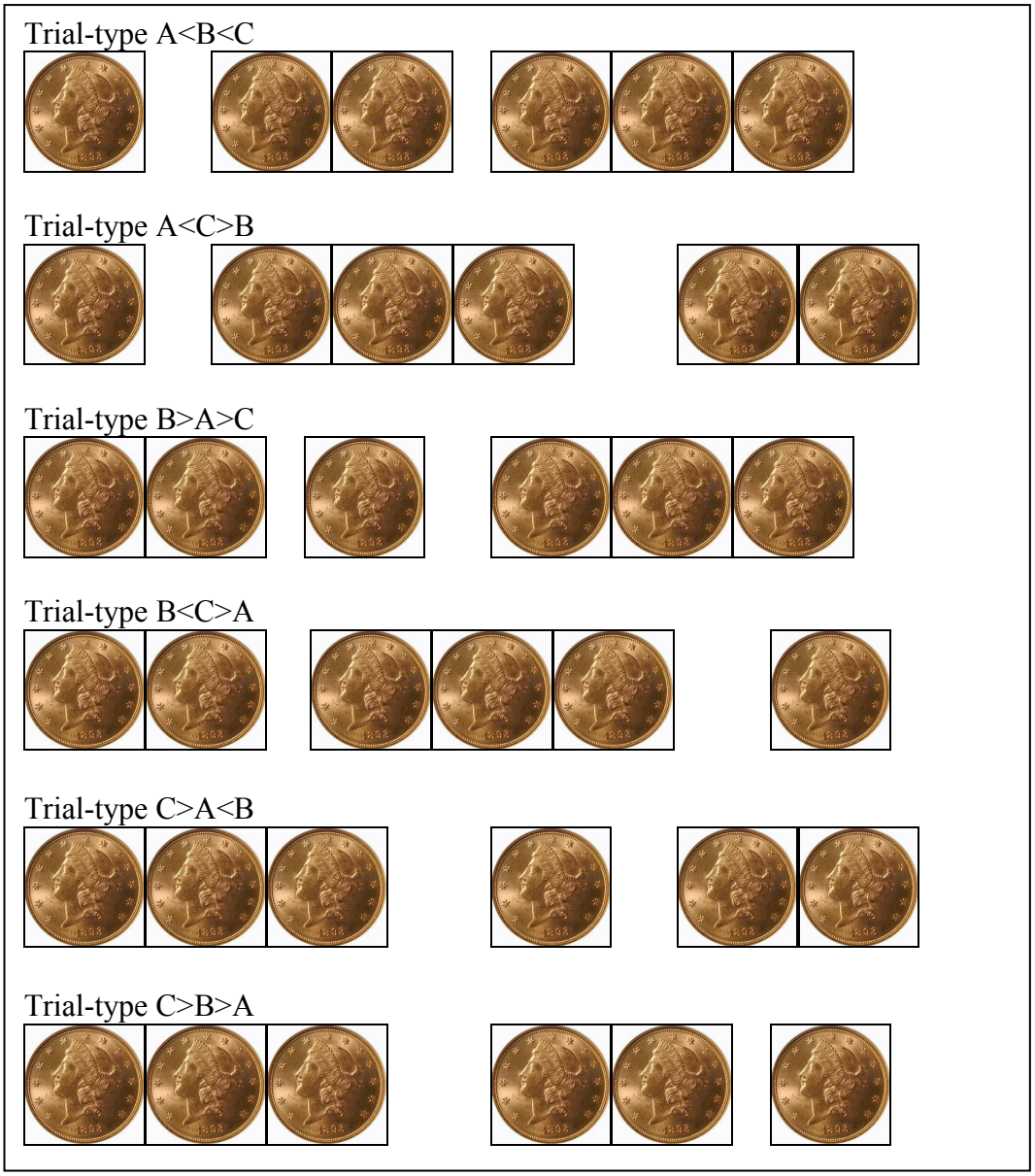

Figure 6: Non-arbitrary trial-types for testing comparison in Study 3.

All non-arbitrary comparison trials involved the presentation of three non-identical flashcards of brass coins. One card depicted one coin (denoted as A), the second card depicted two coins (B) and the third card depicted three coins (C). Consider the following mutual entailment trial. The participant was instructed, for example, that A was less than B and B was less than C (i.e. A<B<C). Pointing to B,

the researcher then asked “Is this more or less than this (pointing to A) (B>/<A)?” Responding “More” was recorded as a correct response. As before, failure to respond correctly, or to respond within 10 secs of the instruction were recorded as incorrect responses. Consider a second mutual entailment trial. Pointing to C the researcher then asked “Is this more or less than this (pointing to B) (C>/<B)?” Responding “More” was recorded as a correct response. Consider the following combinatorial entailment trial. Pointing to C the researcher then asked “Is this more or less than this (pointing to A) (C>/<A)?” Responding “More” was recorded as a correct response. As before, failure to respond correctly or to respond within 10 secs of the instruction were recorded as incorrect responses. This procedure was repeated for each of the six trial-types A<C>B; B>A>C; B<C>A; C>A<B; C>B>A (see Figure 5). Participants who passed this test, were tested on a novel stimuli set; flashcards of silver coins (see Appendix 3). Once the participant scored 80% criterion on the novel test, they proceeded to Phase 2. No participants required training at this stage.

Stage 2: Testing arbitrary comparison relations. Testing arbitrary comparison relations involved four trial-types; A<B<C left to right; A<B<C right to left; C>B>A left to right, and C>B>A right to left (see Figure 6). There were three trials per trial-type; two mutual entailment trials and one combinatorial entailment trial. This generated a total of 12 trials per test; eight mutual entailment and four combinatorial entailment trials.

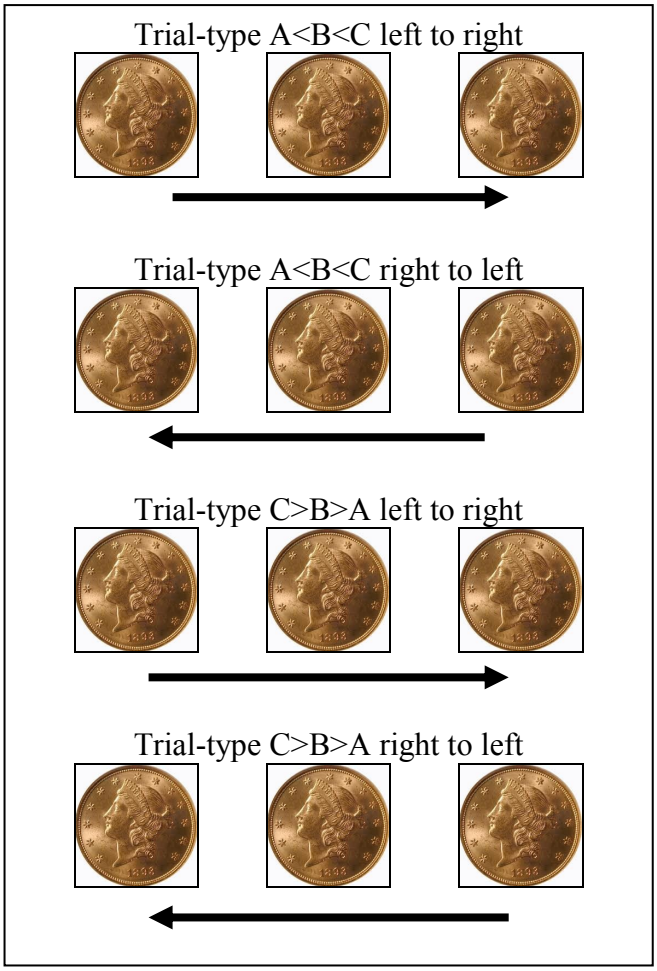

Figure 7: Arbitrary trial-types for testing comparison in Study 3.

The procedure for testing arbitrary comparison relations was identical in part to non-arbitrary comparison relation, except that all arbitrary comparison trials involved the presentation of three *identical* flashcards of brass coins (denoted as A, B and C). Thus, the participant had to visually track the researcher's instruction as to which coin was 'more' and which was 'less'. The procedure was repeated for each of the four trial-types A<B<C left to right; A<B<C right to left; C>B>A left to right, and C>B>A right to left (see Figure 6). Participants who passed this test, were tested on a novel stimuli set; flashcards of silver coins (see Appendix 3). No participants required training at this stage.

Inter-Observer Agreement

Twenty-five percent of testing and training trials across all research sessions were observed by an independent observer. The observer was informed of the target responses, and trained in how to record the rate of correct and incorrect responses on the record sheet. The independent observer could not see the researchers' data sheet during research sessions. Total count inter-observer agreement (IOA) was calculated by comparing the total number of correct responses recorded by each observer per session (see Cooper et al., 2007). Agreement between the observer's and researcher's recorded data was 100%.

Results

The aim of Study 3 was to test relational responding skills in accordance with comparison with five typically-developing children.

Data from Relational Responding

The results for all five participants are presented in Table 16. The table presents the following information: whether the trials were non-arbitrary or arbitrary; whether the trials were test or novel test; whether the participant passed or failed; the number of correct responses on a test; and whether or not the participant reached criterion. All five participants reached criterion for relational responding in accordance with comparison, for both non-arbitrary and arbitrary trials, without training.

Table 16

Total Number of Correct Test Responses for all five Participants during Testing of Comparison Relations, in Study 3.

Test	Pass/Fail	No. Correct Test	Reached Criterion
NON-ARBITRARY Trials			
Test	Pass	18/18	-
Novel	Pass	18/18	**Yes**
ARBITRARY Trials			
Test	Pass	18/18	-
Novel	Pass	18/18	**Yes**

Study 4:

Testing Relational Responding in Accordance with Opposition with Typically-developing Children.

Method

Participants

Study 4 employed the same participants as Study 2.

Ethical Considerations

Ethical considerations for Study 4 were identical to that of Study 1, except that they applied to typically-developing children.

Setting

The current study was carried out in the same setting as study 2.

Materials

A series of laminated colour picture flashcards were specifically made to test relational responding in accordance with opposition for the purposes of Study 4. There was a total of 12 flashcards each depicting a small or big football, or one or three brass coins (see Figure 5). Each trial involved the presentation of three flashcards, one sample and two comparisons. Scoring of correct and incorrect responding based on selection of the flashcards was recorded by pen and paper on tailor-made scoring sheets.

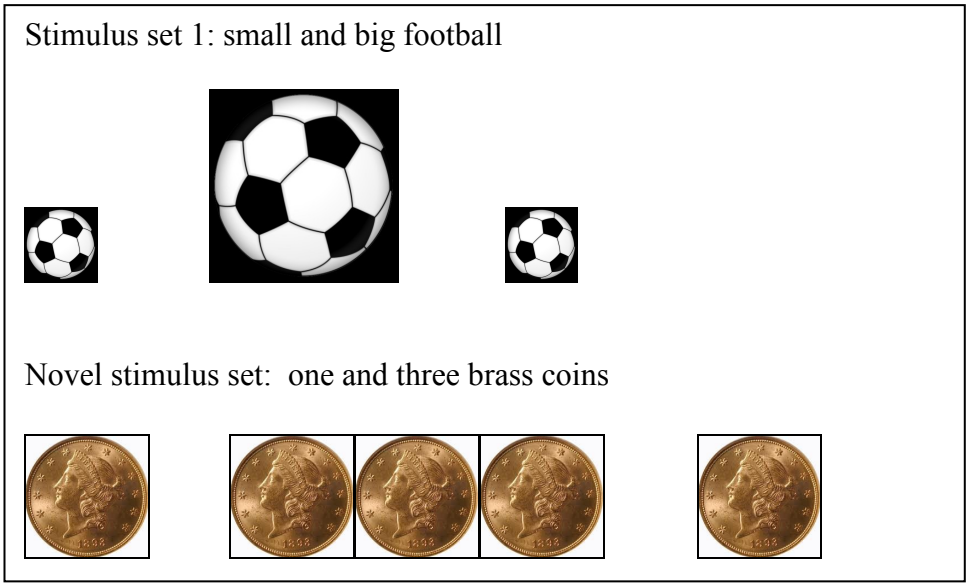

Figure 8: Example sets of picture flashcard for testing opposition relations in Study 4.

Experimental Sequence

Study 4 comprised of three stages. Stages 1 and 2 involved testing relational responding in accordance with opposition from non-arbitrary to arbitrary trials, with a focus on big-small relations. The frame was tested with an 80% overall accuracy criterion, then tested as before but on a single novel stimulus set (whether or not the first test was passed). Stage 3 involved the re-administration of verbal assessments.

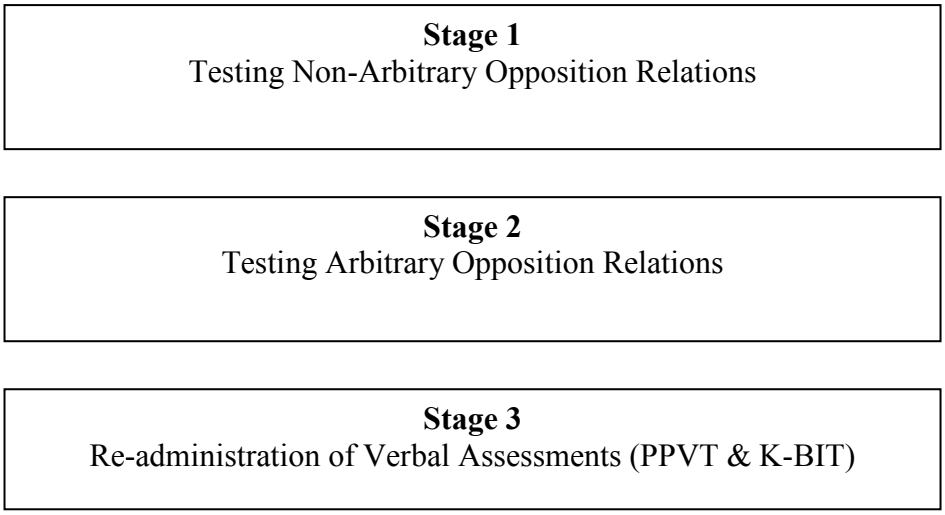

Figure 9: Experimental sequence employed in Study 4.

Corrective Feedback

No feedback was provided for correct or incorrect responding during the relational test trials, or either of the standardised verbal assessments, although all participants received intermittent reinforcement in the form of verbal praise for good attending.

Procedure

Stage 1: Testing non-arbitrary opposition relations. Testing non-arbitrary opposition relations involved four trial-types; A opp. B opp. C left to right; A opp. B opp. C right to left; B opp. A opp. C left to right; and B opp. A opp. C right to left (see Figure 10). There were three trials per trial-type; two mutual entailment trials and one combinatorial entailment trial. This generated a total of 12 trials per test; eight mutual entailment and four combinatorial entailment trials.

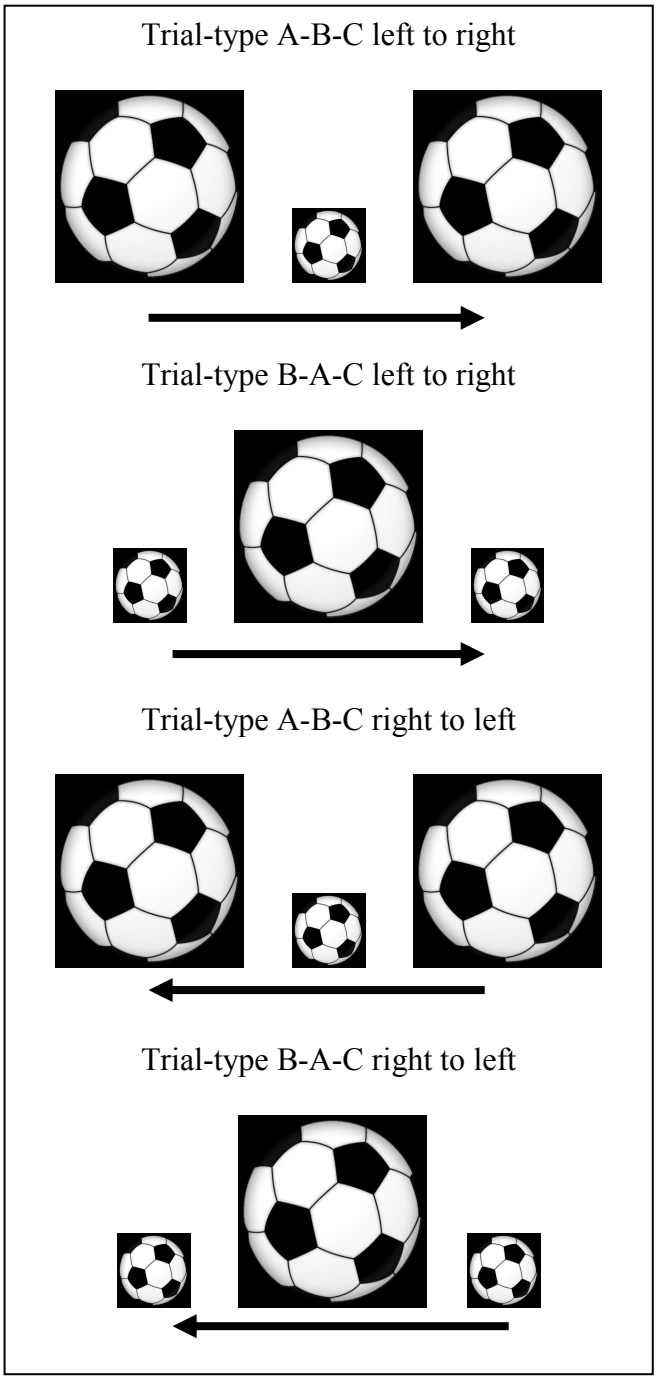

Figure 10: Trial-types for testing opposition in Study 4.

All non-arbitrary opposition trials involved the presentation of three flashcards; two non-identical flashcards (e.g. small football and big football; denoted as A and B, respectively) as comparison stimuli, and a third sample flashcard that

was identical to one of the comparisons (i.e. either small or big football; denoted as C). Consider the following mutual entailment trial. The participant was instructed, for example, that A was big and that it was opposite to B, and B was opposite to C (i.e. A opp. B opp. C). Pointing to B, the researcher then asked "Is this big or small?" Responding "Small" was recorded as a correct response. Failure to respond correctly, or to respond within 10 secs of the instruction were recorded as incorrect responses. Consider a second mutual entailment trial. Pointing to C the researcher then asked "Is this big or small?" Responding "Big" was recorded as a correct response. Now consider the following combinatorial entailment trial. Pointing to C the researcher then asked "Is this the opposite of this (pointing to A)?" Responding "No" was recorded as a correct response. As before, failure to respond correctly or to respond within 10 secs of the instruction were recorded as incorrect responses. This procedure was repeated for each of the four trial-types A opp. B opp. C left to right; A opp. B opp. C right to left; B opp. A opp. C left to right; and B opp. A opp. C right to left (see Figure 10). Participants who passed this test, were tested on a novel stimuli set; flashcards of brass coins (see Appendix 4). Once the participant scored 80% criterion on the novel test, they proceeded to Stage 2. No participants required training at this stage.

Stage 2: Testing arbitrary opposition relations. Testing arbitrary opposition relations involved four trial-types identical to the non-arbitrary trial-types in Stage 1. The procedure for testing arbitrary opposition relations was identical in part to non-arbitrary opposition relations, except that all arbitrary opposition trials involved the presentation of three *identical* flashcards of big footballs (denoted as A, B and C; see Figure 11). The participant was instructed, for example, that A was big and imagine that it was opposite to B, and imagine that B was opposite to C (i.e. A

opp. B opp. C). Thus, the participant had to visually track the researcher's instruction as to which ball was 'big/small' and which ones were 'opposite'. Pointing to B, the researcher then asked "Is this big or small?" Responding "Small" was recorded as a correct response. Failure to respond correctly, or to respond within 10 secs of the instruction were recorded as incorrect responses. Consider a second mutual entailment trial. Pointing to C the researcher then asked "Is this big or small?" Responding "Big" was recorded as a correct response. Now consider the following combinatorial entailment trial. Pointing to C the researcher then asked "Is this the opposite of this (pointing to A)?" Responding "No" was recorded as a correct response. As before, failure to respond correctly or to respond within 10 secs of the instruction were recorded as incorrect responses. As in Stage 1, the procedure was repeated for each of the four trial-types. Once participants reached 80% criterion, they were tested on a novel stimuli set; flashcards of brass coins (see Appendix 4). Participants who passed this test proceeded to the final stage of the research, Stage 3. No participants required training at this stage.

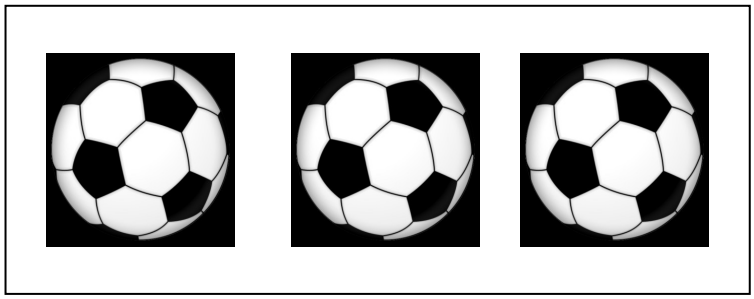

Figure 11: Picture flashcards for testing arbitrary opposition relations in Study 4.

Stage 3: Verbal re-assessment. Potential changes in verbal ability following relational training were measured by re-administering the PPVT-4 and the K-BIT, in a manner that was identical to Stage 1, Study 1.

Inter-Observer Agreement

Twenty-five percent of testing and training trials across all research sessions were observed by an independent observer. The observer was informed of the target responses, and trained in how to record the rate of correct and incorrect responses on the record sheet. The independent observer could not see the researchers' data sheet during research sessions. Total count inter-observer agreement (IOA) was calculated by comparing the total number of correct responses recorded by each observer per session (see Cooper et al., 2007). Agreement between the observer's and researcher's recorded data was 100%.

Results

The aim of study 4 was to test relational responding skills in accordance with opposition with typically developing children using protocol based on RFT, and to investigate whether relational responding testing affect verbal ability scores (as measured by re-administration of the verbal assessments).

Data from Relational Responding

The results for all five participants are presented in Table 17. The table presents the following information: whether the trials were non-arbitrary or arbitrary; whether the trials were test or novel test; whether the participant passed or failed; the number of correct responses on a test; and whether or not the participant reached criterion. All five participants reached criterion for relational responding in accordance with Opposition, for both non-arbitrary and arbitrary trials, without training.

Table 17

Total Number of Correct Test Responses for all five Participants during Testing of Opposition Relations, in Study 4.

Test	Pass/Fail	No. Correct Test	Reached Criterion
NON-ARBITRARY Trials			
Test	Pass	12/12	-
Novel	Pass	12/12	**Yes**
ARBITRARY Trials			
Test	Pass	12/12	-
Novel	Pass	12/12	**Yes**

Data from Verbal Assessments: PPVT and K-BIT

In Stage 3, all five participants produced average (i.e. 90-126/228) overall PPVT performances (see Table 18). Subscores for the three sections of the K-BIT

were mixed, with all five participants producing average performances on two of the sections (vocabulary 18-30/45; and matricies 13-28/48), and weak performances on the third section (definitions 1-2/37). These performances indicated that all participants were of an average verbal ability in receptive language and slightly weak in some expressive domains, as measured by these scales. There were very minor changes in performances on both assessments pre- and post-relational responding testing for three of the five participants. The performances of Participants 1 and 2 on the PPVT decreased slightly (<-5), while their performances on all sections of the K-BIT increased slightly (<+5). There was no change in Participant 3's performance on the PPVT, while the performance on all sections of the K-BIT increased slightly (<+5). However, the performance of Participant 4 on the PPVT increased (+23), with minor changes on the K-BIT (<-5). While the PPTV performance of Participant 5 also increased (+8), with minor changes seen on the K-BIT (<+5). Therefore, there were some changes in verbal ability post relational responding testing/training for two participants in Study 2, however changes were overall insignificant.

Table 18

Participants' Overall Scores and Subscores on the PPVT and K-BIT, Post-Relational Testing/Training, Stage 3 of Study 4.

P	PPVT-4 (Form A)	K-BIT		
		Expressive Vocabulary	Definitions	Matrices
	Maximum Scores			
	228	45	37	48
1	126 (-4)	30 (+2)	2 (+2)	13 (+1)
2	105 (-1)	24 (+4)	2 (+2)	17 (+2)
3	90	18 (+1)	1 (+1)	18 (+4)
4	148 (+23)	28	2 (-1)	28 (-4)
5	118 (+8)	30 (+4)	2 (+2)	19 (+1)

(+ / -) indicates an increase or decrease change in participants' pre relational responding testing and training PPVT-4 and K-BIT raw scores in Study 2, as reported in Table 13.

Chapter 4

General Discussion

The aim of the current thesis was to, 1) test and train relational responding skills using protocol based on RFT (Rehfeldt & Barnes-Holmes, 2009), with children with autism and typically developing children; 2) to investigate whether higher verbal ability scores (as measured by two standard verbal assessments) correlate with higher relational responding skills; 3) to compare the verbal ability and relational responding skills of children with autism to those of typically developing children, and 4) to investigate whether relational responding testing/training resulted in enhanced verbal ability scores (as measured by re-administration of the verbal assessments).

The primary aim of Study 1 was to explore the nature of performances inside and between the relational frames of co-ordination and distinction with 7 participants with autism. The study also sought to identify the potential deficits the children had in this regard and how these might be remediated, with the use of protocol based on RFT. The secondary aim was to explore the relationship between relational responding performances and verbal ability. The study thus assessed each participant's expressive and receptive verbal abilities through the administration of two standardised verbal assessments. All of the participants readily responded, without training, in accordance with co-ordination. However, while one participant required some training (60 training trials) during distinction relations, six of the seven participants needed extensive training (between 240 and 880 training trials) during this stage. Three of these participants failed to meet distinction criterion despite extensive training.

In support of RFT, the results of Study 1 suggest that co-ordination is the most basic relational frame to be established. The findings also suggest that having the ability to respond relationally in accordance with co-ordination does not predict

the ability to respond relationally in accordance with distinction. This perhaps suggests that there is a difference between responding relationally on co-ordination and distinction trials. We know from applied research that initial skills targeted for acquisition in ABA programmes typically focus on areas of severe deficits that characterise autism spectrum disorder (e.g. Harris & Handleman, 1994). Imitation and matching are two important types of discrimination learning that provide the basis for teaching many complex behaviours (Lovaas & Smith, 1989), and are thus primary target skills for many children with autism. The data from Study 1, perhaps, suggests that participants had a different learning history for responding to co-ordination as they did for responding to distinction relations. It is very probable, given the particular participants involved in the current study, that a foundation for appropriate responding to co-ordination relations would be previously established. Furthermore, it would be also probable for this foundation to be lacking for responding to distinction relations.

It has been demonstrated by a number of researchers (e.g. O'Connor, et al., 2009) that relational responding skills, not previously established can be facilitated through the use of multiple exemplar training. However, the time-frame and the classroom restrictions that were in place during the current study perhaps did not permit the extent of training that many of the participants in the current study required in order to establish the level of relational responding required during the combined co-ordination and distinction relations. If this had not been not the case, perhaps a reinforcement history for responding to distinction relations could have been established, facilitating the establishment of relational responding in accordance with distinction.

Additionally, the current study used a match-to-sample (MTS) procedure which has been argued may function as a contextual cue for co-ordination, in that it's very format may be discriminative for matching stimuli that go together (Barnes 1994; Barnes & Roche, 1996). A non-match-to-sample procedure would have perhaps have yielded a different result during testing/training of distinction relations. This procedure was used by Barnes-Holmes (2001) to test and train derived transformation of functions in accordance with symmetry. Barnes-Holmes also noted that the MTS procedure is commonly used in preschool education exercises to teach picture-word co-ordination. Perhaps therefore, a non-MTS procedure would have allowed for a more independent analysis of responding during distinction trials in the absence of the contextual functions of the MTS procedure.

It has been reported that there are a number of pre-requisite skills to relational responding. For example, Pelaez (2009) proposed that the skills of joint attention and social referencing are pre-requisites for derived relational responding. Joint attention involves the use of eye contact and cues such as pointing, to co-ordinate one's attention with another in the sharing of an event (Mundy, Sigman, & Kasari, 1994). Social referencing involves an individual reacting to novel stimuli, by using the social cues provided by others in the immediate environment (Palez-Nogueras & Gewitz, 1997). The establishment of these skills may be relevant to the participants in the current study as deficits in these areas readily differentiate between typically-developing learners and those with autism (Dawson, Toth, Abbott, Osterling, Munson et al., 2004). Although such deficits were not explicitly noted by the researcher, an initial assessment of the participants may have highlighted the need to training such skills prior to relational responding testing/training. A deficit in pre-requisite skills such as joint attention and social referencing cannot, therefore, be

ruled out as a possible explanation for the difficulty in establishing relational responding skills with the children with autism in Study 1.

Another interesting pattern emerged from the relational responding data during Study 1. Three of the four participants who required minimal or no training during Non-arbitrary Co-ordination or Non-arbitrary Distinction Stages, did not reach criterion on the Non-arbitrary Combined Co-ordination and Distinction Stage. However, when, at a later stage, these responses were probed, it was found that participants were still performing at criterion level for both non-arbitrary co-ordination and non-arbitrary distinction trials, when tested separately. This suggests that having the ability to respond relationally to co-ordination and the ability to respond relationally to distinction, independently, does not predict the ability to differentially respond to the two relations when presented in a block of combined trials. There, thus, seems to be an additional variable involved in predicting the ability to rapidly respond differentially between co-ordination and distinction relations. This skill requires an element of flexibility in responding that was not evident among the majority of participants in the current study.

The suggested reasoning for these findings is supported by RFT's assumption that the more randomly combined the relational trials become, the greater the individual's flexibility must also become (Rehfeldt & Barnes-Holmes, 2009). In fact, relationally, flexibility is one of the skills deemed necessary for effective self-directed behaviour. According to RFT, intelligent behaviour involves flexibility because relational frames must come under increasingly subtle and flexible forms of contextual control (Hayes et al., 2001). It is believed that facilitating truly intelligent and creative behaviours requires more than the strengthening of relational responding; there is also a need to harness relational flexibility (Rehfeldt & Barnes-

Holmes, 2009). Although this hypothesis is not new (e.g. Cattell, 1971; Guilford, 1975), a recent study by O'Toole and Barnes-Holmes (2006) demonstrated that the degree of relational flexibility correlated with intelligence.

However, one participant in the current research; Participant 7, did pass the Non-arbitrary Combined Co-ordination and Distinction Stage. Although reaching this criterion required a significant amount of training (840 training trials), this participant then proceeded rapidly through the arbitrary testing without training. However, he then failed to reach criterion once combinatorial entailment trials were introduced. It is important when analysing this participants' data, to note, that the response procedure in place for this participant during these trials was a 'Yes'/'No' Picture Exchange Communication System (PECS). The rationale for the use of this procedure was that the participant was non-vocal and had in the past received training in using PECS in order to respond yes or no during natural and contrived opportunities throughout his school day.

It was found, however, that the participant was not fluent in responding via the Yes/No PECS. Specifically, he only responded using the 'Yes' picture card, regardless of the instruction. As reported in the data, Participant 7 responded correctly to the combinatorial entailment trials 50% of the time (see Table 11). This data would account for incorrect responding on the 50% of trials that required a 'No' response. Unfortunately, the time-frame of the current study did not allow for the training of this prerequisite skill in order to possibly facilitate responding to combinatorial entailments trials. However, this finding was reported to the classroom teacher and an intervention, independent of this research, was put in place to address this communication deficit.

All participants in Study 1 produced very weak overall performances on both verbal assessments prior to relational responding testing/training. No significant changes in verbal ability were detected, as measured by re-administration of the verbal assessments. One can thus conclude that relational responding training did not have a significant impact on the verbal ability of the participants employed in the current study. It may be worth noting that in Stage 1 (i.e. pre-relational training) the PPVT form A was administered and in Stage 8 (i.e. post-relational training) form B was administered. This procedure was in line with general psychometric re-testing recommendations in order to avoid practise effects. However, a more precise analysis of potential change in verbal ability may have been achieved by a re-administration of PPVT form A. It should also be noted that perhaps a different selection of verbal assessments that targeted more specifically the existing verbal skills of the particular participants involved in the current study would have yielded a better measurement their verbal skills and thus allowed for a more comprehensive comparison of verbal ability scores pre- and post-relational training.

There were, nonetheless, some interesting patterns in the data when performances on the verbal assessments and relational responding were compared across participants. As noted in Chapter 1, verbal ability may have an effect of relational responding performances (e.g. Devany et al., 1986; O'Connor, et al., 2009). However, the findings from the current study are somewhat contrary to previous research. Participants who scored the highest on the verbal assessments; PPVT and the K BIT, pre relational training (Participant 2 and 3) did not produce the highest performance on relational responding testing. Furthermore, Participant 7 was the only participant in Study 1 to reach criterion on all non-arbitrary tests and proceeded to arbitrary testing, yet he scored among the lowest in the verbal

assessments pre relational training. Nevertheless, Participant 7 was the only child whose performances improved (albeit very slightly) on the PPVT and the expressive vocabulary section of the K BIT, post relational responding testing/training. Additionally, although it is anecdotal data, an increase in spontaneous tacting following arbitrary relational responding training was also reported by this participant's tutor, who was unaware of the research objectives.

The aim of Study 2 was to replicate Study 1 with typically-developing children. All participants produced average performances on the PPVT and on the expressive vocabulary and matricies sections of the K BIT. All participants reached criterion for non-arbitrary relational responding in accordance with co-ordination and distinction. Only one participant required minimal training to reach criterion during Non-arbitrary Combined Co-ordination and Distinction testing. However, all other tests were passed without training. These findings are in line with predictions based on RFT; in general, no explicit training of co-ordination or distinction relations was required among typically-developing children.

The absence of arbitrary co-ordination trials in Studies 1 and 2 was due to procedural error. However, the only participant in Study 1 to reach the arbitrary stage of the study responded at 100% accuracy during arbitrary distinction relations without training. Testing/training on arbitrary co-ordination was not a necessary prerequisite stage for this participant. Similarly, in Study 2, all participants passed arbitrary relations without training, so we may conclude that arbitrary co-ordination testing/training was not a necessary prerequisite for these participants.

The aim of Study 3 and 4 were to test the relational responding skills in accordance with comparison and opposition, respectively, with typically-developing children. All participants reached criterion for both relations without training. Study

4 also involved the re-administration of verbal assessments. Overall, there were very minor changes in verbal ability pre- and post-relational responding testing/training. However, one participant's performance on the PPVT increased moderately (+23). These findings are in line with predictions based on RFT. No explicit training of comparison or opposition relations was required. And in turn there was, in general, no improvement in verbal ability reported for the participants employed in Studies 2, 3 and 4.

Overall, the research reported in this thesis demonstrated the disparity in both verbal ability and relational responding skills between typically-developing children, and those with autism. The findings also support previous studies (e.g., O'Connor, et al., 2009) that have highlighted the relationship between verbal ability and the ability to respond to various relations, such as co-ordination, distinction, comparison and opposition. Results support RFT predictions that higher verbal ability correlates with higher relational responding, as is evident in the comparison of results of the two groups of children. The current research successfully trained four children with autism to respond appropriately to relations of distinction, a repertoire that was not previously established. However, for some participants extensive relational responding training failed to facilitate the establishment of distinction or combined co-ordination and distinction.

Future RFT research may expand behaviour analyst's knowledge on different, perhaps more efficient methods of teaching relational responding, particularly among populations with autism and other developmental disabilities. Subsequent research may also strive to answer questions that arose from the current thesis; Is there something behaviourally different about responding to co-ordination relations and distinction relations, or is the individual's reinforcement history an

overarching factor in the establishment of these two relational frames?; Is the relationship between verbal ability and relational responding one of correlation or causation? Is it possible to improve verbal ability with relational responding training, as was suggested by Cassidy, Roche, and Hayes (2011), who successfully employed MET to establish a range of relational frames in young children, which subsequently correlated with improved performances on the Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV)?

The vast amount of procedural work that was involved in preparing relational responding testing and training for the current study highlighted the dearth of standardised procedures for testing and establishing relational responding skills in children. It is clear that researchers and practitioners in the field of ABA and RFT would benefit greatly from such standardised relational assessments and training procedures. Although the comprehensive work provided by Rehfeldt and Barnes-Holmes (2009), which fuses both RFT theory and clinical observations, was successful in offering a workable account of establishing relational responding, an advancement on this work incorporating findings from relevant applied research would perhaps make relational responding testing/training more accessible to researchers and practitioners alike.

It is clear that a number of theoretical and methodological issues are still to be addressed within the interlinked spheres of verbal behaviour, developmental disabilities and RFT. However, the body of research that has led us toward these answers will continue to have significant clinical implications in the field of behaviour analysis. The findings of many RFT studies, such as those mentioned in the current thesis, suggest promising predictions for future developments in relational responding and verbal ability interventions for children with

developmental disabilities. The research gathered thus far suggest that RFT may offer a functional approach to ameliorating the problems of rigid and non-generative language in children with developmental disabilities that are so often the criticisms of traditional language interventions in many ABA settings. It is hoped that the current thesis might make a small contribution towards the existing bridge between basic and applied RFT research in this regard.

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Appendix 1: Parent Information Sheet

Information about research:

Research Project entitled: Assessing the Relationship between Verbal Ability and Derived Relational Responding in Children with Diagnosed Autism Spectrum Disorder.

Researcher: Edel Galvin, B.A. Psychology.

Email: edel.a.galvin@nuim.ie

Supervisor: Dr. Yvonne Barnes-Holmes, Department of Psychology, NUIM

Tel: 01 708 6080

Your child is invited to take part in a research study. Before you decide if your child will take part, it is important for you to understand what the research is about. This information sheet will tell you what the research is about and what your child would be asked to do if you consent to his/her participation.

If you would like your child to take part, I will ask you to sign a Consent Form. If there is anything that you are not clear about, I will be happy to explain it to you or give you further information. Please take as much time as you need to read the consent form and information sheet.

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

Details about the Researchers

The research will be conducted by Edel Galvin, B.A. (Hons) Psychology, a registered student on the Doctorate in Psychological Science (Behaviour Analysis and Therapy), at the Department of Psychology, National University of Ireland, Maynooth (NUIM), Co. Kildare. Edel is a full time member of staff and can be contacted via email: edel.a.galvin@nuim.ie. The research will be supervised by Dr. Yvonne Barnes-Holmes, Department of Psychology, NUIM, who can be contacted via telephone: 01 708 6080, or email: Yvonne.Barnes-Holmes@nuim.ie. All research procedures will be supervised by the onsite BCBA

What is the purpose of the research?

The ability to relate things (e.g. same-different or more-less) is thought to be very important for advanced thought and language. The current research aims to address the following question: Are there connections between relational abilities and language ability?

What will the research involve if my child participates?

Study 1: The researcher will assess your child's verbal ability using two standardised tests. The first is the Peabody Picture Vocabulary Test-Fourth Edition (PPVT™-4; Dunn & Dunn, 1997) which assesses the language your child understands when it is spoken. The second is the Kaufman Brief Intelligence Test (K-BIT; Kaufman, A. S. & Kaufman, N. L., 2004) which assesses language your child can use. Each verbal assessment is carried out across 20-minute sessions or less with frequent short breaks.

Please note if there are plans for your child to have a formal IQ assessment within the next 6 months, you should exclude him/her from the research in order to prevent possible practice effects. Please be aware that if an IQ assessment is conducted within 6 months of your child participating in this research, the performances on that assessment may be impacted by practice effects as a result of participation in the research.

Your child's relational skills will also be assessed using published test procedures (Rehfeldt & Barnes-Holmes, 2009). As much as possible, relational targets will also involve his/her current educational targets and materials. For example, your child will be shown two pictures of identical animals to assess understanding of 'same' relations and two different animals to assess 'different'. More complex relations would be tested as follows: your child will be shown three identical pictures of a lion, and the researcher will say "Let's imagine that this lion (pointing to the first) is the same as this lion (pointing to the second) and that this lion (pointing to second) is somehow different to this lion (pointing to third). Then the researcher will then point to the first and third lion and ask the child "Would these two be the same or different?"

During these assessment trials, feedback will not be provided, but your child will receive positive reinforcement for attending to and attempting the task.
A similar format will be used for testing all of more complex target relations, but these will not be assessed if your child is unable to complete the more simple relational tests. The aim is, where possible, to assess: same-different relations; more-less relations; category relations (e.g. apple is a type of fruit); and perspective relations (Me-You).
Study 2 intends to teach relational responding starting at the task your child was unable to complete in Study 1, using a similar format to that used in the assessment trials outlined above.
At this point, you will be reminded by a letter from the researcher that you can opt to withdraw your child's participation. Please note that you may withdraw them for the research without any penalty.

The teaching procedures will use ABA methods, and involve positive reinforcement and frequent short breaks, as is routine school procedure. From the child's perspective, procedures will thus be similar to usual classroom teaching procedures.

When each relational skill has been taught (e.g. same-different, or more-less) the researcher will retest your child's verbal ability using the PPVT and the K-BIT to see if the score is the same, or higher, or lower than before.

When will the research be conducted?

Research will be conducted during the child's typical school-day for 20 minutes 3 or 4 times per week, similar to other programmes scheduled at school. These sessions will be scheduled in consultation with the Classroom Teacher. The timeframe of the research will be approximately 18 months and the projects will take place during the school year across 2012/2014. The research is expected to commence in November 2012.

How much time will it take to complete the research?

It is difficult to predict accurately the amount of time it will take an individual child to complete all research procedures but it is anticipated that it will take an average of

35 hours for participants to complete all assessments and training. This time frame will run across an 18 month time period.

Where will the research be conducted?

The study will take place in your child's usual classroom and under usual supervision, and will be conducted by the Researcher, and possibly up to two other ABA tutors with whom your child is already familiar in the school setting.

Feedback about my child's participation in the study

After the research I will be informed as to whether or not relational responding was shown to influence verbal ability. Any questions or concerns I may have regarding my child's participation in the study will be listened to and addressed as best as possible by the researcher, or referred to a more qualified person if necessary.

In accordance with the guidelines set out by the American Psychology Association (APA, 2000) individual results from the PPVT-IV and the K-BIT will not be made available to either the school or parents as doing because it is not the intention of this research project to guide any clinical or teaching decision. Should you (parent/caregiver) request access to your child's test results, you will be asked to make a formal written request and access will be provided (in accordance with current Freedom of Information legislation) with formal written advice from the researcher and supervisor that the test scores should not be used to guide clinical or other important decisions because the researcher is insufficiently experienced to interpret test results for this purpose.

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

Please note that there is no obligation or penalty of any kind for you or your child for not participating. There are no foreseeable risks or side effects attached to taking part in this study.

What if I give consent but my child doesn't want to participate?

We will attempt to gain consent from your child each time a session is commenced. We will monitor your child throughout to ensure that participation is voluntary on the part of your child and that he/she is not distressed or unhappy with participation.

If your child appears distressed by the research procedures, the session will be terminated. If a number of sessions are terminated, your child's participation will be reconsidered.

Confidentiality

All information collected about your child during the course of the research will be kept strictly confidential and only the primary researcher and research supervisor will have access to the data. The information collected will be stored in a way that protects your child's identity and no participant will be identified in any resulting research publication. All data collected using a paper and pen written records will be kept in a locked filing cabinet in the managing director's office at school. These data will be transferred to a secure computer system (which will be password protected and encrypted) at which point false names will be applied. Details of the link between the false names and participant identity will be kept in an encrypted file on a separate computer and will be retained for no less than 5 years. At the point that data are recorded in computer files, the paper files will be destroyed using a shredding machine. The anonymous computerised encrypted data files will be deleted after a period of 5 years.

*If during participation in this study you feel the information and guidelines that you were given have been neglected or disregarded in any way, or if you are unhappy about the process please contact the Chair of Departmental Ethics Committee, Dr. Bryan Roche. E-mail:*Bryan.T.Roche@nuim.ie

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

Thank you for taking the time to read this information

Appendix 2: Informed Consent Form

Research Project entitled: Assessing the Relationship between Verbal Ability and Derived Relational Responding in Children with Diagnosed Autism Spectrum Disorder.

Researcher: Edel Galvin, B.A. (Hons.) Psychology

Email: edel.a.galvin@nuim.ie

Supervisor: Dr. Yvonne Barnes-Holmes, Department of Psychology, NUIM

Tel: 01 708 6080

Please read and sign this form if you would like your child to participate in the research, thank you.

Research Project entitled: Assessing the Relationship between Verbal Ability and Derived Relational Responding in Children with Diagnosed Autism Spectrum Disorder.

I understand the following:

- The research will be conducted by Edel Galvin, a registered student on the Doctorate in Psychological Science (Behaviour Analysis and Therapy) at the Department of Psychology, National University of Ireland, Maynooth (NUIM) under the supervision of Dr. Yvonne Barnes-Holmes, Course Director and Lecturer at the Department of Psychology, NUIM. Procedures will be conducted with the consent of the school principle, and under the supervision of the onsite BCBA.

- The research should not be understood to be a treatment or intervention of any sort.
- All personal details about my child obtained during the research will be kept anonymous and confidential by the use of false names, and will not be shared with a third party without my prior consent. My child's confidentiality will be protected in any subsequent publication or presentation.

- All data will be stored securely; paper copies filed in a locked filing cabinet and computer records on a secure computer system (which will be password protected and encrypted). Data will be retained securely by the researcher for a period of 5 years, after which it will be destroyed (please see attached information sheet for full details).
- In accordance with the guidelines set out by the APA (2000) individual results from the PPVT-IV and the K-BIT will not be made available to either the school or parents as doing because it is not the intention of this research project to guide any clinical or teaching decision. Should I (parent/caregiver) request access to my child's test results, I will be asked to make a formal written request and access will be provided (in accordance with current Freedom of Information legislation) with formal written advice from the researcher and supervisor that the test scores should not be used to guide clinical or other important decisions because the researcher is insufficiently experienced to interpret test results for this purpose.
- I can withdraw my child's participation at any stage during the research without penalty or obligation for me or my child.
- There are no anticipated risks to my child; the student researcher Edel Galvin is responsible for adhering to ethical guidelines of the Psychological Society of Ireland, and the Behaviour Analysts Certification Board.
- I have been provided with an Information Sheet related to the research project.
- I will be given a copy of the above Information sheet and a signed Consent Form for my own records.

I have read and understand the information provided above and in the Information Sheet, and I agree voluntarily to my child's participation in the research.

Name of child: _____

Parent/Guardian Signature:_____

Researcher Signature: _____

Date: _____

Appendix 3: Non-arbitrary and Arbitrary Stimuli for Testing Comparison;

Study 3

Non-Arbitrary Test Stimuli:

Non-Arbitrary Novel Test Stimuli:

Arbitrary Test Stimuli Presentation:

Arbitrary Novel Test Stimuli Presentation:

Appendix 4: Non-arbitrary and Arbitrary Stimuli for Testing Opposition;

Study 4

Non-Arbitrary Test Stimuli:

Non-Arbitrary Novel Test Stimuli:

Arbitrary Test Stimuli Presentation:

Arbitrary Novel Test Stimuli Presentation: