ABSTRACT

Title of Document: FACTORS AFFECTING THE
                             GENERALIZATION OF "WH-" QUESTION
                             ANSWERING BY CHILDREN WITH
                             AUTISM.

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        The purpose of this study was to examine whether Relational Frame Theory

(Hayes, Barnes-Holmes, & Roche, 2001b) could be applied to increase generalization of

"wh-" question answering (e.g., what, why, how) by children with autism. Students

(N=6) from two self-contained classrooms for children with autism were taught to answer

"wh-" questions in the presence of magazine pictures, pictures from storybooks, and

actions in the natural context depicting a scenario related to the question asked.

Generalization to novel questions was then assessed. If students were not able to answer

generalized "wh-" questions to criterion, a matching-to-sample procedure with exclusion

was used to increase associations between stimuli.

        A multiple probe design across subjects was used for this study. A baseline of

"wh-" question answering, matching to sample, and receptive identification of answers

to questions were conducted prior to training. In addition, students were observed in the

classroom environment prior to training. A descriptive analysis of their verbal behavior,

in which antecedents, student responses, and consequences were recorded, was conducted

to determine the students' verbal behavior ability in the absence of a particular training program.

Two students, one in each school, were able to generalize to novel "wh-" questions after training. Both of these students were able to spontaneously tact items and had a higher number of tacts in relation to mands in the descriptive analysis. Individuals who did not generalize did not acquire relations using a matching to sample with exclusion procedure. They also emitted either an equal number of tacts and mands during the descriptive analysis or more mands than tacts.

Implications for practice include the consideration of waiting to include "wh-" question answering until students are able to emit a high number of spontaneous tacts and possibly early intraverbal behavior such as greetings, the elimination of visual stimuli when teaching "wh-" questions, and the expansion of matching-to-sample goals in behavioral curricula. Suggestions for future research include the continued research into the development of verbal behavior in children with autism, refinement of matching techniques to teach relations, and expansion of the descriptive analysis of verbal behavior.

FACTORS AFFECTING THE GENERALIZATION OF "WH-" QUESTION
ANSWERING BY CHILDREN WITH AUTISM.

By

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Dedication

This dissertation is dedicated to the children with autism whom I serve and their families. You teach me so much on a regular basis, and I pray that I can somehow "pay it forward."

Acknowledgements

It is said that "no (wo)man is an island." Indeed, this dissertation would not be finished if it wasn't for the many people who helped make this study a reality. First of all, I would like to thank Dr. Andy Egel for helping, guiding, and often going above and beyond the call of duty for me. I would also like to thank my committee members, Dr. Francey Kohl, Dr. Sherril Moon, Dr. Olivia Saracho, and Dr. Patricia Kurtz for agreeing to be on this dissertation committee. Their assistance and expertise was incredibly beneficial My data collectors and research assistants whose tireless dedication is impossible to measure, deserve many thanks,. Bonnie, Kateri, Layne, Amanda, Jessie, Amponsah, Lisette, Natasha, Becky, and Heather were invaluable. Sarah, Ron, Stefanie, and JP offered their time, expertise, and resources to make sure that I had the equipment and stimuli that I needed.

My family, and in particular my husband Ralph, have been there for this long road. They would never let me be a quitter, even in my darkest hour. I would be remiss if I did not thank the school systems and the teachers who graciously allowed me into their classrooms to collect data. Last but not least, I would like to thank the students and the parents for participating in this study. I am truly grateful.

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Chapter 1: Introduction

Children with autism have neurological difficulties that inhibit their ability to process stimuli in the environment and make learning extremely difficult. In order to diagnose autism, a child must exhibit a conglomeration of symptoms that include impaired social interaction (such as lack of interactions with peers and social and emotional difficulties), difficulties with communication (such as lack of speech which is not compensated by gestures or sign, or repetitive speech), and circumscribed and repetitive interests (Scott, Clark, & Brady, 2000).

Most students are diagnosed with autism prior to age three. The exact cause of autism is unknown; it is the consensus of most professionals that autism is a biogenetic disorder that most likely has multiple causes (Scott et al., 2000). A recent study of six sites in 2000 and fourteen sites in 2002 estimated the prevalence of autism as approximately 1 in 150 (Centers for Disease Control, 2007). In 2003, over 140,000 children with autism between the ages of 3 and 21 were served under the Individuals with Disabilities Education Act part B (Weststat, 2005). There are about four times more males than females, but females tend to be more severely affected than males. About 80% of children with autism have IQ scores that indicate the co-existence of mental retardation, although mental retardation is neither necessary nor sufficient for a diagnosis of autism. In fact, there are many individuals with IQs similar to those with typical development, and others score in the high ranges of intelligence (American Psychiatric Association, 2000; Scott et al., 2000).

This chapter explores several topics that provide the basis and rationale for this study. First, language and communication issues for children with autism are explored.

Second, issues with generalization and the particular problems that children with autism face are reviewed. Third, the applications of Relational Frame Theory, and in particular stimulus equivalence, are presented. Lastly, I present the research questions that guide the methodology for this study and its contribution to the existing body of literature.

Language and Communication Issues for Children with Autism

Difficulties with conventional language acquisition have been blamed for impairments in social interactions as well as increased problem behavior (E. G. Carr & Durand, 1985; L. K. Koegel, 1995; Sundberg & Partington, 1998) Without intervention, 21-61% of students do not develop communicative speech, and this seems to be the biggest predictor of parental stress (Lord & McGee, 2001; Scott et al., 2000). There is evidence that individuals with autism who learn to use speech by the age of 5 have better outcomes overall than individuals who do not (Woods & Wetherby, 2003).

Pragmatics seems to be the most impaired aspect of language and communication in children with autism. Issues with understanding idiomatic language, reversals of pronouns, and unconventional use of speech (idiosyncratic language) are all often seen in children with autism (Mesibov, Adams, & Klinger, 1997; Scott et al., 2000) Some students engage in preservative speech (staying on the same topic long after it is appropriate) or add irrelevant detail to conversations.

Communication seems to be the most salient predictor of outcome and the development of relationships with others (Woods & Wetherby, 2003) As defined by Layton and Watson (1995), communication is "(the) ability to let someone else know that you want something, to tell someone about an event, to describe and action, and to acknowledge another person's presence" (p. 76). It has been suggested that autism is an

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impairment more of communication than language (Jordan & Jones, 1999). Before 1980, most definitions of autism focused upon the idiosyncratic structures of language such as pronoun reversal. The diagnostic criterion shifted from structure to function when autism was formally entered as a diagnosis in the DSM-III (Lord & McGee, 2001).

Although most children with autism who speak have a good grasp of linguistic structure, the use of language for communicative purposes is almost always impaired to some degree. Often speech tends to be interpreted as formal and pedantic (Howlin & Moore, 1997; Woods & Wetherby, 2003). Some individuals may use unconventional means to convey meaning, such as growls, grunts, or problem behavior (E. G. Carr & Durand, 1985; Jordan & Jones, 1999; Woods & Wetherby, 2003). When communication breaks down, children with autism are less likely to use repair strategies (i.e., attempting to alter the delivery of a message so that the function more closely matches the intent) than other individuals (Prizant & Schuler, 1987; Schuler, 1995).

There are several skills associated with communication that must be in place for the interaction to have the desired effect. What is critical for most interventionists is that the child's communicative intents are understood by the individuals in the child's environment (Scott et al., 2000). In other words, communicative intents on the part of the speaker must match the functions of the communicative acts that are displayed. Intent must equal function for effective communication to occur (Prizant & Schuler, 1987).

Although much is known about the problems with communication and conventional language usage by children with autism, little is known about how or why these problems develop. There are few long-term studies that look specifically at the language development of children with autism; therefore, it is impossible to say whether

children with autism acquire what they do know in the same manner as children with typical development. It is also unclear as to what makes one child with autism choose conventional means to communicate while another chooses unconventional means. It is uncertain, for those who "recover" from autism (that is, regain or learn skills that are similar to their peers without disabilities), whether they typically acquire skills in the same pattern as their peers. These are questions that need to be addressed for curriculum development purposes (Prizant, 1996).

Generalization and Learning by Children with Autism

Another question that needs to be addressed is the most effective method for teaching skills to children with autism to ensure that they generalize to non-teaching situations. In addition to difficulties with learning and communication, children with autism often have difficulty generalizing learned material to novel settings, people, and stimuli (Siegel, 2003). For example, a child may be taught to answer "what is your name" in the classroom, and perform the response without errors. Once in the community, however, the child might not be able to respond to a police officer or someone working in a store. Many children would also have difficulties if the question was varied (e.g., "who are you?"). One of the major issues interfering with generalization by children with autism is stimulus overselectivity, or the tendency to respond to narrow or irrelevant cues (Barthold & Egel, 2001; Lovaas, Schreibman, Koegel, & Rehm, 1971).

Stimulus overselectivity. Students with autism often display stimulus overselectivity. This is a phenomenon in which students selectively respond to irrelevant or narrow cues in the environment (Lovaas et al., 1971). For example, a student may

learn to count coins in the classroom when given instruction, but may be completely unable to count coins in the cafeteria. Problems with responding may be due to the fact that s/he learned to count using plastic coins in the classroom, and therefore, the student cannot count the metal coins. It also may be that the student with autism has learned to respond only in the presence of the teacher but not in his/her absence. Finally, the student with autism may associate the classroom with coin counting, and therefore, coin counting does not generalize to other environments. There is some evidence that students with autism have impairments in quickly shifting attention from one stimulus to another (Rinehart, Bradshaw, Moss, Bereton, & Tange, 2001). Although very little applied work has been done regarding the effects of stimulus overselectivity (see Barthold & Egel, 2001, for a review), numerous anecdotal reports as well as basic research has documented that overselectivity is a serious barrier to generalization and needs to be addressed (Scott et al., 2000). Therefore, programming for generalization is crucial to instruction.

Selected methods for the remediation of generalization problems. Several methods exist for the remediation of generalization problems (Stokes & Baer, 1977) One common method for increasing the generalization of learned skills is using multiple exemplars, or teaching a subset of targets that represent the class of behaviors that the student will be required to emit in the natural environment (Stokes & Osnes, 1988). An emerging theory of language and cognition that draws from the literature on multiple exemplar training is Relational Frame Theory (RFT; Hayes et al, 2001). Relational Frame Theory is a behavioral theory and asserts that novel communicative responses are a product of multiple exemplar training. However, randomly choosing multiple exemplars might not be enough.

In multiple exemplar training, a set of stimuli that are representative of the targeted class are selected. These stimuli share the relevant features that define the class, but have different irrelevant features. For example, to teach a class of stimuli that represent "running", a teacher may select a picture of a man running in a park, a videotape of a group of people running a marathon, and a magazine picture of a cartoon character running from a dangerous situation. The expectation is that, if a sufficient number of exemplars are taught, generalization to untrained members of the class will emerge (Alberto & Troutman, 2003).

Very little literature exists, however, on the impact of multiple exemplar training on language targets. Unlike other instrumental behaviors, language is a "moving target" which requires classification and immediate attention to complex stimuli. Relational Frame Theory addresses the impact of multiple exemplar training on communicative competence as well as its relationship to teaching children with communication deficits.

Relational Frame Theory, Multiple Exemplars, and Language and Communication

A recent theoretical approach to language development has as its hallmark multiple exemplars. Relational Frame Theory (Hayes, Barnes-Holmes et al., 2001b) is a behavioral account of language and cognition that has its roots in stimulus equivalence (Sidman, 1994). According to stimulus equivalence theory, learning the relations between class A and class B, and class B and class C, often leads to relations between class A and C emerging without formal training (Catania, 1998).

Three conditions must be met in order for an equivalence class to be in place. The first is reflexivity (A=A). All stimuli within a class must be equal. The second is symmetry (A=B). That is, if A=B, then B=A. The third is transitivity. If A=B and B=C,

then A=C. Figure 1 shows a graphic display of basic equivalence relations. Basic

equivalence relations have been shown with adults (Bush, Sidman, deRose, & Tania,

1989; Sigurdardottir, Green, & Saunders, 1990; Tyndall, Roche, & James, 2004; Wulfert

& Hayes, 1988), children with typical development (Boelens, 1992; Smeets & Barnes-

Holmes, 2003; Torgrud & Holborn, 1989) and individuals with developmental

disabilities (Rehfeldt & Root, 2004; Saunders & McEntee, 2004). Although symmetric

and reflexive relations have been shown in nonhumans, transitive relations have never

been shown definitively (Hayes & Hayes, 1992).

Figure 1. Basic Sidman equivalence relations.

A
Picture

Key:
------ Derived Relations
_____ Explicitly Instructed
Relations

B
Spoken word

C
Written Word
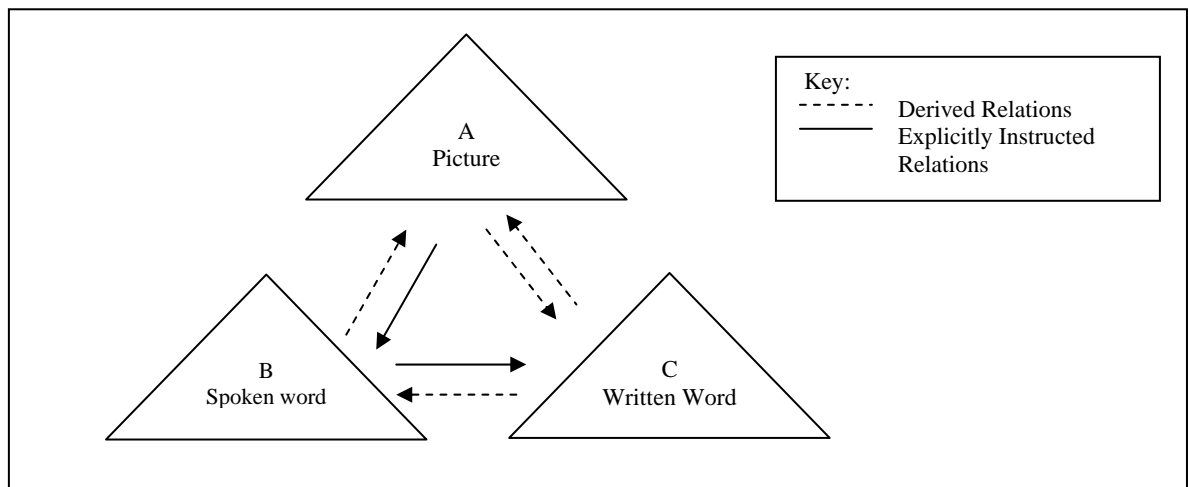
Many authors suggested that stimulus equivalence is a hallmark of language

development and semantic relations (Hayes & Hayes, 1992; Wulfert & Hayes, 1988).

One must be able to match a sample to itself (reflexivity), be able to equate the name of

that stimulus (symmetry), and then be able to use that name generatively (transitivity).

Matching to sample, as described in the preceding paragraph, is considered to be a

prerequisite of language in most behavioral intervention programs for children with

autism (Leaf & McEachin, 1999; Maurice, Green, & Luce, 1996). The Edmark reading

program (Bijou, Birnbrauer, Kidder, & Tague, 1966) also relies heavily on matching-to-sample as a prerequisite skill to reading.

Some preliminary evidence exists that equivalence plays a major role in the development of generative communication, although not necessarily spoken words. Devaney, Hayes, and Nelson (1986) found that preschoolers with spoken language were more likely to learn arbitrary discriminations that did not involve language than those without spoken language. Duker and Michielsen (1983) taught manual signs and verbal responses that corresponded to a picture. However, teaching these two responses did not transfer to verbal naming of the sign. Carr and Felce (2000) suggested that typically developing children learn vocabulary through exclusion; that is, words take on a broad meaning initially, and their meaning is refined as stimulus classes increase. Trained relations are systematically "unlearned" through this process. Exclusion training was effective for teaching the names of food items to an 18-year-old with autism and multiple disabilities, and the effects were replicated with a man with Down syndrome (McIlvane, Rass, O'Brien, Gerouvac, & Steddard, 1984). Equivalence classes have also been referred to in the literature as "semantic fields", and flexible semantic fields are considered germane to decreasing overselective responding by individuals with autism (Boser, Higgins, Fetherston, Pressler, & Gordon, 2002).

Reading and spelling have been taught in the majority of applied studies of stimulus equivalence by having participants match picture to spoken word and picture to written word. Spoken words often emerge without further training, giving preliminary evidence for the use of equivalence in the teaching of reading (Sidman, 1971; Sidman & Cresson, 1973). Snell (1978) delineated a whole-word reading instruction program

based upon the work of Sidman (1971) and Sidman and Cresson (1973). This program uses systematic matching procedures, from matching picture to picture to names to finally words – to teach both decoding and comprehension skills. Hoogeveen, Smeets, and Lancioni (1989) used the stimulus equivalence paradigm to transfer reading stimulus control from pictoral prompts to letter sounds through increasingly complex phonetic patterns. This training procedure led to generalization to untrained words. Sidman's work forms the basis for the Edmark reading program (riverdeep products, 2005) which is still in use today as a remedial program for struggling readers and readers with developmental disabilities.

Equivalence relations have been used to teach skills other than reading to individuals with disabilities. Stimulus equivalence has been used to increase the identification of state capitals and their location for children with autism (LeBlanc, Miguel, Cummings, Goldsmith, & Carr, 2003), teach coin combinations (McDonough, McIlvane, & Stoddard, 1984; McIlvane et al., 1984; Stoddard, Brown, Hurlbert, Manoli, & McIlvane, 1989), and sort laundry (Bock, 1994, 1999).

There are, however, several limitations to the body of applied literature on stimulus equivalence. Most studies do not employ a research design in which replication occurs within or between participants and are presented as brief reports. Subject descriptions are often incomplete, making replication and the extension of the literature to applied situations difficult (O'Donnell & Saunders, 2003). Prior learning histories are often a confounding variable, and individuals with poor matching-to-sample performance are often dropped from the studies. Therefore, application of stimulus equivalence to individuals without matching-to-sample (MTS) repertoires is also difficult (O'Donnell &

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Saunders, 2003). Sorting is sometimes seen as analogous to MTS; however, some evidence exists that some individuals with disabilities are more adept at sorting than matching (Shimizu, Twyman, & Yammamoto, 2003). Although theoretically large equivalence classes can emerge quickly (Saunders, Wachter, & Spradlin, 1988), classes larger than 5 or 6 stimuli are rarely seen, and if so, are presented in the context of basic studies (Sidman, Kirk, & Willson-Morris, 1985). Saunders et al. (1988) were able to teach 8-member classes to individuals with mild to moderate mental retardation; however, replications with classes as large as this were not available. Applied studies are carried out with designs that mimic basic research and are most likely best seen as bridge studies (see LeBlanc, Miguel, Cummings, Goldsmith, & Carr, 2003, for a notable exception).

Most available studies that teach spelling and reading do not test comprehension within the context of natural environments or bodies of text. Hoogeveen, Smeets, and Lancioni (1989) found that teaching reading using stimulus equivalence led to low rates of comprehension. Therefore, it is still not known whether equivalence training is an effective procedure for teaching reading and comprehension in the applied arena.

Another limitation to the stimulus equivalence theory is the type of relations that can be taught. Many relations are neither reflexive nor symmetrical. For example, relations such as big-little or fat-skinny are conditional relations. However, "big" does not equal "little" and "fat" does not equal "skinny". Hayes et al. (2001) extended the stimulus equivalence paradigm through RFT to include relations that are not symmetrical. They also provided a framework for how classes expand or generalize without explicit training of A and B relations.

Relational Frame Theory is based upon the concept of "arbitrary derived relational responding" (Hayes, Barnes-Holmes, & Roche, 2001a). Although some relations are easily bound by their formal properties (e.g., big versus little), most categories are bound by abstract stimulus features. For example, there are very few formal properties in common between an electronic music piece and a piano minuet; however, both are considered musical artwork. A car horn, however, is not considered art, even though it shares many formal properties with the electronic music. Arbitrary relations do not necessarily need to share structural or functional characteristics to "hang together". Most relations are derived or not explicitly trained. A small number of exemplars are typically taught and differentially reinforced. Once a relation is "framed" through these exemplars, the basis is set for complex relationships between infinite numbers of stimuli.

The properties of relational classes, mutual entailment, combinatorial entailment, and transformation, mirror those of equivalence classes, but are defined much more broadly to account for relations that might not be reflexive or symmetrical. *Mutual entailment* is defined as the logical relation between two stimuli. If A is fatter than B, then B is skinnier than A. Mutual entailment allows *frames of coordination* to be formed. *Combinatorial entailment* relates most closely to the idea of transitivity in equivalence theory. That is, if A is fatter than B, and B is fatter than C, then one may derive that C is skinnier than A without direct instruction. *Transformation* refers to the growth, expansion, and refinement of stimulus classes over time (Hayes et al., 2001). Common frames include but are not limited to opposition, distinction, and temporal and spatial relations.

Although much evidence exists for the existence of stimulus equivalence, the majority of studies using RFT as a theoretical framework do not study relations beyond the parameters set up by Sidman (1994). Most of the research on derived relations is done in a basic research format with typically developing adults and children (e.g., Y. Barnes-Holmes, Barnes-Holmes, Smeets, & Luciano, 2004; Hayes & Bissett, 1998; Roche, Barnes, & Smeets, 1997). Applied examples of RFT involving children and adults with disabilities are beginning to appear in the literature, although most of the studies conducted are not as of yet readily available in peer-reviewed journals. Much of the data cited by Barnes-Holmes, Barnes-Holmes, and McHugh (2004) were from presentations at conferences which are not available for review nor peer-reviewed.

According to RFT theorists, concepts are framed through multiple exemplar training. Exemplars are selected that share similar features, and the learner is taught the cues to which they are to respond. This is typically done through the use of a matching-to-sample procedure. Once a sufficient number of exemplars have been taught and reinforced, a frame emerges, which then allows for generative responding. Grammar is considered a relational frame – once grammatical forms are taught, and infinite number of generative phrases can emerge (D. Barnes-Holmes, Hayes, Dymond, & O'Hora, 2001). However, it is important that RFT is considered a functional account of responding, not a structural account – it is only by observing responding under the same arbitrary conditions that one can say that responses are similarly framed.

There are few applied studies, however, that examine the role that multiple exemplar training plays in the instruction of verbal behavior maintained by the verbal behavior of others (i.e., intraverbals; Skinner, 1957), such as answering "wh-" questions

by children with autism. Existing data suggests that it is crucial to teach these multiple

exemplars in carefully constructed frames in order to insure generalization to novel

forms.

Multiple Exemplar Training and Answering "wh-"Questions

Answering "wh-"questions such as "What is the child doing?" is considered to be

a critical skill for reciprocal communication. Although many programs include

answering "wh-" questions as a goal, few empirical articles are available that assess

methodologies for teaching students how to answer them and assess generalization of

learned responses. As part of a larger study that assessed procedures to teach advanced

language skills to students with autism, Krantz and McClannahan (1981) utilized

magazine pictures to teach students to answer several "wh-" questions. Three children

with autism, ages 5-7, participated in this phase of the study. Larger concepts ("what",

"why" "how") were broken into smaller subconcepts by the authors. For example, the

larger concept of how was broken into five subconceps: 1) affect, 2) quantity ("how

many?") 3) time, 4) future actions, 5) and relating to means. Subconcepts were then

trained individually and larger concepts were probed for generalization. Training

increased the probability of generalization to untrained targets.

Secan, Egel, and Tilley. (1989) attempted to increase generalization of "wh-"

question answering by utilizing stimuli other than magazine pictures for conditions where

training with magazine pictures alone were not effective in producing generalized

responses. They conducted booster sessions with pictures from a storybook and actions

occurring in the natural context. When training stimuli were varied, most students were

able to answer questions in novel settings and with novel assistants. Generalization

probes to novel questions produced higher correct responding, but additional training was necessary for some participants to increase correct responding.

Secan et al. (1989) found that students were more likely to correctly answer questions when visual cues were available. Jahr (2001) attempted to replicate the work of Secan et al. (1989) without using any visual cues to prompt responding. In this study, students were not given any type of extra stimulus prompts (e.g., pictures) and were required to answer questions in complete sentences. The author found that when students were required to respond in complete sentences to questions in which the topography of the question and the answer were similar (e.g., "what do you drink from?" "I drink from a cup") students were able to generalize to novel questions.

Barthold et al. (2003) attempted to systematically replicate the Secan et al., (1989) study. The authors used magazine pictures, storybook pictures, and natural context questions as the original training stimuli. Two students with autism ages 9 and 10 participated in the study. The two students in this study learned the responses to the training stimuli; however, they did not generalize to novel questions. Crucial differences in the Barthold et al. (2003) study and the previous three studies are readily apparent. Anecdotal and videotaped evidence of the subjects in Barthold et al. (2003) study suggest that these students did not generatively use vocal language for communication beyond requesting, and although this is consistent with the participants in Krantz and McClannahan (1981), the subjects in the latter study had instruction on using simple sentences prior to the study. Individuals with lower language scores and no spontaneous speech as described in Secan et al. (1989) needed more remedial training to generalize

"wh-" questions than those with higher scores and more spontaneous speech. All of the participants in Jahr's (2001) study were able to answer questions in complete sentences.

Question categorization may have played a crucial role in generalization as well. Krantz and McClannahan (1981) stated, "it is important to define (questions) as separate classes of stimuli" (p.274) because anecdotal evidence at the time suggested that generalization to other classes is rarely seen. The question categories (what, why, & how) in Barthold et al. (2003) were much more broadly defined than they were in the Secan, et al. (1989) study and Krantz and McClannahan (1981), possibly leading to confusion and poorly defined stimulus classes. However, Jahr (2001) also used broadly defined stimulus classes. The subjects in this study were also described as having high levels of verbal skills. Therefore, it is possible that verbally higher functioning children are able to respond more generatively to broadly defined stimulus classes.

Although some evidence suggests that multiple exemplars is an efficient method for promoting generative responding, there is not any available research on how to define a class so that its elements are taught efficiently and so that classes expand and generalize. There seems to be a developmental pattern to the formation of relational framing as well as stimulus equivalence, although naming seems to be unnecessary for the development of stimulus classes (O'Donnell & Saunders, 2003). Green (1990) taught auditory to visual discriminations and visual to visual discriminations to five females with mental retardation. Auditory-to visual classes were most easily learned, and participants were more likely to name auditory-visual stimuli than they were visual-visual stimuli. Peoples, Tierney, Backen, and McKay (1998) found that symmetry relations were more readily maintained when paired with already acquired relational stimuli.

Generative relations are learned through multiple exemplar training and differential reinforcement. According to Hayes et al. (2001), mutual entailment seems to emerge at about 16 months of age, but combinatorial entailment does not emerge until much later (Barnes & Brown, 1995; Hayes & Hayes, 1992; Murphy, 2001a). By 23 months, most simple relational frames are created (Hayes et al., 2001). At first, classes closely resemble the exemplars that they are taught (e.g., all males are "daddy") and tend to be more simplistic in nature. As the child has more contact with the environment and responses tend to become more differentially reinforced, these classes grow and expand (Barnes & Brown, 1995; Dale, 2002). Well-known relations, when paired with novel relations, seem to influence responding to the novel relations (Goss, 1971; Roche et al., 1997).

Existing preliminary literature suggests that more narrowly defined stimulus classes might be more conducive to learning certain concepts as opposed to more broadly defined classes (Dale, 2002). Little is known, though, about the specific exemplars needed to create a class within a communicative context. Therefore, it is possible that there are certain prerequisite language skills that have yet to be identified that promote generalization of "wh-"questions. It is also possible that choosing random exemplars from broad categories may in fact hinder the formation of derived stimulus relations.

Recent evidence provides some preliminary support that multiple exemplar training might increase the verbal behavior of individuals with developmental disabilities. These studies examined the role that relational framing might play in the acquisition of tacts and mands. Skinner (1957) defined tacts as similar to requests; mands are verbal behaviors that typically result in receiving a reinforcer directly related to that item (Skinner 1957).

Greer, Stolfi, Chavez-Brown, and Rivera-Valdes (2005) taught three 3-4 year old students with developmental disabilities to match identical objects, using a delayed multiple baseline design. The teacher named the object with each successful trial. Pointing, expressive labeling (known in Skinner's analysis of Verbal Behavior as tacting; Skinner, 1957), and answering the question "what is it?" were then probed. Multiple exemplar training increased slightly the number of novel words identified. This study, however, had several limitations. Only three novel responses were tested, one from each condition. Given that students had already high responding in the baseline condition (which was attributed to chance) it is difficult to determine whether multiple exemplar training is the most salient explanation for the increase in responding.

Halvey and Rehfeldt (2005a) examined whether establishing some class members as requests (mands) would increase the use of other class members as mands. Three adults with severe disabilities and limited communication participated in this study. The participants were taught to request specific items in the class. Remaining items were taught using conditional discrimination training (matching the picture to the actual item). Novel requests were then tested. All students acquired the stimulus relations and trained vocal requests, but needed interspersed conditional discrimination training and request training interspersed to increase generalization to untrained requests. However, as with Greer et al. (2005), some stimulus relations were at 100% at baseline, which raises the possibility of prior learning as an alternate explanation for the establishment of stimulus classes. Therefore, more research is needed to determine whether conditional discrimination training increases novel responding with individuals with disabilities, and

whether these training procedures can assist in increasing language and communication skills.

Current Study

The current study seeks to extend the work of Secan et al. (1989), and Barthold et al. (2003) using similar procedures to Halvey and Rehfeldt (2005) and Greer et al. (2005). Students who were unable to answer "wh-" questions in baseline conditions were subsequently be assessed using a matching to sample procedure to determine whether they demonstrated relational responding. Baseline naming baselines were also conducted to determine whether students could receptively identify responses to "wh-" questions. The students were then instructed to answer 10 members of a class of questions defined by Krantz et al. (1981; see Table 1 for list of classes). Once criterion was established, the students were tested for generalization to novel questions in the same class. If a student did not generalize, equivalence instruction was conducted with that student using a matching to sample procedure. Exclusion training was conducted concurrently with matching to sample, in which the students were instructed to "put with different" as opposed to "put with same." (D.Carr, 2003; McIlvane et al., 1984). It was hypothesized that for students who did not show generalized responding during training, conditional discrimination training would increase the number of novel questions students were able to answer.

This study has significance for the teaching of generalized question answering, as well as implications for the refinement of behaviorally-based curricula for children with autism. The implications of a successful study are as follows. Matching and sorting might no longer be considered a preliminary skill abandoned once the child has mastered

sorting in the traditional fashion. Instead, sorting and matching should be interspersed throughout the curriculum, not just as a program at the beginning of discrete trial training and abandoned (e.g., Leaf & McEachin, 1998). It is possible that matching and sorting could be used as pretraining for any program requiring a language-based response. It might also reduce the likelihood of overselective responding because the student would need to attend to the distinctive stimulus features that create the class before training. Empirical evidence for careful considerations of the elements of a response class would suggest that choosing multiple stimulus items is not sufficient to produce Derived Relational Responding for "wh-" questions.

<div align="center">Research Questions</div>

1. Does teaching matching and receptive naming of actions correlating to visual stimuli to students with autism increase the probability of generalized answering of "wh-"questions?

2.   Do students with autism who show relational responding formation also show greater levels of generalized "wh-" question answering?

3. Do students with autism with lower verbal repertoires have more difficulty deriving relations than those with more advanced verbal repertoires?

Definition of Terms

   "Wh-" questions. Any question which gives the asker more information about a stimulus is considered a "wh-" question. This study focuses on three different types of "wh-"questions and their subcomponents: "what", "why" and "how" An example of a "wh-" question is "What do you put on your feet?" (ESL Gold, 2002).

Autoclitics. Autoclitics refine other verbal operants by describing, qualifying, or quantifying them. For example, in the utterance "sometimes it's raining", "sometimes" functions as an autoclitic (Skinner, 1957).

Conbinatorial entailment. Combinatorial entailment is an element of derived relational responding similar to the concept of transitivity in stimulus equivalence theory. If stimulus A is older than stimulus B, and B is older than C, then one may derive that C is younger than A without direct training.

Derived relational responding (DRR). Derived relational responding is the central concept behind relational frame theory. When sufficient exemplars of a relation are taught, novel forms emerge without being explicitly instructed. Most relations are "arbitrarily derived", which means that they are bound by abstract and not easily described properties as opposed to formal properties. For example, although a wolf and a German shepherd share several formal properties, they are usually not grouped in the same stimulus class. However, a Chihuahua and a German shepherd share many less formal properties but are grouped in the class of dogs.

Discrete trial teaching (DTT). Discrete Trial Teaching is a behavioral method for teaching developed by O. Ivar Lovaas and colleagues (Lord & McGee, 2001; Lovaas, 1981; Mesibov et al., 1997). The discrete trial is a short teaching opportunity which consists of a distinct presentation of a stimulus and an instruction (e.g., "clap your hands"), a short time frame in which the child is expected to respond, reinforcement for correct responding using food, tangibles and/or verbal praise, and specific error correction procedures. The curricular sequence based upon DTT and developed by

Lovaas is also sometimes referred to as *Discrete Trial Teaching*, *Lovaas*, or *Applied Behavior Analysis* (Maurice et al., 1996).

Echoics. Echoics are the repetition by the listener of another speakers' utterance. In order for a response to be classified as an echoic, there must be point-to-point correspondence between speaker 1's utterance and speaker 2's utterance. For example, if a parent says, "ma-ma" and the child repeats "ma-ma", the child's utterance would function as an echoic (Skinner, 1957).

Exclusion training. Exclusion training refers to a teaching and experimentation method similar to matching to sample. A sample stimulus is presented and the student/subject is expected to match that item with a dissimilar item. At least one *distractor* stimulus (e.g. a functionally or topographically similar item to the sample) is present. The student must discriminate between the similar and dissimilar items and match the sample to the dissimilar item in order for the trial to be successful (Catania, 1998). Exclusion training enhances matching to sample training by teaching nonexamples of a stimulus class.

Function of verbal behavior. The function of verbal behavior is the effect of an utterance on the environment. From a behavioral perspective, this is directly related to the reinforcing contingencies contacted as a result of the utterance. For example, the presence of a stimulus in the environment might evoke a request for that item. The receipt of that item would reinforce requesting in the future (Catania, 1998). From a cognitive perspective, the function of verbal behavior should match the intent of the utterance (e.g., what the speaker is attempting to communicate) for a successful conversational interchange to occur (Owens, 1996).

Generalization. Generalization is the ability to respond to novel stimuli in the environment. For example, a student can put on a pair of sneakers when taught only to put on dress shoes has generalized the response (Catania, 1998).

Induction. Induction is the ability to produce a novel response when presented with a known stimulus. For example, a child who has been taught to say "hello" and says "what's up" as a greeting without being explicitly taught the second greeting has emitted an inductive response (Catania, 1998).

Intraverbals. Intraverbals are verbal behavior which are often evoked by another's verbal behavior but do not have the point-to-point correspondence of and echoic. An interchange in which one person says, "what's going on?" and a second person replies, "not much" would be an example of an intraverbal (Skinner, 1957).

Mands are verbal behavior which specify the maintaining reinforcers (Skinner, 1957). Examples of mands are requests, commands, and questions (which are maintained by access to information).

Matching to sample. A teaching and experimentation method in which a sample stimulus is presented and the student/subject is expected to match that item with a similar or identical item. At least one *distractor* stimulus (e.g. a functionally or topographically dissimilar item) is present. The student must discriminate between the similar and dissimilar items and match the sample to the similar item in order for the trial to be successful (Catania, 1998).

Motivating operations (MO). Motivating operations serve to enhance or diminish the reinforcing or punishing properties of stimuli. MOs can serve an *evocative* effect, in

which the properties of the stimuli are enhanced, or an *abolishing* effect, in which the properties of the stimuli are diminished.

Multiple exemplar training. Multiple exemplar training is a method for programming for generalization in which a set of stimuli representative of a stimulus class are chosen for instruction. For example, a child might be taught to identify several different pictures of dogs. If multiple exemplar training is successful, the child will be able to identify pictures of dogs not explicitly taught (Alberto & Troutman, 2003).

Mutual entailment. Mutual entailment is a concept related to Relational Frame Theory and Derived Relational Responding. It is defined as the logical relationship between two stimuli. For example, if stimulus A is older than stimulus B, then B is younger than A. Mutual entailment allow *frames of coordination* to be formed (Hayes, Barnes-Holmes et al., 2001a).

Naming. Naming refers to the ability to receptively and expressively identify items using conventional spoken language. It is considered a subset of tacting (Skinner, 1957).

Question subcomponents. Subcomponents are further refinements of the larger "wh-" question categories used in this study. A table of the subcomponents and sample questions from each subcomponent are presented in Table 1.

Reflexivity. A condition of stimulus equivalence, reflexivity refers to stimuli being matched to themselves or that A=A. For example, two pictures of a rose are equal (Sidman, 1994).

Relational Frame Theory (RFT). Developed by Hayes and colleagues, RFT expands upon the theory of *stimulus equivalence*, which attempted to describe how

individuals respond to novel stimuli with novel responses (Hayes, Barnes-Holmes et al., 2001b). RFT expands upon stimulus equivalence theory to include relations that are relative (e.g., time and size) as opposed to equal (e.g., spoken and written words).

Response class. A response class is defined as a group of responses maintained by similar contingencies. For example, a student may choose to point to a cookie, sign "cookie", or verbally request a cookie. All three will most likely result in the child accessing the cookie (Catania, 1998).

Stimulus class. A stimulus class is defined as a group of environmental happenings or objects to which individuals are inclined to respond to in a similar manner. For example, when shown a yellow rose or a white rose, individuals are likely to use the word "rose" to describe both (Catania, 1998).

Stimulus equivalence. Equivalence is a theory of how organisms respond generatively to novel stimuli. Upon learning relations between class A of stimuli (e.g., written word) and class B of stimuli (e.g., spoken word), as well as relations between class B and class C (e.g., pictures), a human will be able to then derive relations between classes A and C without explicit training (Sidman, 1994). A graphical representation of stimulus equivalence is presented in Figure 1.

Stimulus overselectivity. Stimulus overselectivity refers to the tendency by children with autism to respond to narrow or irrelevant cues in the environment. For example, a student may respond correctly when asked to sort utensils only when plastic utensils are used (Barthold & Egel, 2001).

Symmetry. A property of stimulus equivalence, this refers to two stimuli mirroring one another, or A=B. For example, a picture of a rose can evoke the spoken word "rose", and vice versa.

Tacts. Tacts are similar to comments and are evoked by a stimulus or stimulus property. Unlike mands, the speaker's behavior is not reinforced by receiving the item specified; rather, the utterance is often reinforced by other stimuli such as social approval (Skinner, 1957).

Textuals. The reading aloud of printed text is a textual. They are considered subforms of echoics (Skinner, 1957).

Transformation. Transformation is a concept within Relational Frame Theory which refers to the growth, expansion, and refinement of stimulus classes over time. For example, young children who derive that all males are "daddy" soon learn that this is not the case, but that those individuals actually fall into the larger class of "men".

Transitivity. Transitivity is the property of stimulus equivalence that allows individuals to apply stimuli in novel combinations. If A=B and B=C, then A=C. For example, if a child is taught that a picture of a rose equals the spoken word "rose", and is also taught that the written word "rose" is equal to the spoken word, s/he should be able to match the written word to the picture.

Verbal behavior. When used in the theoretical sense, verbal behavior refers to a language development model based upon behavioral learning theory proposed by B.F. Skinner (1957). Skinner suggested that language and expression were behavior and therefore acquired and sustained by the same environmental contingencies that maintain other types of instrumental behavior (e.g., on-task responding). Verbal behavior is any

type of responding that is communicative in nature (e.g., speaking, writing, gesturing, or reading) and does not necessarily need to be vocal. The term is also often used to refer to a curriculum for students with autism developed by Sundberg and Partington (1998) for children with autism and based upon Skinner's theoretical analysis.

       Verbal operants. Utterances were defined by Skinner based upon their *function* (how the response affected other environmental events). Examples include mands, tacts, intraverbals, and autoclitics (Skinner, 1957).

Chapter 2: Review of the Literature

This chapter presents a review of the literature pertinent to the research questions. It has two parts: the first is a review of the theoretical underpinnings of research into language and communication of children with autism. The second is a review of empirical research on language and communication of children with autism as well as procedures for the remediation of problems children with autism face. Four models of language and communication development used to describe the problems faced by children with autism are examined: the psycholinguistic model, the sociolinguistic/cognitive model, Skinner's analysis of verbal behavior, and Relational Frame Theory. A review of the problems with generalization often encountered by children with autism, and how Relational Frame Theory offers a possible method of remediation of these problems, is then offered. The chapter ends with the research questions that will organize the methodology in Chapter 3.

Models of Language Acquisition and Development

There are several different theories regarding the acquisition and development of language in humans. It is critical to know theories behind language acquisition and usage in order to understand the problems with language that are often present in children with autism spectrum disorders (ASD) often. This section contains a discussion of the structural aspects of language and the contributions of psycholinguistic theory to an understanding of the development of language structure. Functional elements of language and communication are also presented, along with a discussion of the similarities and differences of the behavioral and cognitive models of communicative function.

Language is a complex entity with structural and functional properties. Although in colloquial usage "speech", "language" and "communication" are interchangeable, it is important to note that they represent different facets of the communicative experience. Language is the code of arbitrary symbols and rules of usage that we use to represent ideas (Arwood, 1991; Owens, 1996). Speech is a verbal form of communication that consists of specific sounds (phonemes) as well as vocal characteristics such as intonation, and rate of utterance (Owens, 1996). Communication is the means by which we exchange our ideas with others (Layton & Watson, 1995). The following is a discussion of the elements of language structure.

Structural Characteristics

Most languages share common structural elements. The smallest meaningful unit of speech is the morpheme, which is created by combinations of phonemes (Owens, 1996). Phonemes are joined together to become syllables and morphemes (Titone & Danesi, 1985). The rules under which our morphemes (words) are used and pronounced is referred to as grammar (Owens, 1996). Grammar is considered by some to be manifested in syntax (Chomsky, 2002). Syntax is the form or the structure of sentences and how we combine words to form sentences.   For example, all sentences must have a subject and a verb. Syntax creates the structure for interpretation (Owens, 1996).

The major theory that drives most of the research into language structure is the psycholinguistic model developed by Noam Chomsky. It is considered both seminal and controversial. It is critical to understand Chomsky's theoretical model of development in order to understand the research into the structure of language.

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Psycholinguistic model and the formation of structure. The leading proponent of the psycholinguistic model is Noam Chomsky (Owens, 1996). Chomsky's book, *Syntactic Structures,* was first published in 1957, and soon became the standard by which structural language issues were studied. A second edition was published in 2002.

Chomsky observed that there were commonalities to grammar in all languages, which he called Universal Grammar (Palmer, 2000b). All sentences (the smallest unit of analysis in Chomsky's theory) contain a subject and a verb at minimum. Each language has rules for creating sentences derived from phonemes and morphemes. We create infinite combinations of words and sentences through transformational rules -- intuitive changes of the utterances to fit our communicative needs (Chomsky, 2002; Titone & Danesi, 1985).

The psycholinguist believes that humans develop language from cognitive processes that have their roots in the structures of the brain. The most plausible account, according to Chomsky, for how we arrange our utterances is biological in nature. He assumed that our acquisition and knowledge of grammar has a large innate component. Through brief contact with the environment, a device in the brain is stimulated to learn our native language and organize it (Palmer, 2000b). Therefore, this was evidence to Chomsky that there was some sort of device in the brain responsible for acquiring and developing language capabilities which he referred to as the Language Acquisition Device, or LAD (Palmer, 2000a). The LAD is activated by the sound of our native language and is responsible for the formation of ideas (deep structure) and ultimately how we express these ideas (surface structure). Deep structure becomes surface structure through transformational rules (Titone & Danesi, 1985).

A refinement of Chomsky's theory, by Chomsky himself, is the government binding theory. This theory addressed the criticisms of his earlier work, which was based primarily upon adult language characteristics. Universal grammar consisted of four levels. D-structure is the sentence rules and personal lexicon that each person maintains. S-structures are derived from D-structures and are created using the move alpha rule, a single rule that replaces the transformational rules of previous theories (Owens, 1996).

Early accounts and theories of structure, starting before Chomsky and continuing into the 1960s, continue to influence study and intervention of language disorders to the present day. Many of the strategies for remediating language issues are structural in nature. For example, many speech pathologists assess and attempt to remediate problems related to syntax or phonology (Owens, 2004). Theoretical accounts of language based solely upon structure, however, do not address meaning or usage of language for communication.

Theories of Meaning and Function

Although the structure of language allows us to interpret communication with some consistency, the majority of researchers, theorists, and practitioners consider communication to be most important (Prizant, Wetherby, & Rydell, 2000). Therefore, the social use of language for communication is considered by some to be the aspect of the communicative experience that encompasses and pulls all of the structural elements together. For some, it is the manifestation of semantic structures. For others, it is how speech acts function. For still others, it is how individuals process speech acts (McTear & Conti-Ramsden, 1992). There are two major points of view regarding the use of language for communication: the cognitive model and the behavioral model.

Cognitive Models of Language Function. Language is considered by most to be a code by which we express our ideas and cognitive processes (Bloom & Lahey, 1978). Therefore, to study how language is used for communication, it is crucial that the underlying processes are understood. Cognitive theorists attempted to address the elements of communication by looking at semantics and pragmatics.

Semantics. Semantics are the rules of meaning – that is, the rules by which we classify the words in a sentence. It is considered to be our representation of our cognitive processes and our perception of the processes that go on in our environment (Bloom & Lahey, 1978; Owens, 1996; Titone & Danesi, 1985). Semantics are our outward demonstrations of knowledge of the environment (Arwood, 1991; Bloom & Lahey, 1978)

Language development from a semantic perspective is the development of emerging grammars as the expression of the child's reality and cognition. Many developmental linguists do still believe that there is a LAD that assists in the language learning process, although they suggested that the LAD is activated by environmental stimuli and the development of language is contingent upon contact with the environment (Bruner, 1983). Bloom studied the development of children and noticed that their syntax did not develop in a linear form (that is, children do not talk like little adults). Bloom theorized that children's grammar often developed in parallel with Piagetian milestones, and therefore must be related to the development of cognition. Semantics develop along with a child's knowledge of the world (Bloom, Lightbrown, & Hood, 1975).Language begins as semantic and becomes syntactic. This process is developmental as opposed to an innate ability – one must proceed developmentally in order for the LAD to operate

properly (Bruner, 1983; Owens, 1996). That is, one must have cognition and "something to say" before expression and structure develop.

Closely linked to the semantic revolution is pragmatics. Pragmatics refers to the social usages of language and related acts for communication. That is, pragmatics answers the question "why do we use language?" whereas semantics answers the question of "how do we use language to convey meaning?" (Owens, 1996).

Pragmatic theory. Pragmatic theory represents a set of rules for the communication and social usage of language (Owens, 1996). Arwood (1991) suggested that semantic elements of an utterance are evaluated through pragmatics – that is, meaning is derived from the social usages of the utterance. There are two theoretical models that guide much of the study of pragmatics – sociolinguistic theory and speech act theory (Owens, 1996). The 1970s and 1980s saw a shift of focus from semantics to pragmatics (Owens, 2004), although much of the theory and research overlap.

For language to make sense, it must be viewed in a referential context (Owens, 1996). Language expression changes over time, and is a social act (Bloom & Lahey, 1978). Therefore, communication development can be viewed from both a personal perspective and a larger sociological perspective (Owens, 1996). Sociolinguistic theorists based their theory of development upon communication functions as opposed to the structural properties of language. Sociolinguists believe that a purely structural analysis of language removes it from its context. Communication occurs in some sort of context; therefore, it must be analyzed within this same context (Owens, 1996). Children can only learn and refine language skills through using language (Bruner, 1983).

The first to identify pragmatics as important was Bloom and Lahey (1978). In their work and observation of the development of five children, the authors concluded that language is a code that conveys meaning and is the means to the end of communication. Language development and usage is based upon what the child knows and the context (Bloom & Lahey, 1978). Semantics are the demonstration of these two things. Communication is a social act that conveys ideas and cognition. Language is the generally agreed upon method to by which ideas are conveyed. (Bloom & Lahey, 1978).

Speech-act theory looks at the functions of our communicative acts. According to this theory, there are two overarching functions of language – the intrapersonal or internal communication (idealations), and the interpersonal communication. A speech act can be analyzed in one of three ways: Locutions (propositions), illocutions (intent) and perlocutions (the interpretation or function of intent). In order to interpret function and intent of language, one must look at the ecological variables that surround the speech act, including the purpose, content, structure of the discourse, setting, and the cognitive context (what shared knowledge do the communicative partners share; Owens, 1996). A propositional force is extended by the speaker (intent) and the listener responds to this propositional force with illocutionary force (Owens, 1996).

This theory is again based upon the observations of adults; however, there has been research on the speech acts of children. Dore (1974) and Halliday, (1975) have suggested that early speech acts, that they call primitive speech acts (PSA), convey intent in one of seven different ways: labeling, repeating, answering, requesting, greeting, protest, and practice (Dore, 1974; Halliday, 1975).

Beyond the speech act, one must consider the paralinguistic and nonlinguistic communicative acts necessary for communication to occur. The transactional model (Bruner, 1983) of child language development states that the give and take of the child and their communicative partners allows the child to learn the rules of communication. Infants learn to express intent through the imitation of the mother. In order to imitate, joint attention, or attention to a shared referent by two or more individuals, must be present (Owens, 1996).

Although semantic and pragmatic analysis is the most commonly recognized theory that explains the social usage of language, it is not the only theory. The first theory of language function was B.F. Skinner's analysis of verbal behavior. This theory has seen a recent renaissance (Sundberg, 1998). A relatively new theoretical model, Relational Frame Theory, has emerged in which the authors refined Skinner's theory to answer questions that Skinner did not address (Hayes et al, 2001).

Behavioral Accounts of Communication Development

Behavioral accounts of communication differ from cognitive accounts in subtle but important ways. In cognitive psychology and linguistics, development is seen as stemming from the innate structures of the brain as well as guided by emotions and constructs that guide our actions. A behavioral model, although not discounting cognitive processes, looks towards environmental events. Behaviorists assert that our interactions with the environment shape our behavior, and that we tend to choose responses that are met with reinforcing consequences. Responses that are met with punishing consequences tend to drop out of our repertoires (Catania, 1997). There are

two main behavioral models of language and cognition: Skinner's analysis of verbal

behavior and Hayes's Relational Frame Theory.

Skinner's analysis of verbal behavior. A complimentary and controversial

analysis of the function of language was offered by B.F. Skinner in 1957, as a result of a

friendly challenge by a colleague. Skinner's goal was to apply his operant conditioning

paradigm to more complex behaviors such as language. It is also the realm under which

Skinner began to look at private events and cognition, elements often erroneously

considered to be ignored by behaviorists (J. S. Bailey & Wallander, 1999).

Often, words are referred to as "things" to be "used".   Skinner, however,

maintained that language and expression were behavior – and therefore subject to the

contingencies that maintain instrumental behavior. Anything communicative that is

mediated by another human being was considered by Skinner and his colleagues to be

verbal behavior, whether conventional, unconventional, or paralinguistic (J. S. Bailey &

Wallander, 1999). Although Skinner argued that the structural or topographical aspects

of language and communication were important, they were secondary to the

contingencies that maintained them (also referred to as function). Linguistic accounts,

while telling quite a bit about the structure of our responding, explains very little about

the contingencies that evoke the use of these structures (J. S. Bailey & Wallander, 1999).

Therefore, Skinner provided the first functional analyses of verbal behavior.

The same verbal behavior is often emitted in the presence of certain stimuli and

not others (referred to as "stimulus control"). Therefore, the interactions with the

environment shape how we will respond to it, both verbally and nonverbally (J. S. Bailey

& Wallander, 1999). Meaning is established through the functions of our verbal behavior

(Winokur, 1976). It is important to note that it is impossible to determine a verbal operant by its form; only through an analysis of the environmental events that maintain verbal behavior can one assign it a category (Skinner, 1957).

For example, a behavior analyst might speak very technically about verbal behavior to a colleague, using the terms defined in this dissertation, and the colleague might respond in kind. However, when speaking to a parent not well-versed in verbal behavior, speaking in such a technical manner might be at best extinguished and at worst punished. As a result, the verbal behavior emitted might be quite different in contrasting circumstances.

Verbal operants and their classifications. A person engaging in verbal behavior has a dual role in most conversational exchanges; that of speaker and listener (Skinner, 1957).   Therefore, verbal behavior tends to be much more complicated than nonverbal behaviors, and the contingencies that maintain responding in the natural environment can be difficult to observe (J. S. Bailey & Wallander, 1999).   However, once the variables that maintain communication can be isolated, patterns of responding emerge. These common patterns were referred to as verbal operants in Skinner's analysis.

Meaning is established through the functions of our verbal behavior (Winokur, 1976). A description of verbal operants follows. It is important to note that it is impossible to determine a verbal operant by its form; only through an analysis of the environmental events that maintain verbal behavior can one assign a category to it.

Mands. The term mand is derived from a class of words such as "command" or demand", and specifies the reinforcers that maintain this particular types of verbal behavior.   A discriminative stimulus (S^D), either public or private, triggers the speaker to

emit verbal behavior. This verbal behavior is an S^D for the listener (also known as the mediator, Winokur, 1976) to respond, which simultaneously reinforces the speaker's behavior.

For example, an individual might see an object on a high shelf (S^D that triggers the mand). S/he cannot reach the object; therefore, the individual asks a taller individual to get the object for him or her (S^D for the listener to respond). The listener reaches for the object and hands it to the person (reinforcing the response by the speaker). The listener is then reinforced by the speaker then saying "thank you".

There are several different types of mands. The first is a *request*. In a request, Skinner stated that the listener freely provides the reinforcer (such as in the example provided previously). The second is a *command*, in which compliance terminates an aversive situation (such as giving a wallet to a criminal). The third is an emotional request, such as prayer, and the last is a *question*, in which the mand specifies a verbal response (e.g., "Where is the grocery store?" "It's down the street and to the right." Skinner, 1957).

The mediator's behavior might be reinforced by several stimuli. It is possible that the person saying "thank you" is a reinforcer. In some cases, the abatement of an aversive stimulus (such as the termination of a tantrum) or the avoidance of aversive is enough to reinforce the mand (Winokur, 1976).

Echoic. The next type of verbal operant is called an echoic. To be classified as an echoic, the listener must repeat the utterance of another person with direct correspondence. It has also been referred to as a "reproduction" (Winokur, 1976). Echoics do not function as mands, although they often operate in the presence of other

verbal operants. For example, a person may ask the question, "where is the nearest

bathroom?" (a mand). If the listener responds, "the nearest bathroom? It's down the hall

and to the right", s/he has emitted an echoic response as well as a potentially reinforcing

answer to the other person (Skinner, 1957). It is important to note that echoics are not

synonymous with echolalia, which Skinner refers to as a pathological use of echoic. In

fact, only immediate echolalia would be considered in any way echoic; delayed echolalia

would function as another type of verbal operant (Winokur, 1976).

     According to Skinner (1957), echoics are how speech is often shaped. Parents

will often tell a child "say ma-ma" and expect the child to respond in kind. Winokur

(1976) stated that children often acquire an echoic repertoire in developmental stages.

The first is the *operant level*, where babbling of any sort is reinforced. The second is the

echo-babble, where babbling is automatically reinforced. This babbling begins to sound

more like a parent's utterances. In the final (tutorial) phase, the parents begin to teach the

child to utter phonemes and eventually whole words (Winkour, 1976).

     A subform of echoic is a *textual*. A textual response is the reading aloud of

printed text, unless the text forms some sort of a mand. Textuals, according to Skinner,

are "reinforced by the verbal community" (p.67). Although one may be predisposed to

limiting textuals to words, actions such as playing music from a score would also be

considered textual behavior. The opposite of a textual is transcription, in which the

listener records on paper the auditory stimuli s/he has just heard.

     Intraverbals. With *intraverbals*, the contingencies that maintain them are much

less clear. Although there is no point-to-point correspondence with the verbal stimuli, the

stimuli nonetheless evokes a narrow range of verbal responses. An example of this

would be a call-and-response word play or singing some sort of duet. Intraverbals can be written or vocal, and are used in our everyday routines (e.g., "How are you?" "I'm fine"). Something that is emitted before the response "triggers" the person to respond. Translation is also a form of intraverbal. Memorization of long pieces can be considered chains of intraverbals. The reinforcer is a verbal response but the stimulus might be more covert. It is important to note that while intraverbals are often associated with the structure of discourse, they are not synonymous with grammar (Skinner, 1957; Winokur, 1976).

Tacts. The next type of verbal operant is the tact, which derives from the term "contact". A tact is a verbal response that is evoked either by a stimulus or a stimulus property. For example, a person might look at a painting and exclaim "What a pretty picture!" A child who sees a train might say something like "choo-choo!" The tact does not change the listener's behavior to evoke the reinforcer. Most tacts are reinforced by generalized responses such as social approval "you're right!" When there is a congruence during conversation between the environmental events and the tact, that tact is often reinforced (Winokur, 1976). These are examples of completely pure tacts, but others might operate in conjunction with verbal operants. For example, saying "thank you" upon the presentation of a reinforcing stimulus acts as a tact, since a stimulus evoked a response. However, there are some intraverbal properties to the response as well, as most of the time "thank you" evokes the response "you're welcome" (Skinner, 1957).

Autoclitic. The final type of verbal operant is the autoclitic. Autoclitics refine other verbal operants. A *descriptive* autoclitic might be "I guess…" or "I can see that…" *Qualifying* autoclitics provide either negation (e.g., "this is an ex-parrot") or assertive

(e.g., "the concert is going on now"). *Quantifying* autoclitics are expressions such as "sometimes" or "never". Relational autoclitics describe the syntax of the verbal operant (Skinner, 1957). Winokur (1976) stated that autoclitics were the person actually tacting the operant, and should be considered a sub-form of tact. That is, an autoclitic is a description or comment that further refines a tact.

It is important to note that an utterance can only be classified by its function in the environment. Therefore, the same utterance may have very different operant properties in differing contexts. One person can hold out a piece of gum and say, "stick of gum?" If the listener responds by saying "thank you" and taking the stick of gum (or, conversely, "no thank you"), this utterance has functioned as a mand for the other person to take the stick of gum. If the listener responds to the person by saying, "yes, it is," then the utterance has served the function of a tact.

In order to complete the theory of verbal behavior, Skinner discussed the role of private events in the shaping and maintenance of verbal behavior. Private events are behaviors defined as those that are measurable only to the person experiencing them, and are maintained by the same types of contingencies that maintain our overt behavior. It is a common misnomer that behaviorists do not deal with private events. It is more accurate to state that behaviorists do not deal with constructs, as constructs cannot be measured directly (J. S. Bailey & Wallander, 1999).

Private events can act as a discriminative stimulus (e.g., pain) and the verbal behavior that accompanies them might be reinforced by overt means (e.g., saying, "my hands hurt" might result in someone prescribing pain medication). "Thinking" may be described in some cases as an avoidance response. An overt response might be punished

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(for example, swearing in front of a person of authority). A person learns to think of a response first and then change it so that it might be less aversive either to the speaker or the listener.

Covert behavior might also be useful in learning overt responses (J. S. Bailey & Wallander, 1999). For example, we might rehearse to ourselves the lines of others in a play so that we emit the correct lines at the proper time. Often, this behavior is emitted less and less as we become more proficient in the overt behavior (J. S. Bailey & Wallander, 1999).

Often, listening is considered a form of perception as opposed to an operant response. However, the listener has a powerful role in Skinner's theory. A person does not necessarily need to be engaging in some aural response to be considered a listener. A reader or someone watching a signer is considered a listener as well (J. S. Bailey & Wallander, 1999). A listener has the power to reinforce or extinguish the speaker's verbal behavior by their responding. (J. S. Bailey & Wallander, 1999) suggested that the actions of the listener might have an impact on whether a speaker will tell the truth or recount certain events in a certain fashion (such as accounts of abuse in therapy or revelation of suicidal ideologies).

A subset of listening is understanding. Understanding is defined as a speaker's verbal behavior evoking the listener to engage in some sort of behavior that relates to the speakers' response. For example, if a listener groans at a bad joke, one might say that the listener understood the speaker. However, if the listener engages in some other type of response (for example, nodding in agreement) it may be that understanding has not occurred (J. S. Bailey & Wallander, 1999).

Skinner, through the analysis of verbal behavior, attempted to provide the first hypothesis of function or social usage of language. His work, however, was slow to catch on, and later theorists either ignored Skinner's work entirely or dismissed it as incomplete. More recently the analysis of verbal behavior is receiving newfound attention, especially in applied settings.

Additional refinements to the antecedent-behavior-consequence contingency. Many individuals, including some behavior analysts, feel that Skinner's analysis of verbal behavior is incomplete. Laraway, Snycerski, Michael, and Poling (2003) have suggested that a fourth term be added to the three-term contingency proposed by Skinner. *Motivating operations* are stimuli which either enhance or reduce the reinforcing or punishing effects of stimuli in the presence of the antecedent. For example, reducing pain in a child with CP might decrease the probability of acting out behavior during writing assignments (which could be interpreted as a mand for escape). Reducing pain, in this case, serves an *abolishing effect*. Conversely, for some children, reducing pain might result in the child asking to write instead of dictate. In this case, pain reduction serves a *reinforcer-evocative effect.*

The most troublesome feature of VB for some is the lack of explanation of novel forms of responding (Hayes et al., 2001). Skinner does not explain how individuals produce novel utterances in sometimes novel situations, even though the explicit contingency has never been experienced before (Hayes et al., 2001). Hayes (2001) attempted to repair this flaw and expand Skinner's analysis through Relational Frame Theory (RFT).

Relational Frame Theory. A post-Skinnerian approach to the acquisition and maintenance of language, Relational Frame Theory has particular relevance to the generative usage of language for communication (Hayes, Barnes-Holmes et al., 2001a, 2001b; Hayes, Blackledge, & Barnes-Holmes, 2001; Hayes & Hayes, 1992). Developed by Steve Hayes in 1985 and further refined by Hayes and Hayes in 1992, RFT and Verbal Behavior share many similarities, and is considered by most to be an extension of the VB model. Like Skinner's analysis of Verbal Behavior, RFT theorists believe that the learning and usage of language is mediated by the environment and that verbal behavior is a response sensitive to operant contingencies (Hayes, Blackledge et al., 2001). In addition, those supporting RFT asserted that function is paramount to form as is similar to Skinner's analysis (Hayes, Blackledge et al., 2001). However, Hayes and colleagues believe that Skinner's analysis does not account for untrained responding and its functional properties are difficult to test. RFT attempts to correct this omission in Skinner's analysis through the theory of Derived Relational Responding (DRR).

According to RFT theorists, individuals learn to use language through Derived Relational Responding (DRR). It is not necessary to have a history with every single member of a response class (i.e., a set of responses that evoke the same contingency) in order for those behaviors to be emitted (Blackledge, 2003). Novel responses that evoke the same contingencies may emerge without being trained. The key to DRR is stimulus equivalence, which was developed by Sidman (1994). There are three elements to an equivalence class. The first is reflexivity, or A=A. That is, two pictures of roses are equal. Symmetry means that two stimuli mirror one another, or A=B and B=A. For example, the word "rose" and the picture of a rose are interchangeable. Transitivity

represents the application of a relation to a novel combination. If A=B and B=C, then A=C. For example, a student is taught that a picture of a rose is equivalent to the written word, "rose". S/he is then taught that the written word "rose" is equivalent to the spoken name. If the child emits the spoken name in the presence of the picture, then transitivity is demonstrated (Catania, 1998). A graphic display of stimulus equivalence is presented in Figure 1 in Chapter 1.

Most equivalence relations are researched using matching to sample and in a discrete trial format, although some researchers have also used sorting as well (Catania, 1998; Hayes & Hayes, 1992). A sample stimulus is presented to the participant. The participant is then presented with an array of comparison stimuli. If the participant chooses the correct matching stimulus, this is considered to be a successful trial (Catania, 1998).

Stimulus equivalence has a rich experimental history, dating back to the earliest days of behavioral research (Catania, 1998). Literally hundreds of basic studies of stimulus equivalence in humans exist in peer-reviewed journals (Pilgrim & Galizion, 1990; Tyndall et al., 2004; Wulfert & Hayes, 1988). It was first discussed by the early Greeks, and examples of equivalence have been shown in the literature since the 1930s. In fact, some consider the difficulties with reconciling equivalence relations to be the main contributing factor to the fall of S-R psychological theory (Hayes & Hayes, 1992). However, the applied significance of stimulus equivalence is still being investigated.

Most of the applied studies of stimulus equivalence involve reading and spelling. Reading and spelling have been effectively taught to students with and without disabilities using stimulus equivalence. Word and object relations have all three

components of stimulus equivalence, and is one way that semantic relations can be explained (Hayes & Hayes, 1992). Snell (1978) outlined a program created by Sidman (1971) to teach reading to students with mental retardation. It utilized matching of visual and auditory cues to increase the members of a reading class and to teach associations between spoken words, pictures, and written words. The Edmark reading program (Bijou et al., 1966) also relies heavily on matching, and is still used today.

Connell and Witt (2004) used a computer-based matching intervention to teach spelling words to two kindergarten aged children with typical development. They found that training the students to match lowercase letters to the sound of three-letter words increased the likelihood of the student being able to spell the word when spoken. However, the small response requirement makes it difficult to predict how students would do on more complex tasks, a large number of spelling words, or words with more than three letters.

Stromer, MacKay, Howell, McVay, and Flusser (1996) taught spelling using a combination of computer-based and tabletop matching-to-sample procedures to two adults with hearing loss. Each of the participants was diagnosed with autism and mental retardation, respectively. Subject 1 learned spelling without errors. Subject 2 displayed written spelling errors but was able to retrieve items from a written list. Fingerspelling of words, however, was low.   The results were not replicated across subjects, though; the generality of the results is unclear.

Although equivalence training has been used to teach reading and spelling, generalization to novel relations has not been consistently demonstrated. Hanna, deSouza, deSouza, and Fonseca (2004) found that teaching first graders spelling using a

matching-to-sample procedure increased their ability to write and dictate spelling words correctly. These gains, however, did not generalize to other spelling words.

The applied significance of equivalence relations beyond reading and spelling has been demonstrated in the literature. McDonough et al. (1984) and Stoddard et al. (1989) taught an adult with moderate mental retardation relations between coins and price markings in increasingly complex combinations. Bock (1994; 1999) taught children with autism to sort laundry based upon a matching to sample procedure. The participants matched an icon placed on the article of clothing to an icon on a poster and placed the clothing in piles based upon these icons. Individuals quickly learned how to sort laundry using this method; generalization and maintenance was observed for all but one participant. LeBlanc et al. (2003) taught two males with autism to match state names with icons of states on a map, and state capitals with state icons. Relations between state names and state capitals were tested. Both learned to match state names with state capitals.

Exclusion training has been used to increase the probability of correct responding when children have difficulty learning stimulus relations. In exclusion training, participants are taught both examples and non-examples of the correct response in order to increase discrimination between correct and incorrect responses (Dube & Serna, 1998; Stromer & Osborne, 1982). McIlvane et al. (1984) used exclusion training to increase receptive identification of preferred food items. New food was paired with known foods, with new foods always being the correct reinforced choice. Exclusion training decreased the number of trials needed to learn correct food names, and most responses maintained upon follow-up. Deborah Carr (2003) taught students with autism to select unknown

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items by using known items as comparison stimuli. Exclusion training increased the selection of novel items, and these gains maintained when trained items were presented with new, unlearned stimuli.

Not all relations have all of the properties that Sidman laid out for equivalence. For example, a ball can only be larger than another ball relative to the second ball's existence. Often, if a child is shown a third ball, s/he can make a comparison of size without being explicitly taught the relation. However, the larger ball and smaller ball are neither reflexive nor symmetrical. Sidman does not account for how these response classes are created. Hayes et al. (2001) attempted to broaden the definition of equivalence to include classes that do not have all of the elements of Sidman's equivalence relations.

Hayes et al. (2001) stated that DRR can still be established when not all of the elements of an equivalence relation (especially symmetry) are present. Therefore, Hayes and his colleagues defined the characteristics of DRR much more broadly than Sidman did when defining equivalence relations. DRR has three components: mutual entailment, combinatorial entailment, and transformation. Mutual entailment means that when Response 1 is defined, that response 2 logically follows. For example, if John is older than Mary and Helene is older than John, than Mary is younger than Helene. Combinatorial entailment is similar to Sidman's equivalence relations. That is, if A=B and B=C, then A=C. This entailment is theorized to emerge later in the developmental sequence. According to RFT theorists, classes also undergo transformation, or change over time. Humans classify relations through "relational framing". (Hayes, Barnes-Holmes et al., 2001b)

Relational responding is arbitrary; that is, relations are agreed upon by members of the community and relative to the stimuli in the environment. For example, John is sitting next to Mary, and in front of Mark. But from Mark's perspective, John is behind him, and no one is next to him (Hayes et al, 2001). It is common to attempt to classify relational frames through formal properties; however, as is consistent with most behavioral theories, it is more important to look at the functional relationships between stimuli and responses. There are often very salient formal properties that correspond with function (e.g., big versus little), However, this is not always the case, and some relations are under the control of arbitrary stimuli. For example, a Chihuahua and a golden retriever part of the same class (dogs) even though they share few topographical characteristics. A wolf is in a separate class from the golden retriever, even though they share many more characteristics. Arbitrary relational responding such as this is specific to humans, and is rarely seen in non-human species (Hayes & Hayes, 1992).

There is no limit to the number of relational frames that can be created; however, there are some common frames that are outlined by Hayes, Barnes-Holmes, et al (2001). Coordination involves similarity of stimulus features (matching to sample). Opposition involves opposite stimulus features (e.g., big versus little) and is established by usage. Distinction involves the ability to make the distinction between stimuli. Comparison includes big versus small (don't understand the difference between this and opposition), temporal relations, and deictic relation (e.g., I/you, here/there).

According to RFT theorists, all relations are a product of their reinforcement history, and are established by multiple exemplar training. To train stimulus relations it is necessary to select the stimulus relations that the child needs to attend to and appropriate

responses are differentially reinforced. Relations can be trained even when the stimulus

features are not readily apparent (D. Barnes-Holmes et al., 2001) The relational frames

become a generalized operant (Hayes, Barnes-Holmes et al., 2001a). That is, the

individual relates complex ideas to one another, and uses that information to create novel

responses (Blackledge, 2003).

The body of literature to support multiple exemplar training is typically basic in

nature and teaches simple, arbitrary relational fames. Bridge studies and applied studies,

however, are beginning to emerge (Greer, Stolfi, et al., 2005; Greer, Yaun, et al., 2005;

Halvey & Rehfeldt, 2005; Rehfeldt & Root, 2004). Many of these applied empirical

articles, however, relate to cognition and a type of therapy known as Acceptance and

Commitment Therapy (ACT). For this dissertation, I will review articles that relate to

RFT in its theoretical sense or have direct application to language and communication

learning.

It has been suggested that RFT can be extended to non-arbitrary relations, and

that derived stimulus relations should be the focus of educational research as opposed to

trained stimulus relation (Y. Barnes-Holmes, D. Barnes-Holmes, B. Roche, O. Healy et

al., 2001). Errors in generalization should be considered poorly formed relational

classes.(Y. Barnes-Holmes, Barnes-Holmes, & Cullinan, 2001).

Relational Frame Theorists attempted to extend Skinner's analysis of Verbal

Behavior. Both theories share common characteristics. Each asserts that communication

is learned through interactions with the environment, and that past experiences with the

environment help to shape both what and how we communicate. RFT (including stimulus

equivalence) also attempts to explain why humans are able to be flexible in their

communication and quickly learn relations between stimuli without being explicitly

instructed or encountering the contingencies that surround that particular response. The

research on behavioral approaches to communication development is rich, but primarily

consists of basic research in contrived situations. Verbal operants or equivalence relations

are created and tested in all of the studies reviewed. No descriptive accounts of the use of

verbal operants or the generation of stimulus classes in the absence of environmental

manipulations were available. Therefore, little is empirically known about how verbal

behavior is emitted in naturalistic settings.

There has also been little comparison of cognitive approaches to communication

as opposed to behavioral approaches. No writings were available where authors

compared pragmatic accounts of communication to Skinner's analysis of verbal behavior.

Much of the discussion and controversy surrounds Chomsky's reactions to Skinner's

writings.

Analysis and Synthesis of Communication Development Models

Psycholinguistics as well as cognitive and behavioral models of communication

has had quite a bit of influence on how we view the development of communication and

language. These theories have also guided much of the diagnostic and intervention

efforts for individuals with communication disabilities (including autism). However,

theorists tend to be at odds regarding who is right and wrong.

Skinner's analysis of verbal behavior is considered to be very controversial Most

people are familiar with the book only through a scathing review published by Noam

Chomsky (Chomsky, 1959; Richelle, 1993). Chomsky's article, published in 1959, was

about 30 pages long, considered to be quite persuasive, and also destructive in its tone.

Chomsky's arguments against verbal behavior were that one cannot interpolate from the laboratory to the real world, where events are too unpredictable. He often referred to the studies which Skinner used to support his arguments as "pseudo-scientific" "bar-pressing experiments" (Chomsky, 1959, p. 34). Skinner's focus on the observable ignored the inner workings of the brain, which were crucial to the understanding of the acquisition of language. Therefore, Chomsky asserted, verbal behavior was an incomplete and simplistic analysis of the way we acquire and use language (Richelle, 1993).

Skinner's reaction to Chomsky's commentary. Skinner never responded to Chomsky's criticisms, and for some cognitivists this was considered an admittance of defeat. Skinner later stated that he did not respond to Chomsky for several reasons. The first was that he found Chomsky's writing style aversive to read and therefore never read the whole document. Skinner also stated that he considered psycholinguistics and verbal behavior to be two separate things – Chomsky was interested in form and Skinner in function. Skinner was convinced that his analysis was more likely to gain popularity than Chomsky's in the long run, and therefore did not respond (Richelle, 1993).

Many behaviorists, however, see flaws in Chomsky's analysis that warrant commentary. Richelle (1993) argued that it is clear from Chomsky's writing that he never read Skinner's work thoroughly. Chomsky speaks of the stimulus-response model as Skinner's work, when in fact it is the work of earlier behaviorists such as Pavlov. In addition, Chomsky asserted that Skinner never addressed private events, when in fact large sections of *Verbal Behavior* (1957) are dedicated to it, and the work was, in part, a vehicle for Skinner to address these same issues (Richelle, 1993).

Palmer (2000a; 200b) stated that Chomsky assumes that all people will respond in the same way, and provides no explanation for outliers from his theory. His argument is not at all parsimonious, and he attempts to assume order in an environment that is often chaotic (i.e., Chomsky speaks of the ideal speaker speaking the ideal sentence as opposed to what typically occurs in the environment). Palmer also took issue with the sentence being the smallest unit of analysis, as our utterances can take many forms. Skinner, however, provides a theory in which there are very few exceptions to the rules (Palmer, 2000b). Although Chomsky's theory has been refined a bit (Palmer, 2000a), and he espouses a more minimalist position, Palmer asserts that the flaws in his theory remain.

Some behaviorists assert that the lack of interest in Skinner's analysis of verbal behavior was due to several factors. The first was the lack of dissemination which was due in part to Chomsky's scathing critique of the work (J. S. Bailey & Wallander, 1999; Richelle, 1993; Sundberg, 1998). However, most believe that Chomsky did not single-handedly bury Skinner's work. Some behaviorists themselves had a difficult time accepting Skinner's work as it had no empirical data to support its findings (Sundberg, 1998).

Skinner's writing style was often difficult to follow and might have been aversive to some individuals who would have ordinarily read and adopted his views. Although Skinner himself believed that his work would evoke many scientific studies of verbal behavior, this has largely not been the case (Proctor & Weeks, 1990; Richelle, 1993). In fact, many mainstream behavior analysis textbooks do not address verbal behavior at all (Sundberg, 1998).

The reversal of a trend. There are some authors who believe that Skinner's analysis of verbal behavior is about to reach a much larger audience, due to increased interest in the functions of communication. Sundberg (1998) stated that there has been an increase in empirical analysis of verbal behavior in the last 30 years, owing in part to the journal *The Analysis of Verbal Behavior* as well as the formation of special interest groups within the Association for Behavior Analysis. Many linguists feel that it does not adequately address the origins or structure of language. Others have stated that such assertions are irrelevant, and that Skinner's analysis should be considered complimentary to, as opposed to antithetical of, other accounts of language development (Catania, 1997). From the writing of behavior analysts and non behavior analysts alike, it seems that Skinner's analysis of verbal behavior is receiving a fresh appraisal (Sundberg, 1998).

However, there seems to be neither interaction nor debate between individuals who espouse Skinner's analysis of verbal behavior and those who ascribe to a more pragmatic point of view. Skinner's analysis predates the cognitive models of function, and both theories share common elements. Both look at communication within the context of the environment (Owens, 2004; Skinner, 1957). In addition, each divides communicative responses into some sort of functional pattern – requests, protests, and behavior regulation may function as mands, comments may function as tacts.

There are some differences; as a pragmatic model is cognitive in nature, the ideas of function (the effect of the utterance on the environment) and intent (the effect that the speaker planned to have) are two separate entities. According to Duchan (1994) intent begins mentally and forms a basis for interpreting function. In Skinner's analysis of verbal behavior, intent is a private event that cannot reliably be measured and therefore

cannot be studied. Duchan believed that this was a limitation to Skinner's approach –

utterances that have ambiguous function are difficult to interpret without a hypothesis of

intent (Duchan, 1994). Skinner, however, might state that this is a circular reasoning;

without function, it would impossible to interpret intent.

Indeed, pragmatics and verbal behavior models seem to function in parallel to

each other. Certainly, there are individuals who criticized the cognitive model for

indirectly studying private events; however, these critiques tend to be more towards the

mentalistic views such as Chomsky as opposed to more cognitive models (Chase, 1986).

Cognitivists see behaviorism as providing an incomplete account of language – in order

to truly understand language and communication, it is necessary to study cognition,

however indirect that may be.

Regardless of the theoretical model one espouses, it is clear that most children

develop language, speech and communication in much the same manner. To truly

understand communication, language, and its origins, it is important to take into account

both structure and function. Both behavioral and cognitive explanations are useful to

understanding the influence of the environment on language development, and most

should be examined in their entirety in order to drive communication.

It is important to understand the theoretical models that drive diagnosis and

intervention for students with communication issues (including autism). These models

allow curriculum to be developed that can increase a students' communicative

responding and language competence. It is also important to insure that these gains are

displayed in novel situations, with novel stimuli, and with novel behavior change agents.

The next section examines the importance of generalization in intervention programs, the

particular issues that children with autism face, the typical manner in which

generalization is addressed in behavioral interventions, and how relational frame theory

can assist in promoting generalization for children with autism.

Generalization Issues and Language Impairments in Children with Autism

The ability to communicate is considered to be crucial to both the development of

social functioning and the prevention of problem behavior (E. G. Carr et al., 1994;

Sundberg & Partington, 1998). Therefore, it is critical to utilize effective intervention

methods that address communication and language issues, and that these interventions

have effects outside of the school or clinical setting. Children with autism have

particular difficulty generalizing new information; that is, applying learned information

in novel ways, novel settings, or with novel people (Siegel, 2003). This section

describes the importance of addressing generalization issues with children with autism,

the specific problems that children with autism face, and how Relational Frame Theory

and stimulus equivalence could contribute to increasing generalization for children with

autism.

Generalization Defined

There are two types of generalization – stimulus generalization and response

generalization, although the lines between the two often blur in the applied literature.

Stimulus generalization is the demonstration of responding in the presence of a class of

stimuli not explicitly taught. For example, a child who can zip a blue coat in the

classroom and then can zip the same coat at home exhibits stimulus generalization.

Stokes and Baer (1977) were the first authors to review strategies for stimulus

generalization in the applied literature. However, their definition of generalization is

controversial because it is more topographical as opposed to functional (Stokes & Osnes, 1988). Stokes and Osnes (1988) suggested that a more appropriate definition might be "obtaining widespread change across diverse stimuli conditions, response and time without comprehensive programming" (p.6).

Response generalization (also known as induction; Catania, 1997) is the presentation of novel responding in the presence of specific stimuli. For example, a child who is taught to say, "Hi" in the presence of friends and one day greets a friend with "What's up" is exhibiting and inductive response or response generalization (in this dissertation, response generalization will be referred to as induction).

Generalization and Children with Autism

In their review of the literature on behavioral interventions for children with autism, Matson, Benavidez, Compton, Paclawskj, and Baglio (1996) identified generalization as the biggest challenge for teachers of children with autism. More recent authors have voiced the same concern, indicating that generalization is still an issue almost 15 years later (Lord & McGee, 2001). Not analyzing generalization in research, according to Stokes and Osnes (1988), is equivalent to engaging in "train and hope" teaching, where teaching is conducted and no programming for generalization is made.

When students with autism were first instructed using behavioral methods, stimulus control (that is, responding in the presence of a distinct stimulus) was considered sufficient to demonstrate learning. However, it soon became apparent that the demonstration of generalization was necessary to show the face validity of the treatment (Stokes & Osnes, 1988). Albin and Horner (1988) stated that much time and consideration needs to be given to generalization. Often, a little generalization is

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considered to be enough. However, the authors assert that teachers need to teach so that

skills are exhibited in the full range of stimuli and environments in which the child will

be expected to perform them, and not be performed in inappropriate situations. That is,

the student should be taught what is both expected and not expected in the environments

in which they are expected to live and work (Albin & Horner, 1988). The natural

environment contains variable stimuli and expected responses, and schedules of

reinforcement are complex and variable. Therefore, children need to be taught to

discriminate the immediate contingencies.

Generalization Problems and the Effects on Language and Communication Development

One of the hallmarks of autism is some degree of impairment in language usage.

Both the structural components (i.e., how language is organized to convey messages) and

the functional components (i.e., the message conveyed) are often impaired to some

degree (Paul, 1987). Leo Kanner, considered the first person to classify the disorder of

autism, identified several difficulties with language in his early writings. He noted that

the children he saw exhibited "mutism", especially in stressful times, literal usage of

language, both delayed and immediate echolalia, and little use of speech for

communication (Paul, 1987).

The Diagnostic and Statistical Manual of Mental Disorders, or DSM-IV-TR

(American Psychiatric Association, 2000) outlines several core deficits in language for

diagnosis, including problems with the production of spoken language, conversational

skills, and idiosyncratic speech. A qualitative impairment in communication is considered

necessary for a diagnosis of autism (Mesibov, Adams, & Klinger, 1997; Scott, et al.,

2000).

When specific environmental events are not programmed, children with autism often use a restricted range of communicative acts as opposed to their peers. Children who speak tend to have the Mean Length of Utterance, or MLU, of their peers when formally assessed; however, in natural discourse situations, generalized length of utterances tended to be smaller (Brown, 1973; Mermelstein, 1983). In addition, discourse tended to be more adult-directed as opposed to peer directed (Paul, 1987). Therefore, the generalization of programmed responses needs to be a crucial component of any teaching curriculum for children with autism.

Stimulus overselectivity. As defined by Lovaas, Schriebman, Koegel, & Rehm (1971), overselectivity is the responding to a narrow dimension of a stimulus. Overselectivity is also seen in younger, typically developing children, children with learning disabilities, and children with severe and profound mental retardation (S. L. Bailey, 1981; Lovaas et al., 1971). Since children are often tuned into very specific stimuli, this can preclude learning and generalization of cause and effect relationships (Layton & Watson, 1995).

Conversational difficulties seem to stem from not being able to discriminate relevant from irrelevant information in the partner's speech acts. When conversational partners ask children with autism questions for clarification, the children with autism often gave answers with more irrelevant information (Paul, 1987). Breakdowns in communication may result from the child's adherence to strict routines, gaze, posture and proximity to the conversational partner, joint attention issues, and an inability to shift from one topic to the next (Prizant & Schuler, 1987). Individuals with autism often have difficulty with the discourse aspect of language – the turn taking and contextual

referencing needed to stay on topic. Conversation tends to be rigid in individuals who

attempt to converse, and children with autism have a difficult time with sustained use of

conversational rules (Paul, 1987). Studies show that children with autism tend not to

expand or elaborate on initial statements (Paul, 1987).

How Behavioral Teaching Methods Address Generalization

There are several major behavioral methods for addressing generalization, both

within curricula and across curricula. This section will address programming for

generalization within specific behavioral curricula, and then address general methods for

reducing overselective responding and increasing generalization. The section will end

with a discussion of multiple exemplar training and its specific relation to RFT and

language development.

Discrete trial training and generalization. Perhaps the best known behavioral

method for teaching children with autism is the curriculum developed by O. Ivar Lovaas

(Lord & McGee, 2001; Lovaas, 1981; Mesibov et al., 1997). This intensive early

intervention is often conducted for 35-40 hours per week and often in the home. The

curriculum targets a variety of social language and life skills that are broken down into

very specific "programs". These programs are designed to exaggerate the features of the

environment that the child is expected to attend to (Lovaas, 1981).

The hallmark of Lovaas's intervention is the "discrete trial". This refers to the

timing and pacing of the teaching. Each trial has a distinct beginning and end. The

beginning consists of presenting some sort of distinct stimuli and an instruction (e.g., "do

this" while touching the nose). 3-5 seconds are allotted for the child to respond. If the

child responds correctly, reinforcement is provided, which is selected based upon the

child's preferences. If the child responds incorrectly or not at all, the response is

prompted through a specific error correction techniques (Leaf & McEachin, 1999;

Lovaas, 1981; Maurice et al., 1996). Typically, 5-10 trials are presented to the child in

succession and the child is given frequent breaks to keep motivation high. Lovaas's work

has been demonstrated to be effective in literally hundreds of studies. In addition, DTT is

the only intervention program to date with longitudinal effectiveness data (Anderson,

Avery, DiPietro, Edwards, & Christian, 1987; Birnbrauer & Leach, 1993; Lovaas, 1987;

McEachin, Smith, & Lovaas, 1993; Sallows & Graupner, 2005).

One of the criticisms of DTT is that learning does not generalize well to other

environments. The teacher controls what targets are presented and in what order.

Reinforcers are arbitrary and often are not directly related to the response. Therefore, the

fear is that responding can be restricted and not relevant to the natural environment

(Siegel, 2003). Lovaas (1981) stated that DTT programs are conducted with different

teachers and in several different environments by programming common stimuli as much

as possible as well as thinning the schedule of reinforcement. By transferring skills to the

natural environment, Lovaas suggests that both generalization and induction are affected

(1981). A more structured approach is often used to teach specific skills or speech

sounds (Ogletree & Oren, 2001).

Naturalistic teaching approaches, such as milieu teaching, incidental teaching,

mand-model or natural language paradigm, time delay, and activity-based instruction,

attempt to address issues with generalization typically associated with discrete trial

teaching (Kohler, Anthony, Steighner, & Hoysin, 2001). Naturalistic approaches share

some similar characteristics. They are child initiated. That is, stimuli are selected that

the child is currently engaging in as opposed to stimuli chosen by the instructor or developed specifically for training.   Teachers engage themselves in the activity that is going on and begin teaching from that point. Teaching is interspersed into the child's natural environment as opposed to being overtly scheduled and carried out. It has been suggested that naturalistic teaching looks less like teaching than its DTT counterparts (Delprato, 2001). Reinforcers are naturalistic in nature and occur logically as a result of the response (e.g., a teacher gives a child a cookies in response to the child asking for a cookie; (L. K. Koegel, Carter, & Koegel, 2003; R. L. Koegel, Koegel, & Carter, 1999; Woods & Wetherby, 2003). Language is facilitated through techniques such as sabotage or violation of the child's routines (e.g., putting a cookie in a tightly locked tin so that the child needs to ask for the cookies), and comments and questions that facilitate speech and joint attention. The teachers prompt expansion of speech acts and often use peers to enhance the learning process (Kohler et al., 2001).

There is a large body of literature that support the use of naturalistic teaching methods for increasing language and communication (Kohler et al., 2001). However, there are no available peer-reviewed, controlled, longitudinal studies looking at the long-term or global effects of naturalistic teaching methods for children with autism. Overall, most studies comparing DTT to naturalistic teaching suggest that naturalistic methods might increase the probability of generalization over DTT methodologies (Delprato, 2001). Woods and Wetherby (2003) advocated the use of naturalistic teaching methods over DTT methods for teaching children with autism for its effects on generalization. However, there are no studies that assess the effectiveness of a combination of DTT and naturalistic teaching methodologies (Delprato, 2001).

It is often erroneously assumed that because naturalistic teaching methods do not use the same structure as Lovaas, they are not behaviorally based. In fact, some authors have stated that behaviorists look upon naturalistic teaching methods with disdain (Cohen, 1998). However, most naturalistic teachers espouse the theoretical basis of Applied Behavior Analysis in their work, including emerging curricula such as those based upon Skinner's Analysis of Verbal Behavior.

Interventions based upon Skinner's Analysis of Verbal Behavior. A third approach that is growing in popularity is basing teaching situations upon Skinner's (1957) Analysis of Verbal Behavior (Carbone, 2003; Sundberg & Partington, 1998). Verbal Behavior (VB) interventions use a combination of discrete trial methods and naturalistic teaching techniques to increase the communication of students with autism. In VB curricula, the form of the response is not as crucial as the function of the response, and there is an emphasis placed on capturing and contriving motivating operations to increase verbal behavior. Therefore, there is an emphasis on the functional use of communication as opposed to its structure.

Although the authors of VB training modules are quick to point out that their approaches are an empirically supported method of teaching children with autism, the body of literature directly related to teaching verbal operants to children with autism is quite small. Most of the studies teaching children with autism have been under the auspices of mand training, mostly functional communication training (FCT). Functional Communication Training is a methodology in which problem behaviors are addressed by teaching some sort of communicative response that serves the same function as the problem behavior. For example, if a child is engaging in problem behavior to escape

from task, the child might be taught to request assistance or a break (E. G. Carr et al., 1994). Expansion of communicative responses or the training of responses beyond manding is usually not addressed in FCT, as the goal is the reduction of problem behavior.

Very recent studies have begun to provide evidence that interventions based upon Sundberg and Partington's (1998) curriculum and methods are effective in increasing the verbal behavior of students with autism (Barbera & Kubina, 2005; Hartman & Klatt, 2005; Karmali, Greer, Nuzzolo-Gomez, Ross, & Rivera-Valdes, 2005; Miguel, Petersdottir, & Carr, 2005b). Karmali et al. (2005) taught specific tacting responses to five 3-4 year old students who engaged in delayed echolalia (described by the authors as palilalia). For example, if a student began to recite the text of a book upon seeing the book, they were taught to say "that's a book" instead. Teaching tact responses was effective in suppressing palilalia. However, tacting did not increase. The function of palilalia was not assessed in this study, which may account for the modest results. In addition, the authors attempted to use a reversal design to demonstrate functional control. The behavior, however, did not reverse. These two factors limit the conclusions drawn from the study.

Barbera and Kubina (2005) taught children a 7-year-old child with autism and mild mental retardation to tact three sets of unknown words using an echoic-to-tact transfer procedure. The student was shown the item and asked "what is it?" If the child was not able to answer the question, the answer was modeled and the child was required to emit an echoic response (i.e., repeat the correct response). The child was then asked "what is it" again. For items which the child was having difficulty tacting using this

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procedure, an additional step of receptively identifying the item was included prior to prompting the echoic response. This procedure produced a steady increase in tacting, although generalization to novel words was not assessed. In addition, a delayed multiple baseline procedure was used in which all three baselines were not run concurrently to each other. This research design increases the possibility of threats to internal and external validity and therefore limits some of the conclusions that can be drawn from the data.

Preliminary data suggest that interventions based upon Skinner's analysis of verbal behavior are effective for increasing the amount and diversity of verbal behavior for children with autism. However, due to limitations in research design and the small number of studies available that directly assess the procedures used by Sundberg and Partington (1998), more research is needed to draw empirical conclusions regarding the effectiveness of this approach.

These data do not test generalization to novel stimuli, subjects, or situations. Available recent studies on the verbal behavior of children with autism and generalization of learned behaviors utilize RFT, specifically a multiple exemplar approach, to teaching. However, the body of research is small and much remains to be investigated regarding the best way to choose and teach verbal behavior using a multiple exemplar strategy.

Multiple Exemplar Training, RFT, and Generalization

Relational Frame Theorists believe that DRR, taught through multiple exemplar training, is the basis of language, communication and cognition. That is, it is crucial that a person be able to generalize in order to communicate effectively. If this is the case, it would logically follow that children who do not easily learn DRR would have difficulty

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with language and socialization. Research suggests that children with autism have difficulty learning DRR using a multiple exemplar approach (Blackledge, 2003). Recent research looks at the creation of classes and whether multiple exemplar training increases the probability of novel responses to untrained stimuli. It is possible that how exemplars are framed as well as prior skills and knowledge are crucial to the generalization process.

In multiple exemplar training, a subset of stimuli from a larger class is taught to the student. For example, if a child is being taught to put on a coat, the child might be taught to put on a yellow coat with a zipper, a blue coat with buttons, and a green coat with Velcro closures. It is hoped that by training using sufficient exemplars will increase the probability that the same student would be able to put on a new coat of any color and with any type of closure without additional instruction (Alberto & Troutman, 2003; Y. Barnes-Holmes, D. Barnes-Holmes, & V. Cullinan, 2001; Jahr, 2001; Secan et al., 1989).

To date, there are few available studies that look at how RFT relates to the acquisition of communicative responses in individuals with developmental disabilities. Rehfeldt and Root (2004) taught 3 adults with no functional communication to use the Picture Exchange Communication System, also known as PECS (Bondy & Frost, 1994). They were then taught to relate the name of the stimulus to the picture, the name to text, name to the item, text to the item, and picture to text. All learned to match the picture to the word and the word to the picture, but none read or verbally named the stimulus.

There are several characteristics of this study that make the findings preliminary. The multiple probe design was difficult to follow, so it is unclear whether all threats to internal and external validity were accounted for. There is a possibility that the PECS instruction affected the participants' ability to match (this is very likely given that they

were not able to read the printed text). In addition, reinforcement for correct responding was presented "occasionally" through verbal praise and the preferred item. Therefore, manding was reinforced on a thin schedule, which negates the possibility of relational responding. The authors did not test to see if new classes were formed with novel stimuli.

Halvey and Rehfeldt (2005) used a similar approach to teach vocal manding to three adults with mental retardation and little communicative skill. In this study, however, generalization to untrained stimuli in the same class as the trained mands was tested. Nine items were chosen for training, and categories were assigned to each of the items by the experimenters. The participants were taught to respond to the prompt "what do you want?" using a discrete trial approach. Once they were taught to request items, conditional discrimination training (matching a picture to an item) was conducted. All participants acquired the stimulus relations and trained vocal mands, but needed booster sessions in which discrimination training was interspersed with mand training to generalize manding to novel items.

Greer et al. (2005) investigated whether teaching matching pictures to identical pictures while teachers named correct responses (i.e., when a student matched a picture of a cup to another picture of a cup, the teacher said, "that's a cup") would increase pointing, tacting, or answers to the question "what is it?" (considered by the authors to be an impure tact). Three children with developmental disabilities ages 3-4 participated in this study. All participants were able to mand, tact, and engaged in intraverbal behavior, but did not point to items. Intervention had a modest effect on pointing and tacting, and the least effect on impure tacting. The authors state that multiple exemplar training had an effect on increases in responding. However, baseline probes of the target

responses revealed high responding, which was explained as chance responding. Therefore, it is possible that the students had pointing and tacting already in their repertoire (Greer, Stolfi et al., 2005).

Greer, Yaun, and Gartreux (2005) examined whether teaching written and spoken spelling skills using a multiple exemplar approach would increase the probability of generalization to untrained words with 4 students with language delays, autism, and mental retardation. Each were taught three sets of five spelling words. One word from each set was reserved for generalization probes and was tested post-training. Multiple exemplar training increased the amount of written and spelled words learned and results generalized to untrained spelling words. Results were replicated for four additional subjects with autism with more complex words and additional generalization stimuli per set (Greer, Yaun, & Gautreaux, 2005).

Preliminary evidence suggests that multiple exemplar training increases the probability of generalization to novel targets. Creating frames using multiple exemplars seems to be an effective method for increasing communication and language skills for individuals with autism and other developmental disabilities. However, questions remain regarding how to best define frames and how frames emerge for students with autism.

Multiple Exemplar Training and Answering "wh-" Questions

Studies are available which asses the effects of multiple exemplar training on the ability by students with autism to answer "wh-" questions such as "what is the boy doing?" or "how do we get to school?". The body of literature suggests that how categories of questions are framed, as well as a demonstration of prerequisite skills, may increase the probability that students will generalize to novel questions and stimuli.

The first study to examine the use of multiple exemplar training to increase the acquisition of answers to "wh-" questions was conducted by Krantz et al. (1981). The investigation was part of a larger study in which the authors instructed students on a number of advanced language skills.   Three children ages 5-7 participated in this study. All students could follow directions and use sentences to mand and tact. They could also use modifiers such as color and shape. One child showed symptoms of hyperlexia. The broad concepts of "what", "why" and "how" were broken into smaller subconcepts. Examples of these subconcepts are presented in Table 1. The authors used magazine pictures to teach five items from three selected subconcepts of each of the larger concepts using a multiple probe design across question forms. Correct answers were defined as "reasonable", "socially acceptable", and in complete sentences (Krantz et al., 1981). Points were given to students for correct answers, and error correction consisted of asking additional questions to prompt responding.

Table 1.

"Wh-" Question Forms, Subcomponents, and Sample Questions.

Subcomponents	Sample Questions
What	
1. as object or noun	1. What do you write with?
2. as "which"	2. What room do you eat lunch in?
Why	
1. relevant to cause/effect	1. Why is he eating?
2. relevant to affect	2. Why is he smiling?
3. relevant to potential action	3. Why is he picking up a fork?
How	
1. Relating to action	1. How do you start the CD player?
2. Relating to means	2. How do you get to school?
3. Relating to affect	3. How do you show you're sad?

When students were able to answer the training questions, untrained targets from the larger concept were tested once three subconcepts were acquired. If generalization (defined as 80% correct responding on untrained concepts) did not occur, retraining was conducted using magazine pictures. Training subconcepts increased the probability of generalization to untrained concepts in the larger target concept (Krantz et al., 1981).

Secan et al. (1989) attempted to replicate Krantz et al. (1981)'s findings with 4 students with autism ages 5-9. Before instruction, students were able to initiate and answer greetings, provide personal information, request items, spontaneously comment,

and answer simple "what" questions. Wh-questions were taught to these children using magazine pictures and procedures similar to Krantz et al. (1981). Complete sentences, however, were not required for correct responding. Error correction consisted of modeling the appropriate response. Generalization probes were conducted after training using novel questions as well as novel stimuli – magazine pictures, natural context stimuli (i.e., stimuli that occurred in the student's classroom environment), and pictures from a storybook. Maintenance probes were also conducted between 1 and 39 weeks after instruction. Students learned and maintained the ability to answer questions using the magazine training stimuli; however, generalization was lower. Booster training was conducted using the storybook pictures. Three students increased generalization using the storybook pictures; however, one subject needed direct training with the natural context questions to acquire correct responding (Secan, et al., 1989).

Jahr (2001) taught five students with autism, ages, 3-7, to answer "wh-" questions without any visual cues. Prior to intervention, students were able to label items using adjectives, but rarely used sentences to answer questions. Four questions from each of the broad categories defined by Krantz et al. (1981) were selected for training. These questions were taught in a discrete trial format, but without any type of visual cue. For example, the student would be asked, "what do you drink from?" However, no cups or pictures of cups would be immediately available to cue responding. Students were required to answer in complete sentences, and error correction consisted of modeling the correct response. Prompts were faded until students were able to answer questions independently. Generalization was measured across settings and novel trainers. Instruction without visual cues increased correct responding as well as almost perfect

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generalization to untrained stimuli. It is important to note, however, that several of the participants had two or less data points of generalization in one or more question forms; therefore, trend was not established.

Barthold et al (2003) attempted to replicate the results of Secan et al (1989). Two students with autism, ages 9 and 10, were taught to answer "wh-questions". As opposed to using magazine pictures as initial training stimuli and changing the form of exemplars, initial training stimuli consisted of storybook pictures, natural context questions, and magazine pictures randomly interspersed among 10 questions. Both students acquired the response to training, reaching criterion of 80% over three consecutive sessions. Generalization to previously untrained stimuli was then assessed with novel assistants, stimuli, and questions. These students acquired responses to the training stimuli, but did not generalize to novel stimuli or questions.

There are several factors that may explain the disparity in the results between these four studies. First is the language level of the students. In Barthold et al (2003), the participants emitted little generative language outside of the training sessions. The participants described in Krantz, et al. (1981) did not engage in spontaneous language in the classroom; however, they differ from the subjects in Barthold et al (2003) in that they had instruction in answering simple sentences prior to the study. It seems that these students were also able to answer yes/no questions, as this was used as a prompting strategy in the study (Krantz et al, 1981). The students in Secan et al. (1989) did emit some spontaneous speech; however, it is important to note that the student who needed the natural context training was also the student with the lowest standardized language

scores. Participants in Jahr (2001) were able to answer questions in complete sentences and were described as having a large verbal repertoire.

Another factor that may have affected the outcome of the studies was how the concepts were framed. Krantz et al. (1981) stated that it was important to break down the larger concepts into subconcepts because generalization rarely occurs between the subconcepts. Secan et al (1989) used similar subconcepts in training. Barthold et al (2003) and Jahr (2001) used the larger concepts only during instruction. Therefore, it is possible that each of the subconcepts is its own relational frame. While the subjects in Jahr (2001) were easily able to generalize to unlearned targets, it may be that their high verbal skills may have been indicative of existing relational frames that increased the probability of generalized responding.

Teaching to generalization, therefore, may not be sufficient for ensuring generalized responding. It is possible that there is a sequence of prerequisite skills needed to not only acquire but generalize more "advanced" skills. It is difficult, however, to identify the most effective teaching sequence for children with autism, and there is some evidence to suggest that relying solely on developmentally appropriate practice may not be sufficient.

The properties of any relational frame grow and evolve over time and are considered to be created by 23 months (Hayes et al, 2001). Verbal competence seems to be related to transitivity – nonhumans rarely show transitive relations (Hayes & Hayes, 1992). Preverbal humans also do not necessarily show transitivity. There is also some preliminary evidence that the way that individuals create associations may be developmental in nature as well. Younger children tend to sort items thematically (e.g.,

sorting cakes and donuts together) as opposed to taxonomically (putting TVs and radios together). Older individuals tend to sort more taxonomically (Murphy, 2001b), although this sorting can be altered somewhat through training (Osborne & Koppel, 2001) It is important to note, however, that the stimuli used in Osborne and Keppel's (2001) study were common stimuli (pictures of items) that might have already had a strong history to the participants. In addition, neither study tested the adults for any type of disability. Therefore, any mixed results should be viewed with caution.

Barnes and Brown (1995) found that younger children are less likely to form complex relations than older children. They trained a group of children 2-6 years old conditional discriminations between arbitrary stimuli as well as a transfer task (clapping was associated with one stimulus and waving was associated with another). A verbal response was used to test for equivalence. Only the older children had transferred the conditional discrimination to waving. Although no information was available about the characteristics of the children themselves, this study presents preliminary evidence that learning to transfer is a developmental skill. However, how this relates to the language level of the child remains unclear.

Prior learning also seems to affect how relations are learned, and there seems to be a developmental sequence to learning. Roche, Barnes, and Smeets (1997) paired sexual stimuli with arbitrary stimuli during the teaching of relational responding. When the matching to sample task involved relations between two stimuli that were both paired with sexual stimuli, learning of equivalence relations was more rapid and more consistent, suggesting that stimuli paired with strong reinforcement histories is more likely to produce strong equivalence relations than those which are from mixed

reinforcement histories. Wilson and Nunnally (1971) associated nonsense syllables with activities in a 6th grade classroom. When the children were asked which syllable reminded them of an attribute, students were likely to state emotions related to classroom activities. Goss (1971) found that students were more likely to recall word associations when words were more meaningful, and that results generalized to different contexts.

Murphy, Barnes-Holmes, and Barnes-Holmes (2005) used a conditional discrimination procedure to teach generalized manding to seven children with autism and attention deficit hyperactivity disorder. Participants were ages 5-9. All students were early speakers/readers according to the developmental pattern defined by Greer and Keohane (2006). Students were taught arbitrary relations between nonsense syllables. Students were then taught to mand using stimulus cards (also arbitrary stimuli) for items needed to complete a matching-to-sample task. Manding within classes was taught to all participants and maintained for most students when sequences of stimulus presentation were altered. The authors also studied the impact of rule instruction on relation learning. Instructions facilitated performance, suggesting that preexisting verbal behavior impacts the speed by which new relations are learned (Murphy et al., 2005).

Greer and Keohane (2006) suggested the use of a developmental approach to behavioral intervention. They suggest nine levels of development of verbal behavior, called developmental cusps. Answering questions are considered a fundamental skill as a speaker and listener capable to exchanges with others. Prerequisites to this behavior or the ability to receptively respond to commands (listener stage) and engage in mands (speaker stage).

Although it is tempting to infer that children with autism will follow the same developmental sequence as their peers, this might not be the case. From Kanner on, there has been note of a "developmental discontinuity" of children with autism. Children with autism often exhibit relative strengths when compared to their peers, and concomitant deficits (Prizant & Schuler, 1987). Several authors have noted that the development of children with autism can be quite uneven (Burack et al., 2001; Harris & Weiss, 1998). Therefore, developmentally appropriate practice might not be sufficient.

Very little is known about the developmental sequence of children with autism (Peeters, 1994). Children with autism often have very uneven language development, with "splinter skills" interspersed with extreme delays (Mesibov et al., 1997; Prizant & Schuler, 1987)). It is clear that children with autism use language differently than other children with language delays and this points to the possibility that a developmental model might have limitations for making predictions regarding progress or development. It is also possible that by using developmental models without question that some targets might be irrelevant for the generalization of skills or skills that might be crucial for learning generalization might be ignored.

In their review of the literature, (Burack et al., 2001) suggested that some problems might be more pronounced in some stages for some children than with others. These problems are individual in nature and cannot be grouped. The authors also propose that the remediation process in and of itself might lend itself to the uneven development and delays. That is, if all skills are taught with equal frequency, there is the possibility that stronger skills will gain more strength and that the gaps in development will remain (Burack et al., 2001). The goal is consistent demonstration and

generalization of skills, which may mean that certain concepts are covered longer than what looks necessary on the surface (Harris & Weiss, 1998).

Summary

While much is known about the language and communication issues surrounding children with autism, much is left to investigate. Little is known about how children with autism differ from other children in the developmental process, and whether these differences affect learning new skills. Generalization of learned skills, especially language and communication skills, continues to be of issue for both teaching and research. Most intervention programs, including behaviorally-based programs, incorporate strategies for increasing generalization of skills to non-teaching environments. Multiple exemplar training may increase the probability that learned skills are generalized to the natural environment (Barthold et al., 2003; Hayes et al., 2001; Krantz et al., 1981; Secan et al., 1989). However, it is possible that prior knowledge, what exemplars are selected, and how categories are framed may influence the probability of generalization for children with autism. Therefore, these factors need to be examined in greater detail.

This study was conducted to determine whether using different types of stimuli increased generalized "wh-" question answering by children with autism. A descriptive analysis of verbal behavior (Lalli, Browder, Mace, & Brown, 1993) was conducted to determine the types of verbal behavior students emitted during a typical school day in order to determine their level of verbal ability. A baseline of students' ability to answer "wh-" questions and match similar but not identical pictures was conducted. Matching and naming baselines as well as descriptive analysis results were examined to answer

whether students with autism with lower verbal repertoires had more difficulty deriving

relations than those with more advanced verbal repertoires (Research Question 2).

Students were instructed to answer "wh-" questions using different types of visual stimuli

and generalization was then tested. If generalization was not observed, students taught

to match nonidentical stimuli in order to answer whether teaching matching and receptive

naming of actions correlating to visual stimuli to students with autism would increase the

probability of generalized answering of "wh-" questions (Research Question 1).

Matching baselines were compared to descriptive analysis and generalization data to

answer whether students with autism with lower verbal repertoires have more difficulty

deriving relations than those with more advanced verbal repertoires (Research Question

3).

Chapter 3: Methodology

This chapter describes the methods used in the present study. First, the participants, selection process, and the setting of the study will be described. Second, procedures for securing approval from the University of Maryland as well as county school systems and parents or guardians of potential participants will be discussed. Selection and training of research assistants will also be described. Third, stimuli and questions will be described. Fourth, pre-instruction assessments to determine students' present level of functioning will be outlined. Fifth, research protocols, including baseline, tests of relational frames, and procedures for teaching "wh"- questions, generalization assessments, remediation protocols, and research design will be illustrated. Finally, the procedures for measuring interobserver agreement and treatment fidelity will be delineated.

School Selection

Individuals from two schools participated in the current study. All students were in self-contained classrooms for students with autism, and had a diagnosis of ASD or PDD-NOS. In both schools, students scored in the mild/moderate and severe range of autism symptoms, and all were identified as having difficulties with generalization of learned targets according to classroom and program staff. Each student had answering "wh-"questions as an active Individualized Education Plan (IEP) goal.

It was important to control for experience with behavioral teaching methods as a potential confound. Students introduced to discrete trial teaching methods who had not received behavioral interventions in the past could have acquired new skills regardless of the specific procedures used. Therefore, each student selected for the study received

behavioral intervention in a school-based setting prior to the beginning of the study.

Instruction in both classrooms used in this study was based upon behavioral methods.

School 1 implemented a behavioral model within a group setting; School 2 used a

primarily 1:1 behavioral teaching model.

Teacher consent form. The investigator provided the teachers of each of these

two classrooms with a consent form (Appendix A). The consent form contained summary

information about the research question and their role in the research process. Teachers

were informed that they could withdraw at any time during the study without penalty.

Selection and Training of Research Assistants

Ten graduate and undergraduate students in Special Education from the

University of Maryland were recruited to assist in teaching and data collection through

personal contacts in the College of Education. Assistants were paid hourly for their work

in the classroom, and were required to sign a confidentiality agreement as per school

system requirements. A sample confidentiality agreement is found in Appendix B.

Assistants were trained in data collection procedures and discrete trial teaching by

the investigator and helped with collecting reliability data, conducting baseline and

generalization sessions, and measuring the affects of instruction on the targeted

behaviors. Periodic meetings were also held with the assistants to review operational

definitions, schedule data collection sessions and assignments, and address any issues as

needed. The assistants' teaching and data collection skills were assessed via role playing

and ongoing monitoring of reliability as well as treatment integrity checks.

The investigator described and modeled the procedures for both data collection

and baseline and generalization sessions while meeting with the assistants as a group.

The assistants also practiced *instructional and baseline session implementation* with the investigator playing the role of the student. The rubrics in Appendices C-H were used to assess the assistants' ability to carry out the baseline and treatment procedures with acceptable fidelity. A score of 90% or better was considered sufficient for implementing baseline and instruction sessions. Training to this level helped to increase the likelihood that procedures would be implemented accurately. All assistants achieved 90% or better within one role-playing session.

The assistants also practiced *data collection* with the investigator playing the role of the student. The investigator reviewed operational definitions, allowed the assistants to ask questions, and then ran simulated sessions while the assistants collected data. Reliability of 80% or better was attained in data collection training sessions prior to collecting data in the experimental sessions. After each data collection session, the investigator reviewed disagreements between assistants and the operational definitions to insure high reliability of data collection. All assistants reached criterion in one teaching session.

Participant Selection Process

Permission to conduct research was secured from the University of Maryland Institutional Review Board (IRB) and the school systems in which this research was conducted before participants and schools were selected. The investigator met with the principals and administrative staff of each school to obtain permission to conduct the present investigation in their school. Once permission was obtained, parent consent forms were distributed to all students in the classroom in School 1, while staff from School 2 selected students based upon conversations with the investigator and send home

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permission forms to the parents. The consent form sent home to the parents of the students in the classrooms provided information on the research question and their child's role in the research (Appendix I). Parents were informed that they could withdraw their child from the study at any time without penalty. Parents of two participants elected to withdraw their children before completion of the study.

After permission from parents was obtained, the investigator reviewed the students' IEPs, general testing data, conducted informal observations of the students to confirm students had answering "wh-" questions as an active IEP goal, and determined whether there were also ongoing issues with respect to generalization of learned skills. Teachers and administrative staff were also asked for information about students based upon their knowledge of the students' communicative competence.

The investigator administered two formal assessments, and conducted evaluations of the students to confirm teacher reports of students' level of communication skills as well as severity of autism. The data from these observations and assessments were compared to the results of instruction to answer Research Question 3 (whether students with autism with lower verbal repertoires have more difficulty deriving relations than those with more advanced verbal repertoires).

Childhood Autism Rating Scale (CARS). The *Childhood Autism Rating Scale* (Schopler & Reichler, 1980) was completed by the classroom teacher and scored by the investigator to determine the severity of autism. Students were rated on 15 domains: Relating to people, imitation, emotional response, body use, object use, adaptation to change, visual response, listening responses, taste, smell and touch response and use, fear or nervousness, verbal communication, nonverbal communication, activity level, level

and consistency of intellectual response, and general impression. Students were rated on a scale 1-4 within each domain, where "*1*" represented less severe symptoms and "*4*" represented very severe symptoms. Scores on each domain were summed to determine a composite score: *15-30* is considered "not autistic", 31-*36* "mild/moderately autistic", and *37-60* "severely autistic". Students were identified as having "more severe autism" or "less severe autism" based upon their subsequent CARS scores.   All participants scored in either the mild/moderate to severe range of severity. In the original validation study, internal consistency was calculated to be .94, Interrater reliability was .71 with a range of .55-.93. Test-retest reliability was conducted one year later (.88) and two years later (.64). When compared to clinical descriptions of severity, correlations with the CARS yielded scores of .84 and .80. Construct validity, assessed through reviews of the CARS as well as training videotapes, was calculated to be .81. When classroom assessments were compared to psychometric assessments of severity, correlation coefficients were calculated to be .86 (Schopler & Reichler, 1980) . With the exception of interrater reliability, the CARS has sufficient reliability and validity coefficients for screening purposes as proposed by Salvia and Ysseldyke (Salvia & Ysseldyke, 2001).

Assessment of Basic Language and Learning Skills (ABLLS). The *Assessment of Basic Language and Learning Skills* (Partington & Sundberg, 1998), an assessment completed by the classroom teacher and/or administrators in the schools selected, was reviewed by the investigator to assess the students' acquisition of basic skills related to their verbal behavior. This assessment is a criterion-based measurement of specific skills considered crucial to effective social and communicative functioning. The person completing the ABLLS rated each student based upon his/her ability to complete tasks in

25 different domains. If the rater was not able to determine from prior experience whether the student was able to complete a particular task, the individual completing the ABLLS could consult archival records or ask the student to perform that particular task. The ABLLS domains and their corresponding codes are presented in Table 2.

Table 2.

Domains Measured by the Assessment of Basic Language and Learning Skills

(Partington & Sundberg, 1998)

ABLLS Code	Domain
A	Cooperation and Reinforcer Effectiveness
B	Visual Performance
C	Receptive Language
D	Imitation
E	Vocal Imitation
F	Requests
G	Labeling
H	Intraverbals (i.e., verbal behavior prompted and reinforced by the verbal behavior of another; Skinner, 1957)
I	Spontaneous Vocalizations
J	Syntax and Grammar
K	Play and Leisure
L	Social Interaction

ABLLS Code	Domain
M	Group Instruction
N	Following Classroom Routines
P	Generalized Responding (no O category)
Q	Reading Skills
R	Math Skills
S	Writing Skills
T	Spelling
U	Dressing Skills
V	Eating Skills
W	Grooming
X	Toileting Skills
Y	Gross Motor Skills
Z	Fine Motor Skills

Each domain contains 6 – 52 tasks. The individual completing the ABLLS is asked to rate the student's skill in performing each task on a 0-2, 0-3, or 0-4 scale. Information may come from prior observation of the student, records review, and/or direct observation of the student. The scoring guide to the ABLLS breaks down learner profiles into beginning and advanced learners (Partington & Sundberg, 1998). No data were available regarding the reliability and validity of the ABLLS; however, this assessment is widely used by parents and professionals to assess skills and to develop

curricula, and is the only comprehensive assessment available of communication from a behavioral perspective.

Domains C –I of the ABLLS were analyzed by the investigator for patterns in the data. These domains are directly related to the verbal behavior of children: requests, receptive language, labeling, intraverbals, and spontaneous vocalizations. Imitation is considered to be a prerequisite to communication (Lord & McGee, 2001). Therefore, the imitation and verbal imitation domains were also analyzed for patterns.

Descriptive analysis of verbal behavior. Descriptive analyses of each student's verbal behavior (Lalli et al., 1993) was conducted by the investigator to determine the conditional probability of the utterance of verbal operants by the participants in the natural environment. These data were used to provide evidence to answer whether students with less advanced verbal repertoires have more difficulty deriving relations than those with more advanced repertoires (Research Question 3).

A descriptive analysis is a form of direct observation in which no environmental variables are manipulated or held constant; rather, the behavior of the target student is recorded in the natural environment (Lalli et al., 1993; Mace & Lalli, 1991). An outside observer records the actions of all individuals (including student, teachers, adults, and peers) in the environment and analyzes the data for patterns in antecedents and consequences. *Adults* were defined as any individual at least two years older than the student due to the presence of peer buddies. These peer buddies acted in much the same way as the teachers and paraprofessionals in the school; therefore, they were considered adults for the purposes of assessment.

The participants were observed in the classroom environment, with particular emphasis on noninstructional situations (e.g., free play, lunch, recess), to determine the verbal behavior they emitted when in non-directed settings. In School 2, participants were videotaped during lunch and during library instruction, as these were the only times in which they were not participating in 1:1 instruction. Participants from School 1 were not observed outside of the classroom environment nor videotaped due to constraints set forth by the school system in which the research was conducted. The investigator coded the antecedents, responses, and consequences of each instance of verbal behavior by the student using the OBSERVE data collection program, a computer program in the public domain. Information on the development of the OBSERVE program is no longer available. A table of codes is presented in Tables 3-6.

Table 3.

Codes and Definitions of Conditions for OBSERVE

Conditions	
Code	Definition
Play Peers	Student is engaged in an activity with one or more peers without adult mediation
Adult 1:1	Adult or older individual is working/interacting exclusively with the student
Adult Dyad	Adult or older individual is working/interacting with student and one other classmate
Adult Group	Adult or older individual is working/interacting with student and more than one other classmate
Low Attention	No other individual is interacting with student for longer than 15 seconds

Table 4.

Codes and Definitions of Adult Antecedents

Antecedents	
Code	Definition
Instruction	Teacher or any other individual present in the room provides any sort of command to the child (e.g., "say cookie" or "pick up the blocks")
Question	Teacher or any other individual present in the room asks an interrogative to the student (e.g., "what do you want?" or "what are you doing?")
Prompt	Teacher or any other individual present in the room provides some sort of clarification or error correction to the student (e.g., "raise your hand")

Table 5.

Codes and Definitions of Student Responses

Student responses	
Code	Definition
Item Name Present	Student states the name of an item present in the room and with his or her line of sight either within or without the context of a sentence or clause. Scripted or memorized responses should not be scored with this response
Item Name Not Present	Student states the name of an item not within his or her line of sight either within or without the context of a sentence or clause. Scripted or memorized responses should not be scored with this response

Student responses	
Code	Definition
Abstract event	Student qualifies a statement with an abstraction (e.g., "I'm sure" or "of course")
1:1 correspondence	Student repeats back exactly the same words as the teacher (instances of echolalia should not be scored)
Scripted response (SR)	Student uses the same word or phrase to answer a questions with the exact same prosody or tone each time the question is asked, repeats a word or phrase out of context, or utters nonsense jargon
Point/Nod	Student uses some sort of symbolic gesture such as raising his/her hand, pointing to an item, or nodding.
Question	Student makes some sort of interrogative statement (e.g., "are you going back to your office now?")
No (student)	Student cries, says "no", or screams

Table 6.

Codes and Definitions of Consequent Responses

Consequent Responses	
Code	Definition
Verbal Praise	Teacher or other individual in the room gives student verbal affirmation that a response is correct
Item Removed/ Received	Teacher or other adult in the room provides item stated or removes item after a No (student) response

Consequent Responses	
Code	Definition
Related Adult Response	Teacher or other individual in the room provides a response that is related to the student utterance (e.g., "tomorrow" for "when are we coming back to school?")
No (teacher)	The student is told s/he cannot have the item
Error Correction	Student receives some sort of error correction for responding (grammatical, etc…)

Combinations of antecedents, responses, and consequences were considered to be indicative of particular verbal operants. Therefore, the coded antecedents, responses, and consequences were then analyzed using the rubric presented in Table 7. In addition to the antecedents, responses and consequences, the investigator also recorded the setting in which these responses occurred and how long the student was present in the setting. The number of times a particular verbal operant was emitted was divided by the amount of time the student was observed in a particular setting to determine the conditional probability of an utterance given the setting. In addition to total verbal behavior, unprompted verbal behavior was calculated across conditions. Any verbal behavior emitted by the student more than 5 seconds after an adult antecedent was considered unprompted. Conditional probability of verbal behavior, as with total behavior, was calculated by dividing the number of times a verbal operant was emitted by the total time in each condition.

Table 7.

Analysis of Antecedents, Student Verbal Behavior, and Consequences

Antecedent	Student Behavior	Consequence	Verbal Operant
Instruction, Question, no antecedent	Item Name Present	Verbal Praise, related adult response	Tact
Instruction, Question no antecedent	Item Name Present, Item Name Not Present, Point/Nod	Item Received, No (teacher)	Mand
Instruction, Question no antecedent	No (student)	Any response	Mand
Instruction, Question no antecedent	Question (student)	Any response	Mand
Instruction, Question no antecedent	Item Name Not Present	Verbal Praise, Related Adult Response	Intraverbal
Instruction, Question no antecedent	1:1 Correspondence	Related Adult Response, Verbal Praise	Echoic

Note: Scripted Responses were tallied as stereotypic behavior.

Descriptive analysis technology is best known for providing information leading to the determination of the function of problem behavior (Dunlap, Kern-Dunlap, Clarke, & Robbins, 1991; Lalli et al., 1993; Taylor & Romanczyk, 1994); however, in this investigation, these data were used to determine what types of verbal behavior the participants emit in noninstructional environments. The purpose of the descriptive analysis was to provide data regarding the verbal repertoires of the students and to provide the basis for evaluating whether the students' existing verbal repertoires affect generalization and relational responding (Research Question 3). Results of the CARS, ABLLS, and descriptive analysis were then compared to instruction and generalization data to provide evidence for Research Question 3.

Tomasello and Stahl (2004) analyzed the hypothetical probability of observing linguistic phenomena given the amount of time observed. According to the data calculated, 4-8 hours of observation per week would yield an accurate sampling of linguistic acts given these acts were not of extremely low frequency. There are no data available that show how often students with autism engage in verbal behavior when it is not explicitly prompted; therefore, power cannot be easily estimated. Students were observed or videotaped in the classroom for at least four cumulative hours over two weeks to determine the frequency of verbal behavior. In School 1, the average length of observation was 4.60 hours (range: 4.09-5 hours). In School 2, the mean length of observation was 4.08 hours (range: 4-4.15 hours).

Based on all of the above data, six participants, ages 7-10, were selected for the present study. Specifically, three participants were selected from School 1 and three from School 2. Each of these students met the DSM-IV-TR (American Psychiatric

Association, 2000) definition for Autism Spectrum Disorder or Pervasive Developmental Disorder. Information about the participants' age, diagnosis, and school placement was substantiated from school records as well as through consultation by classroom teachers and supervisory staff of the programs each child attended.

Description of Participants – School 1

Joon, Allen, and Dino attended the same classroom. This class was part of a district-wide public school program for students with autism spectrum disorder. The classroom was self-contained, and was housed in a local public school. Instruction was provided primarily in group format, although all students also received 1:1 instruction for specific skills. All three of these students were considered by school and program staff as having less advanced verbal skills, and engaged in low levels of spontaneous communication during informal observation.

A table of Dino, Joon, and Allen's CARS, standardized test scores and descriptive analysis results are presented in Table 8. The GARS, or Gilliam Autism Rating Scale (Gilliam, 1995), a standardized checklist used to diagnose autism, and the Leiter International Performance Scale-Revised (Roid & Miller, 1997), a nonverbal test of intelligence, were administered by the school psychologist to Joon and Dino as part of their Triennial evaluations. Both Joon and Dino were rated "very likely" to have autism by both their parents and teachers.

Table 8.

Descriptions of Present Levels of Functioning for School 1

Name	Age/ Sex	Standardized Test Scores	CARS	Mean Mands/h (Total/ Unprom.)	Mean Tacts/h (Total/ Unprom.)	Mean Intraverbals/h (Total/ Unprom.)
Joon	7-5 Male	*GARS* – 110 (Parent) 92 (Teacher) *Leiter-R* full IQ – 71 (borderline)	36.5	4.80/5.99	25.82/13.98	1.12/.88
Allen	7-1 Male	N/A	37	72.15/16.65	135.42/40.55	10.23/8.25
Dino	7-0 Male	*GARS* – 87 (Parent Score) 87 (Teacher) *Leiter-R* full IQ –84 (low average)	32	19.12/16.71	23.55/20.96	1.84/.13

Note: CARS scores are indicative of severity of symptoms: 15-30 is considered "not autistic", 31-36 "mild/moderately autistic"; 37-60 "severely autistic" A GARS index of 85 or higher indicates that the probability of autism is "very likely."

Joon. Joon was a 7.5 year old male. His CARS score was 36.5, which placed him in the severe range of symptoms. According to informal observations and reports from the classroom teacher, Joon rarely emitted spontaneous verbal behavior outside of the teaching environment. His preferred reinforcers were edibles, videos, and items related to "Toy Story". Occasionally, he would request preferred items (e.g., "Toy Story", "motel"); often these requests were out of context and seemed to function as escape from instruction. Joon also engaged in problem behavior such as lying on the floor when presented with a demand, screaming, or attempting to slap other students in the class. The function of these problem behaviors was unclear. He would also emit many mands during snack time to acquire any type of food reinforcer. Joon often engaged in delayed echolalia such as scripts from cartoons. According to Joon's present levels of performance on his IEP, Joon could read and comprehend a sight word vocabulary and copy words from a model. He could also follow complex commands according to his IEP, although Joon's present levels of performance did not include how many steps in the commands Joon could follow.

Joon's IEP listed 1 hour/week of Speech and Language services. According to Joon's IEP, the ability to answer "what" questions was emerging, as well as the ability to answer "who and where" questions within the context of a story. According to Joon's present level of performance on his IEP, his phonics, counting and computation skills were strong. IEP goals for Joon included being able to answer wh-questions about pictures and text in reading materials, asking wh-questions with prompts, and answer questions about people and events present in the environment.

According to Joon's ABLLS results, Joon was able to complete a number of tasks related to receptive language, including delivering items to at least two items and two places, demonstrating the use of at least 5 objects, and locating at least 3-4 items in a complex display. He was able to imitate a number of stimuli, including at least 10 actions without a direct verbal prompt. Requesting (manding) skills included being able to answer the question "what do you want?" with 10 or more different answers, answering yes/no questions, and emitting spontaneous requests at least 20 times per day. Joon was able to acquire labels by listening to others, label items by function, and label at least 20 pairs of compound stimuli such as "fork and knife", and label at least four different community helpers. Very few intraverbal skills were reported as mastered; he could fill in words from songs, could perform at least 25 different Signs (using Signed Exact English) and fill in at least 20 different phrases with two different functions. Mastered spontaneous vocalization targets included singing phrases from songs and at least 10 spontaneous requests for items or activities. A presentation of page 1 of Joon's ABLLS is presented in Figure 2.

Figure 2. Joon's ABLLS results page 1.
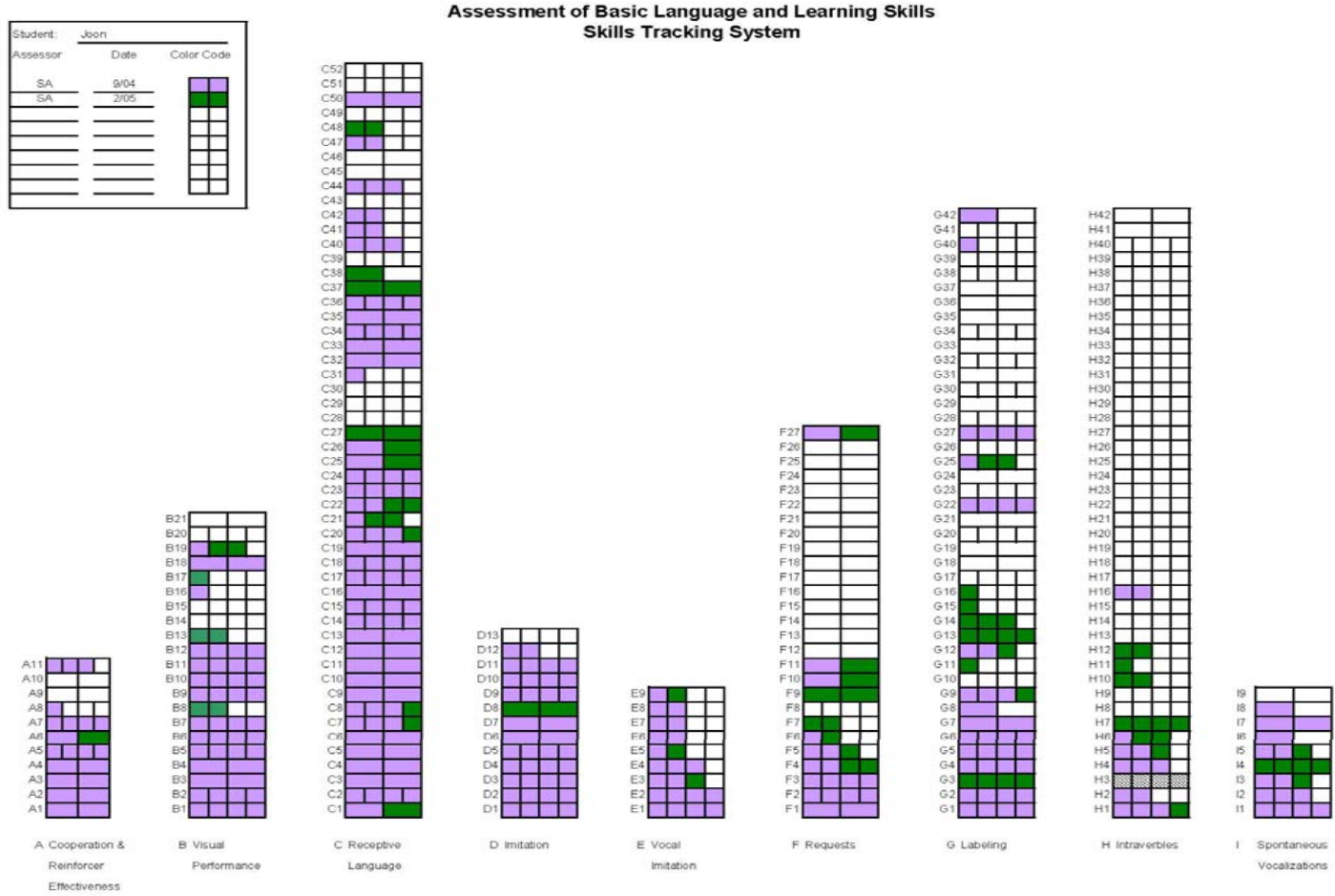
Allen. Allen was 7 years, 1 month at the beginning of this study. His CARS score was 37, which is borderline between mild/moderate and severe. Allen often engaged in requests for attention such as pointing or showing, and would mand for highly preferred items such as videos and the computer. Although according to Allen's IEP he did not have a formal diagnosis, Allen also engaged in what appeared to be hyperlexia; he could decode most age-appropriate children's books but often did not correctly answer comprehension questions without significant prompting. Occasionally, Allen would cry when presented with difficult tasks, but was able to attend to and comply with complex demands. Often, Allen would engage in extremely affectionate behavior such as crawling into an adult's lap and kissing them on the cheek. Allen's preferred reinforcers were videos, computers, and adult attention.

According to Allen's IEP, he received 1.5 hours/week of Speech Language services. He was able to select items by their feature, function, and/or class, and his ability to identify opposites was emerging. IEP goals for Allen included answering what, where, and who questions with pictoral or textual prompt present and in 4-5 word sentences as well as asking wh-questions with prompting. Goals also included the ability to initiate greetings to peers as well as answer questions about familiar places and events, sustain conversation for two exchanges, demonstrate comprehension of 4-5 word sentences, and request the use of the bathroom.

According to Allen's ABLLS receptive language matrix, he was able to Follow instructions to do at least three preferred activities out of context and without prompts, hand an adult a named and non-preferred items, and could approach four or more people when asked to do so. Allen was able to imitate the speed of most movements, and could

imitate a movement without prompting. He was also able to imitate most consonant

blends in any position in a word, accurately imitated at least 20 words per day without a

direct prompt. In the requesting domain, Allen was able to respond to the question "what

do you want?" with at least 10 different items/activities, and engaged in a variety of

requests at least 20 times per day. Allen's labeling skills included being able to identify

at least 10 or more people when asked "who is this?", label at least 20 common actions,

and acquired common labels without intensive training. He was able to label parts of at

least 6 items (e.g., wheels on a bicycle), body parts, at least 20 compound labels, and

spontaneously labeled at least 20 items per day. The only target Allen mastered in the

intraverbal domain was filling in at least 10 different phrases about enjoyable activities.

Allen was able to spontaneously say at least 30 phrases per day, and could label at least

10 items per day. Page 1 of Allen's ABLLS results are presented in Figure 3.

*Figure 3*. Allen's ABLLS results page 1.
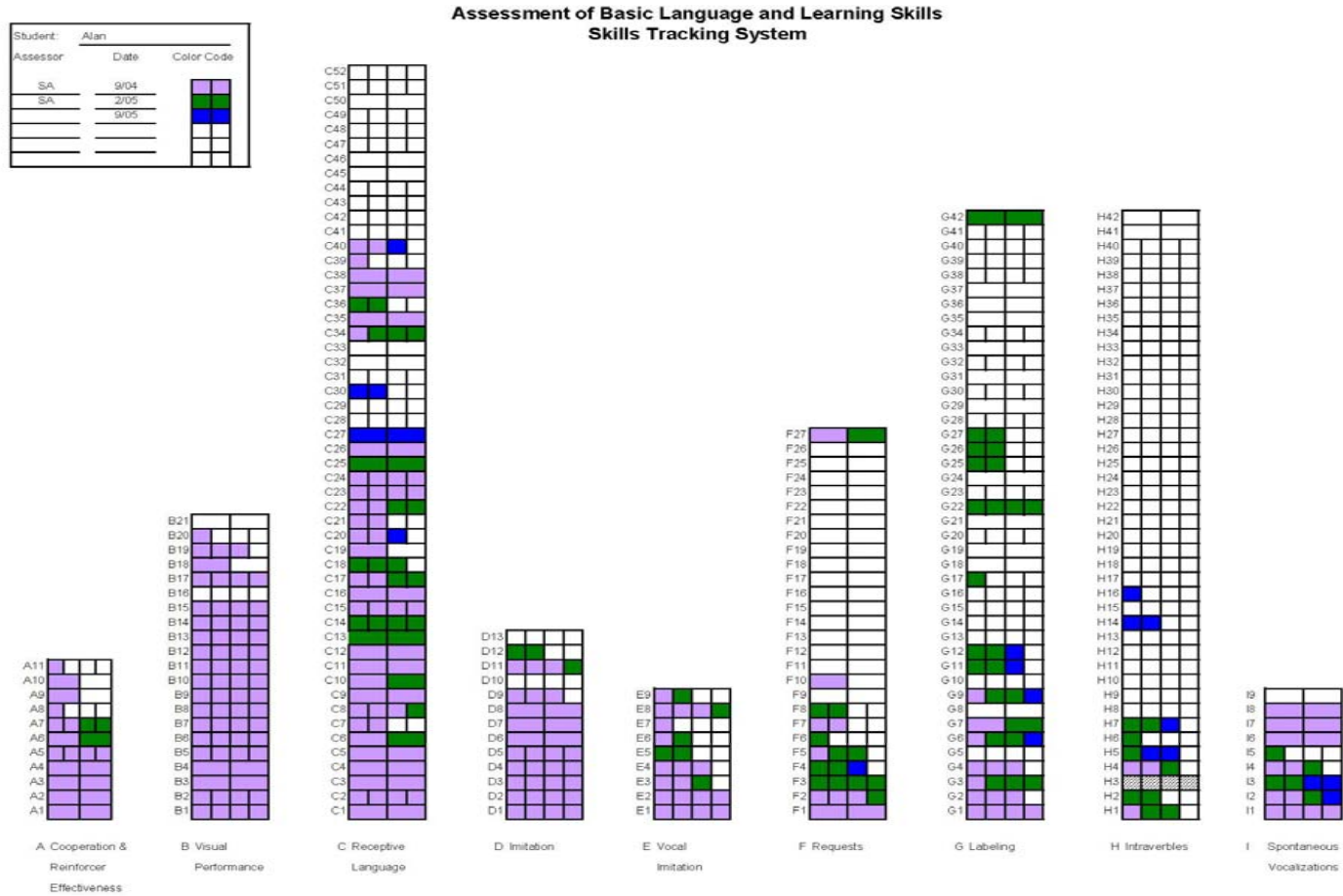
Dino. Dino was 7 years, 1 month old at the beginning of the study. Dino scored 32 on the CARS, which placed him in the mild/moderate range of severity. Dino often engaged in loud vocalizations such as singing to himself or giggling that appeared to sensory-maintained, and rarely engaged in spontaneous verbal behavior even when presented with preferred items. Dino's manding consisted primarily of asking for food items and physical contact such as back scratching and deep pressure activities. Occasionally, Dino was observed pointing at items and made excellent eye contact in one-one-one interactions. Dino engaged in problem behavior such as non-compliance and lying on the floor when presented with a difficult task. His preferred reinforcers were drawing with markers (he would often draw very elaborate pictures sometimes accompanied with captions) and physical contact such as hugging, squeezing, and scratching his back.

According to Dino's IEP, he received 1 hour/week of Speech Language services. His indicated strengths included the ability to name letters and rote counting skills. He was also able to answer "what" questions about stories. His IEP goals included being able to answer what, where, and who questions about pictures and text in reading materials, ask what, who, where and when questions, initiate greetings, and answer questions about events in the present environment.

According to the ABLLS, Dino could receptively follow an instruction to complete at least 5 different simple motor actions, go to at least four different people upon request, select 20 or more actions with two distractor pictures present (including novel pictures), and select at least four different pictures of locations and activities (e.g., swimming in a pool). Dino was able to imitate at least 10 gross motor actions and

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hand/arm movements, and could imitate actions of a teacher with matching speed. Dino

had not mastered any verbal imitation programs. As with Allen and Joon, Dino could

request at least 10 items upon the request "what do you want?" According to the

ABLLS, he also engaged in at least 20 spontaneous requests per day. Dino's ABLLS

results are presented in Figure 4.

Figure 4. Dino's ABLLS results page 1.
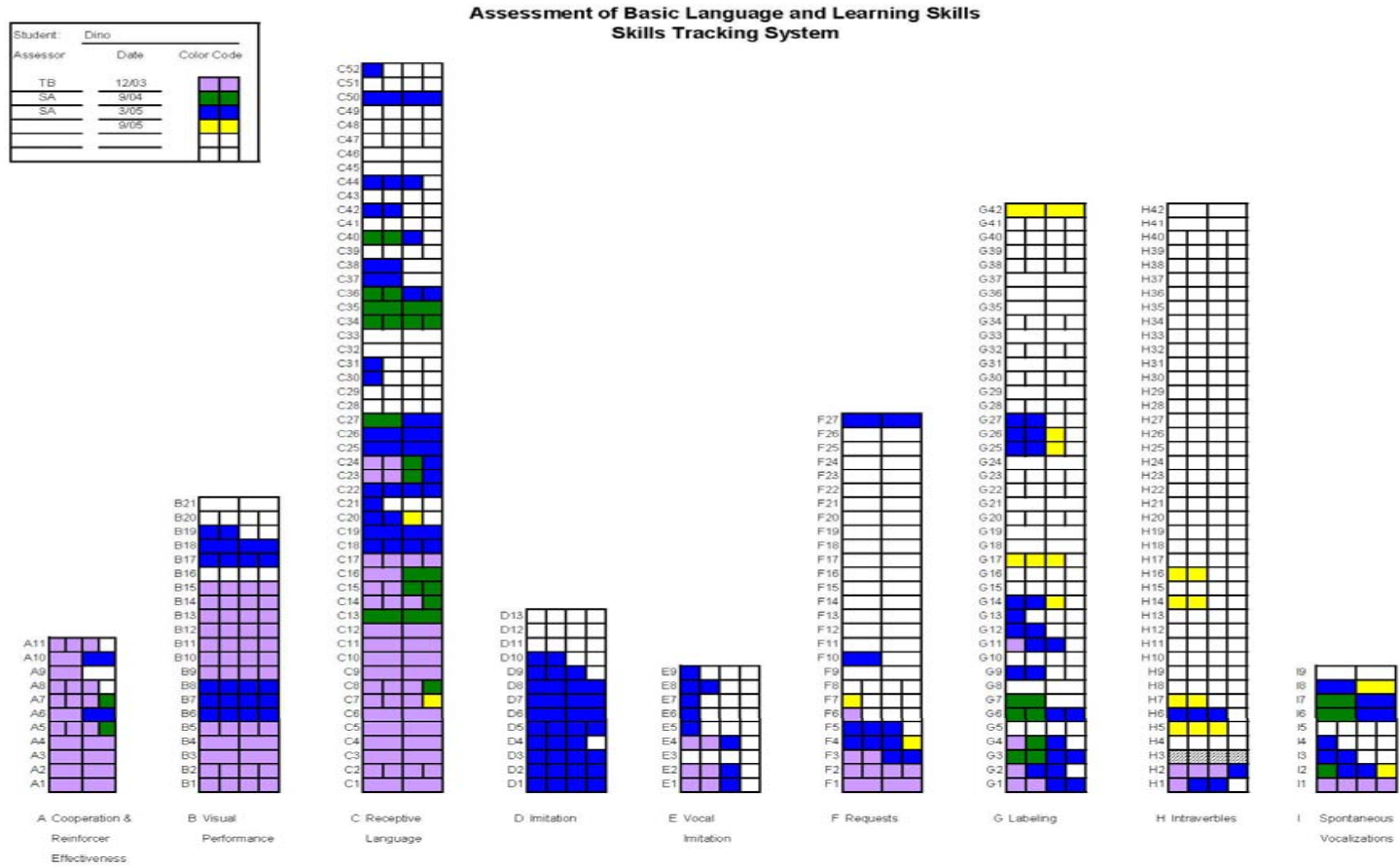
School 2 Participant Description

Simon, Colin and Darren attended the same classroom within a private school program for children with autism. In this program, instruction was primarily provided on a 1:1 basis. In School 2, all students received Speech and Language services on an indirect and consultative basis, and communication goals were addressed during discrete trial teaching. Speech Language evaluations were conducted through a structured observation protocol created by the school; therefore, no standardized data on these students were available. The classroom teacher nominated participants, and information about students was not available to the investigator until the consent forms were obtained. Descriptions of present levels of functioning are presented in Table 9.

Table 9.

Descriptions of Present Levels of Functioning for School 2

Name	Age/ Sex	CARS	Mean Mands/h (Total/ Unprompted)	Mean Tacts/h (Total/ Unprompted)	Mean Intraverbals/h (Total/ Unprompted)
Simon	9-1 Male	43	9.42/4.60	42.24/11.78	36.52/20.76
Colin	10-1 Male	46	7.61/4.89	43.02/4.76	.42/0
Darren	10-8 Male	34	111.22/86.62	71.60/39.64	3.79/1.78

Simon. Simon was 9 years, 1 month at the beginning of the study. He scored 43 on the CARS, which is in the severe range of symptoms. He often initiated conversations with adults in the room with the question "what's your name?" And would mand for adults to say scripted responses. If the adults in the room did not comply, Simon would scream. He engaged in a variety of gross and fine motor play with many different items, although his preferred reinforcer was watching movies on a television in the classroom and materials with pictures of nuns.

According to Simon's IEP, he engaged in high levels of verbal stereotypy and responded to yes/no questions, but did not initiate verbal behavior. His strengths included asking for the bathroom, following 1-step directions, receptively identifying coins and numbers 1-15, and identifying sight words and uppercase letters. He correctly responded to rote questions such as "what's your name". Simon often spoke at a very high rate of speech, and was given a visual cue system to slow his rate of speech. Goals for Simon included talking about past events, describing a picture, increasing peer interaction, and initiating communicative exchanges.
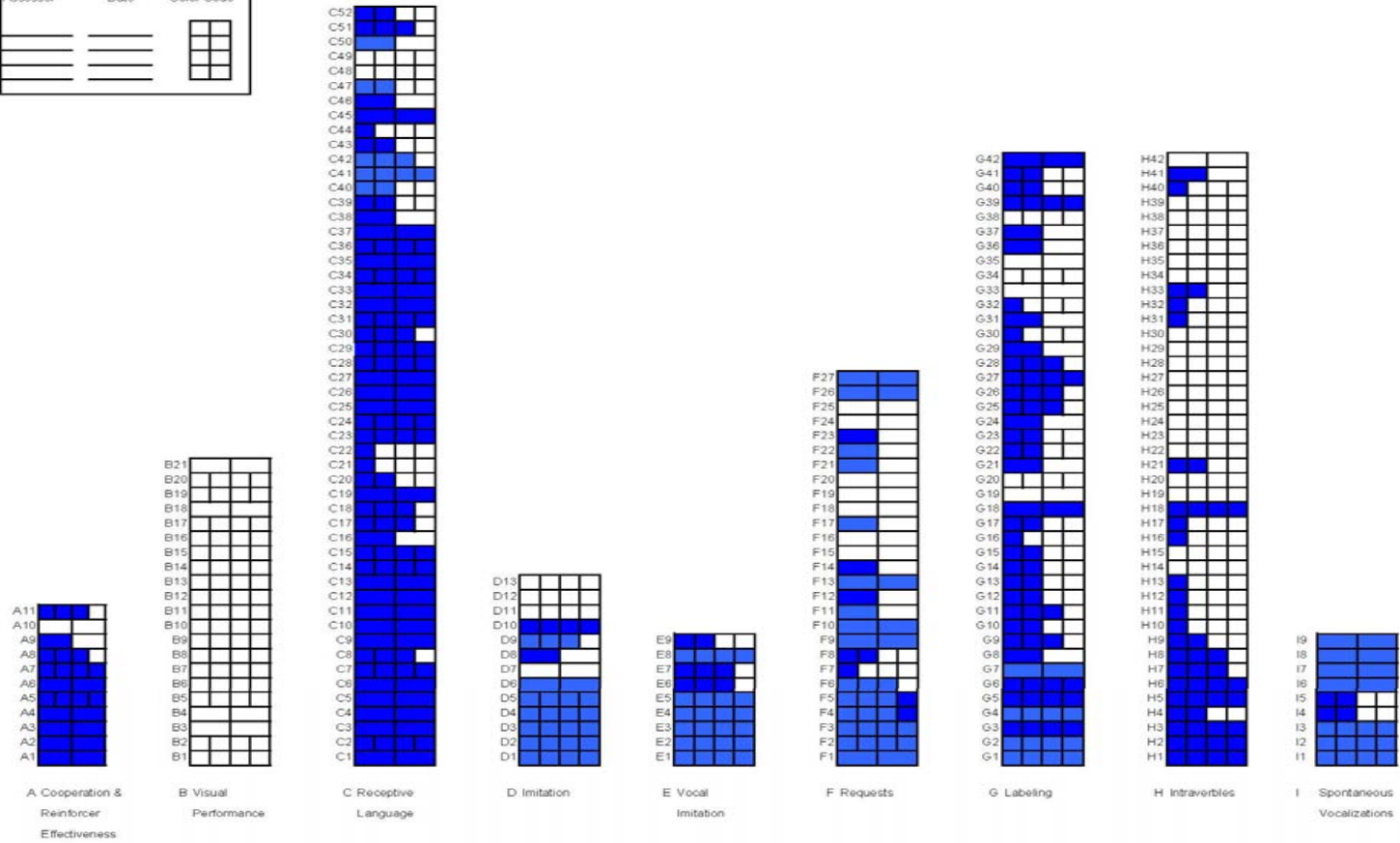
According to Simon's ABLLS, he was able to receptively select pictures of at least 50 different common items with one distractor present, identify different examples of at least 100 objects, as well as identify at least 20 different complex stimuli (e.g., the thin shiny magazine as opposed to the thick blue book). He was also able to receptively touch items in a three-step sequence. He could imitate three different head movements and a sequence of at least 10 actions. Simon could imitate 6-word phrases as well as a variety of different prosodies of speech (e.g., loud, soft, fast).

In the requests domain, Simon was able to spontaneously request at least 10 items not in his immediate environment, use yes/no to request items, and usually used sentences to request items. He spontaneously requested at least 20 items or actions per day, and spontaneously learned new requests. Simon mastered many of the labeling targets, including learning labels without intensive training, answering yes/no questions, labeling at least four community helpers. He could also label at least four emotions in the natural context as well as in pictures. For intraverbals, Simon could fill in information about enjoyable activities out of context, provide at least 4 examples of personal information, and complete phrases about at least 10 common activities. Simon could sing phrases from at least 5 common songs, could repeat at least 5 words emitted by others per day, and requested at least 10 different items per day without prompts. Simon's ABLLS results are presented in Figure 5.

Figure 5. Simon's ABLLS results page 1.

Colin. Colin was 10 years, 8 months at the beginning of the study. His CARS score was 34, which placed him in the mild/moderate range. Colin often played quietly by himself, and preferred watching videos and jumping on a trampoline. Occasionally, Colin would cry or scream with no apparent antecedent. Classroom staff often prompted him to tell them "what's wrong" during these episodes. Colin also engaged in stereotypic vocalizations in which he would repeat words or phrases over and over; these were seen across the teaching session and the antecedents were not clear.

According to Colin's IEP, he was able to answer "who" and "what" questions, follow simple directions, and answer rote questions. He was also able to respond "yes" or "no" based upon preference. He could tell time, add numbers using tally marks, count without a number line, and identify numbers and money. Colin was also able to identify several sight words. Goals for Colin included initiation of communicative acts, increasing intelligibility, and asking "wh-" questions to gain clarification. Increasing his understanding of "More" and "Less" were also IEP goals for Colin.

.According to the ABLLS, Colin could select objects using a variety of requests (e.g., "show", "point", "get"), receptively identify 4 or more items he was wearing, could select 100 or more pictures of items when two distracters were present and two pictures from a display of 10 or more. He could also approach at least 4 different people upon request. Colin could identify at least 20 different actions, at least 20 different compound stimuli (e.g., a green, fluffy blanket), and select at least 4 pictures representing activities and locations.

In the imitation domain, Colin had mastered gross motor and fine motor imitation, including at least three head movements. Colin could fluently imitate most words. In the

requesting domain, Colin could request at least 10 different items with the prompt "what do you want?" Use yes/no or sentences to request items, and emitted at least 20 requests in the absence of a direct verbal prompt. Colin could label at least 10 reinforcing items, 10 or more common people in Colin's immediate environment, and four or more community helpers. In the intraverbals domain, Colin could fill in at least three phrases of common songs and complete at least 10 different phrases about reinforcing activities. He could provide at least four pieces of personal information and fill in at least 10 different phrases about common activities. Colin could spontaneously sing phrases from at least 5 common songs, imitate words without prompting at least 5 times per day, and generatively request a minimum of 10 actions/items per day. Colin's ABLLS results are presented in Figure 6.

Figure 6. Colin's ABLLS results page 1.

Assessment of Basic Language and Learning Skills
Skills Tracking System
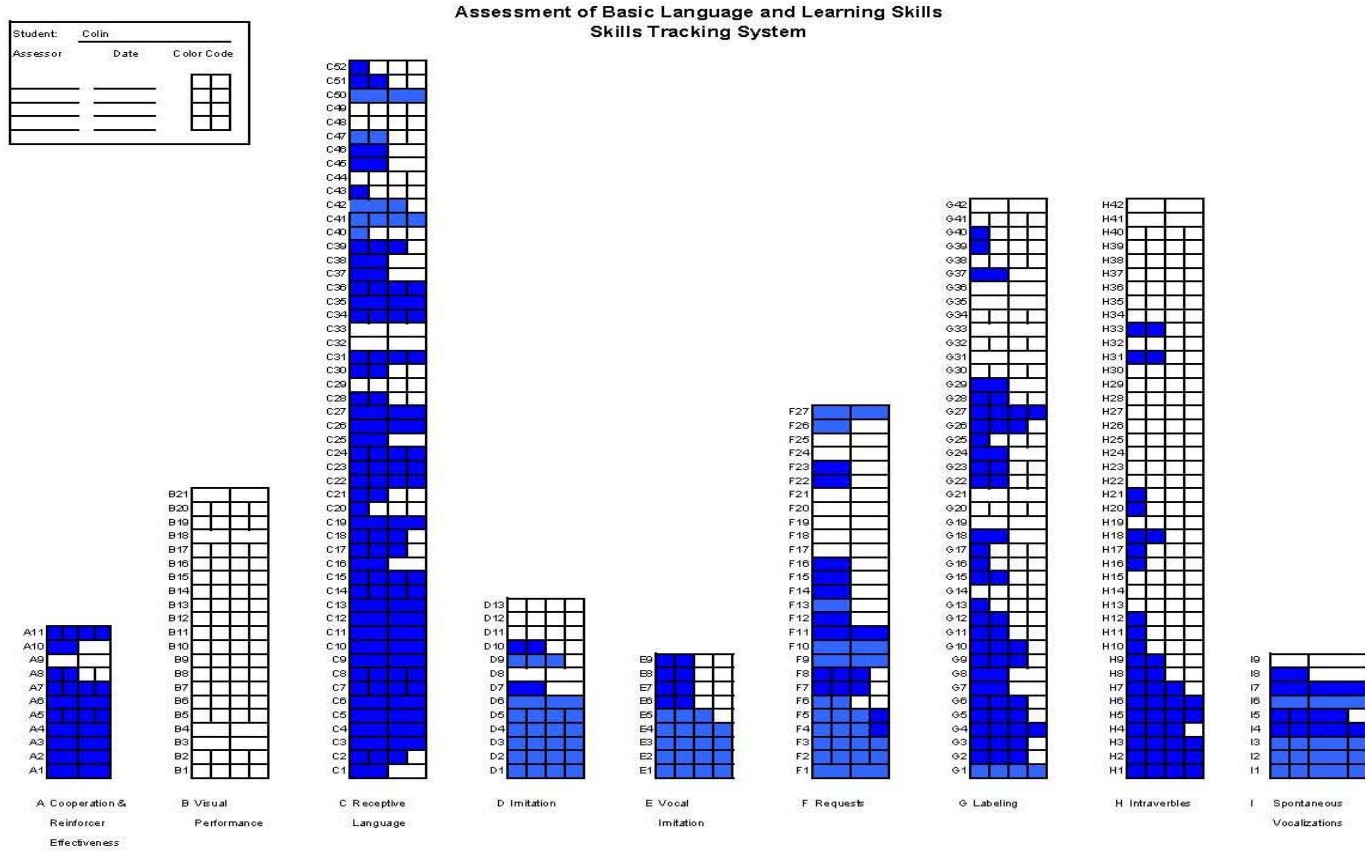
Darren. Darren was 10 years, 1 month at the beginning of the study, and was diagnosed with Pervasive Developmental Disorder, Not Otherwise Specified (PDD-NOS). His CARS score was 46, in the severe range. He emitted spontaneous words or phrases, although most spontaneous speech consisted of delayed echolalia (e.g., "Sorry to scare you"). As the study progressed, Darren expanded the number of items he would mand for, including food items. His preferred activities included swinging outside and sitting in an area outside the classroom with a staff member. Darren was also able to answer rote questions such as "What is your name?"

During the study, Darren was observed engaging in severe problem behavior, such as head hitting which required the contingent application of a helmet. He also engaged in high rates of spitting on his desk. Behavioral support for Darren included reinforcing all mands for preferred items. As the study progressed, the schedule of reinforcement for mands was thinned.

According to his IEP, goals for Darren included expanding his utterances supported by the Picture Exchange Communication System, increasing intelligibility, and increasing mands. Additionally, asking "wh-" questions to gain clarification were identified as goal for Darren. Identified strengths for Darren included responding to rote questions about him, use of familiar vocabulary, and responding to greetings. Responses to "what" questions in context were inconsistent according to his IEP.

According to Darren's ABLLS, he could receptively find items regardless of position comply with requests to do at least 5 different simple motor actions and could select a reinforcing item from an array of two. He could receptively identify at least 4 different items of clothing he was wearing. He had not mastered any of the targets in the

imitation domain. In the verbal imitation domain, he could imitate most words and parts

of words upon request. He was able to request at least 10 different items when prompted

with "what do you want?", use yes/no to request items, and emit at least 20 spontaneous

requests per day. Darren mastered only one target in the labeling domain. He was able

to label 10 or more reinforcing items. In the intraverbal domain, Darren was able to fill

in phrases from at least six different songs, and answer at least 4 different questions with

personal information. Darren spontaneously emitted at least 30 phrases over the course

of a day, requested at least 10 items per day without prompts, and emitted at least 10

spontaneous labels daily. Page 1 of Darren's ABLLS results are presented in Figure 7.

Figure 7. Darren's ABLLS results page 1.
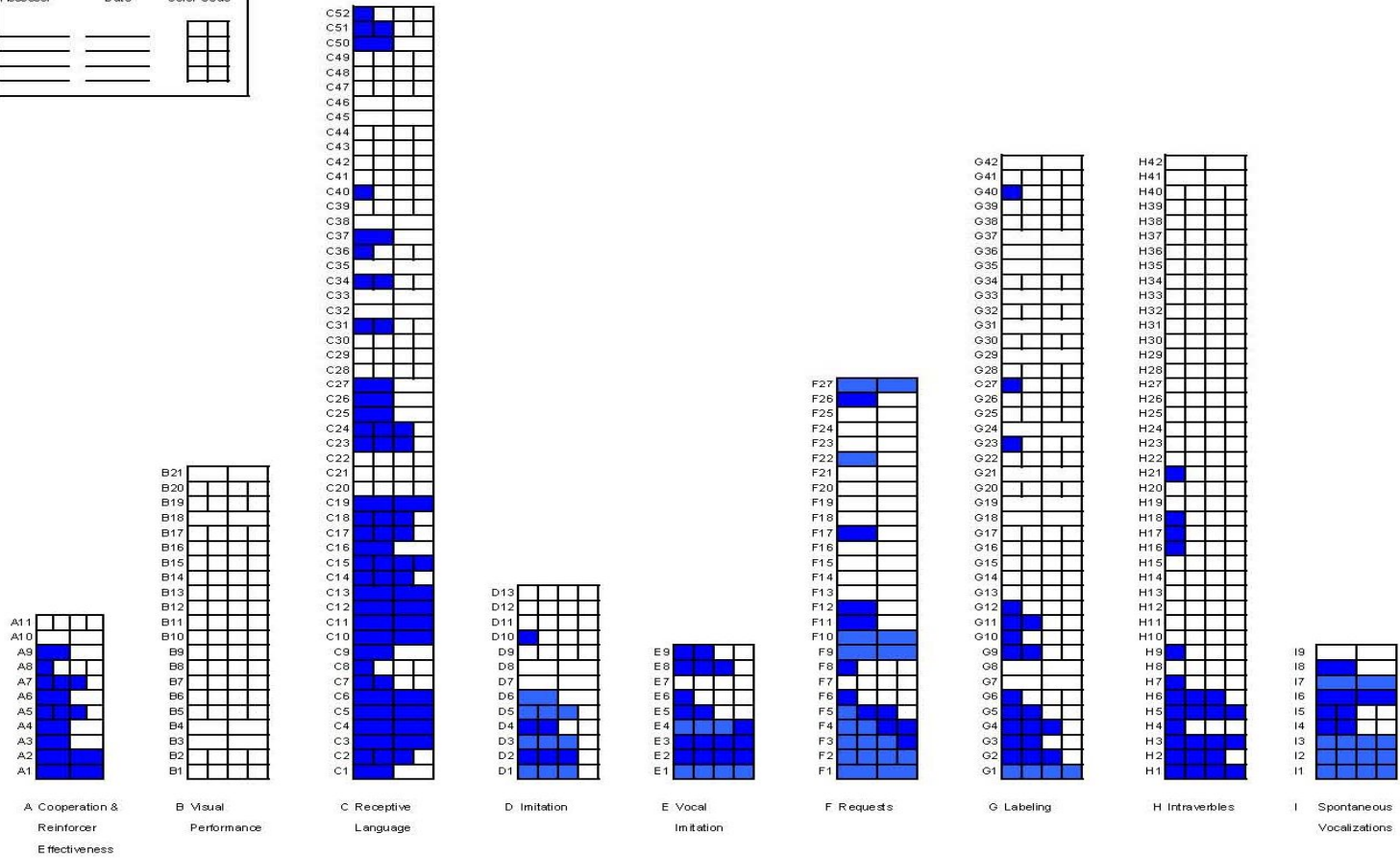
Setting

        School selection. Two schools were selected which housed self-contained classrooms for children with autism spectrum disorders. School 1 was a local public school where a program for students with ASD was located. School 2 was a local private school for students with ASD.

        Two classrooms serving students with autism spectrum disorder were the settings for the investigation.   In School 1, students received instruction primarily in a group or 2:1 setting; there were a minimum of two adults in the room at any time. The participants shared the classroom with 4-6 other students who were not participants in the study. Instruction for this research study was conducted within the classroom in a corner of the room with partitions used when necessary to reduce distractions.

        Students in School 2 received instruction primarily in a 1:1 setting, and each student had his own instructional area sectioned off by dividers. Instruction for the present study was conducted in the students' regular instructional area. Darren's sessions were often conducted on the playground to increase compliant responses and to allow classroom staff to implement behavior management plan (which at the beginning of the study included responding to mands on a CRF schedule). A staff member from School 2 assisted the investigator and data collectors at each session with implementation of behavior management protocols.

Stimuli and Apparatus

        Two hundred "wh-"questions were generated for use in this study. Each question had one visual stimulus – a magazine picture, a storybook picture, or a natural context question associated with it. For example, the question "What do you wear when it's

cold?" may have a picture from a magazine of a person wearing a coat associated with it. The question "What do you clean the floor with?" might be associated with a picture of a storybook character sweeping the floor. The question "What do you drink from?" might be associated with someone in the classroom pretending to drink from a cup (i.e., a natural context stimulus).

Twenty five questions were assigned to each of eight subcomponents of "what" (n=2), "why" (n=4) and "how" (n=3) questions. Subcomponents from which the investigator may have chosen included:

1) *What* as object or noun

2) *What* as "which"

3) *Why* relevant to cause and effect

4) *Why* relevant to affect

5) *Why* relevant to potential action

6) *How* relating to action

7) *How* relating to means

8) *How* relating to affect (Krantz & McClannahan, 1981)

A list of subcomponents and sample questions is presented in Table 1 in Chapter 2. Subcomponents were chosen as opposed to the larger categories of "what", "why", and "how" due to evidence in Krantz, et al. (1981) that teaching subcomponents led to greater generalization. For example, 25 questions related to *what as object or noun*, 25 questions related to *why relevant to affect*, and 25 questions related to *why relevant to potential action* would selected for a hypothetical student. Fifteen of these questions were used for baseline, categorization, and instruction sessions. Ten more were reserved

for generalization tests. Selection of subcomponents was independently verified by two graduate students in the field of special education and one master's level general educator. Operational definitions of correct responses for each question were also verified. One subcomponent was selected for each participant based upon teacher report of student needs and data collected by school staff to document progress towards IEP goals.

Joon and Dino were assigned the question form *what as object or noun*. Allen was assigned the same category; however, his baseline performance suggested that he had mastered this question form. Therefore, his question form was changed to *why relevant to cause and effect*. Simon, Colin and Dino were all assigned *why relevant to cause and effect*.

Procedures

During baseline sessions, participants' ability to answer "wh-" questions, receptively identify stimuli based upon answers to questions, and match similar stimuli to each other was assessed. Participants, during training, were taught to answer "wh-" questions when one constant stimulus was present. Generalization to novel stimuli and novel questions was then assessed, and participants with low generalization scores were taught to match similar stimuli.

"Wh" question baseline. Baseline procedures were conducted to determine whether students were able to answer 15 questions from the selected subcomponents. Each student was assigned one of the subcomponents for baseline and training. Subcomponents were selected for each student with the input of the classroom staff and, when available, the Speech-Language Pathologist (for School 1).

For each question, the research assistant presented the stimulus (magazine picture, storybook, or natural context) associated with the question and called the student's attention to the item. Once the student was oriented towards the stimulus, the research assistant asked the student the question associated with the stimulus (e.g., "What is he doing?").

If the student answered correctly within 5 seconds of being asked the question while being presented with the stimulus, a + was put on the data sheet. Correct responding was defined as any verbal response logically related to the stimulus item and contextually relevant (c.f., Krantz et al., 1981; Secan et al., 1989). For example, if the student was asked, "What do you write with?" and the visual stimulus is a picture of someone holding a pen, the answers "pen," "pencil," or "crayon" was considered acceptable. Examples of unacceptable responses were the repetition of the question, "drawing a picture", or "do your ABCs". If the student did not respond within 5 seconds of being asked the question and shown the stimulus or responded incorrectly to the question, a "–" was placed on the data sheet. In either case, the research assistant moved to the next question. Each question was only asked once per session. Questions were presented in random order during each baseline sessions. Ten of the questions from baseline were chosen at random from the students' incorrect answers to be included in instruction. Baseline sessions were conducted by a research assistant not associated with the reinforcement of correct responding to control for possible history effects (Kennedy, 2005). The student moved to "wh-" question instruction after three consecutive stable or descending data points.

No direct consequences were given for correct or incorrect responding during baseline. The research assistant did, however, reinforce attending to the stimulus and general, on-task behavior on a variable interval schedule of reinforcement. Social praise as well as edibles and tangibles also used by the classroom teacher were used as reinforcers and presented intermittently to the student for on-task and attentive behavior.

Categorization baselines. To determine whether students were able to categorize a stimulus into a relational frame or stimulus class (Research Question 2), each student was tested using matching to sample procedures. Five of the ten baseline questions were chosen at random and an additional visual stimulus was assigned. For example, if the question "What is the girl holding?" was associated with a magazine picture, either a storybook picture or a natural context action was associated with the picture as well. This allowed the student to compare and match two stimuli in an array. Distracter stimuli pictures were chosen at random.

The assistant placed the comparison and distracter stimuli in front of the student. The assistant randomly changed the placement of the comparison stimulus from right to left for each trial to control for responding to side preferences. The assistant held up the matching stimulus and instructed the student to orient to the matching stimulus. The assistant then told the student to "put with same" while the assistant handed the student the matching stimulus. Correct responding was defined as the student matching the stimulus with the comparison stimulus. Incorrect responding was defined as matching with the distracter stimulus or no responding within 5 seconds of the request. No overt consequences for responding were given for correct or incorrect responding; however, the research assistant provided verbal praise and other reinforcement commonly used in the

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classroom on a variable interval schedule for attending and on-task behavior such as sitting with the instructor and looking at the stimulus items when asked.

Each stimulus in the pair of pictures was presented as both the matching and comparison stimulus, for a total of 10 trials per session. If the student responded correctly to a high number of trials and subsequently learned to generalize "wh-" questions without further instruction, this suggested a possible link between relational responding and generalization. Categorization trials were conducted by a person not associated with the reinforcement of correct responding to control for possible history effects (Kennedy, 2005).

Receptive responding baselines. Receptive responding was tested to determine the symmetry between receptive and expressive responding. Symmetry is considered to be a component of equivalence and is related to the concept of mutual entailment in Relational Frame Theory (Hayes, Barnes-Holmes et al., 2001b; Sidman, 1994). To test receptive responding, the investigator used the same sets of stimulus items used in the tests of categorization. One visual stimulus item and one distracter item were placed in front of the student by the research assistant. The student was then told to "give me…. (action name or answer that corresponds to question)".

Correct responding was defined as giving the experimenter the picture that corresponded to the action requested by the assistant. Incorrect responding was defined as handing the assistant a distracter card or no response within 5 seconds of the presentation of the stimulus. No consequences were given for correct or incorrect responding, although the assistant gave verbal praise and other reinforcement commonly used in the classroom for on-task and attending responses such as sitting with the

assistant and looking at the stimulus items when asked. Naming sessions were conducted by a research assistant not associated with the reinforcement of correct responding to control for possible history effects (Kennedy, 2005). Fifteen trials were conducted per session. If the student responded correctly to a high number of trials and subsequently learned to generalize "wh-" questions without further instruction, this would suggest a possible relationship between naming and generalization.

"Wh" question instruction. All sessions associated with reinforcement were conducted by either the investigator or a research assistant not associated with baseline or generalization. Individuals who are associated with reinforcement are referred to as *trainers.* Each student was instructed on 10 of the "wh-" questions in each of the three subcategories. These questions were chosen from those consistently answered incorrectly in baseline trials. Answers to questions were taught in a traditional discrete trial format (Lovaas, 1981). The student was presented with the visual stimulus corresponding to the question and asked the "Wh" question. If the student responded correctly to the question and visual stimulus, verbal praise and other reinforcers commonly used in the classroom were given to the student. As in baseline, correct responding was defined as any verbal response logically related to the stimulus item and contextually relevant (c.f., Krantz et al., 1981; Secan et al., 1989).

If the student answered incorrectly or did not respond within 5 seconds of the presentation of the stimulus, the answer was provided to the student and the trial was repeated. If the student subsequently responded correctly to the question, the trainer provided verbal praise and a reinforcer. If the student responded incorrectly once again, the trainer provided the student with the correct answer, the trial was terminated, and the

trainer moved to the next trial. Questions were presented in a random order for each teaching session, and all 10 questions were presented in each session. The response was considered acquired when the student answered 8/10 questions correctly over three teaching sessions. Teaching trials were conducted by a trainer not associated with baseline or probe sessions to control for history effects (Kennedy, 2005).

Generalization tests. Ten novel stimuli from the same question subcategory were then used for generalization probes. Once the student acquired a subcategory, the 10 novel questions and corresponding visual stimuli were presented in the same manner as baseline trials, with no reinforcement for correct responding. Each question was presented only once per session. Generalization was considered to have occurred if the student responded correctly to 7/10 novel questions over three consecutive sessions. Correct responding was defined as any verbal response logically related to the stimulus item and contextually relevant (c.f., Krantz et al., 1981; Secan et al., 1989). If the student generalized to criterion of 7/10 over three trials, instruction was terminated for that student. Generalization sessions were conducted by a research assistant not associated with the reinforcement of correct responding.

 In order to determine whether students with autism who show relational responding formation also show greater levels of generalized "wh-" question answering (Research Question 2), generalization data were compared to baseline tests of naming and categorization. A link between categorization and naming abilities and generalization of "wh-" question answering is suggested if correct responding is high during categorization and naming baseline trials and generalization trials (or conversely,

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low responding in each condition). If the criterion of 7/10 for generalization was *not* met, the student then participated in remedial categorization instruction.

Remediation sessions – categorization. If the student did not meet or exceed criterion in the generalization trials for questions in any of the three subcomponents, the student then received categorization instruction for 5 of the 10 questions (Greer, Stolfi et al., 2005; Halvey & Rehfeldt, 2005). Exclusion instruction, shown to increase stimulus equivalence in young children by teaching nonexamples as well as examples (D. Carr, 2003; McIlvane et al., 1984), was added to increase the likelihood that relations would be learned.

For categorization instruction the visual stimuli (e.g., a picture of crying) associated with each of the questions was presented in random order and the student was presented with two additional visual stimuli, one that depicts a similar action in a different modality (e.g., a storybook character crying) and a non-example (e.g., a person typing at a computer). The student was then asked to "put with same" (e.g., Halvey & Rehfeldt, 2005). Correct responding was defined by the student placing the matching stimulus with the comparison stimulus (i.e., the stimuli in the same category are placed together). For exclusion instruction, the student was presented with identical visual stimuli and asked to "put with different". Correct responding was defined as the student placing the matching stimulus with the comparison stimulus (i.e., stimuli in different categories are placed together).

For natural context questions, the trainer acted out the answer, and the student was asked, "which one am I doing" or "which one am I not doing". The student was given two pictures of actions – one that corresponded to the actions the trainer was

demonstrating and one that did not correspond. The student was expected to give the trainer the correct picture that corresponded to the question. Same and different were equally interspersed among the trials for a total of 10 trials per session.

If the student matched correctly, the trainer provided verbal praise and other reinforcement as appropriate. The trainer used a prompt hierarchy (i.e., gesture, model, physical) to prompt the student to respond if the student did not respond correctly within 5 seconds of the presentation of the stimulus. Criterion for acquisition of matching and exclusion was defined as 8/10 unprompted responses over 3 consecutive teaching sessions.

Treatment Fidelity Measures

To measure the procedural consistency with which sessions were being conducted, 33% of all sessions were scored against the rubrics presented in Appendices 3-9 by an independent research assistant trained by the investigator. Treatment fidelity averaged 99.93%, with a range of 96-100%. Treatment fidelity never fell below 90%; no retraining was needed for any research assistants.

Inter-observer Agreement

Inter-observer agreement (IOA) was collected to determine reliability of the data; that is, whether the operational definitions of responding were being interpreted with consistency within and across data collectors. As with treatment fidelity, 33% of sessions were scored by a second, independent observer. For each session, correct responses recorded by each observer were summed. The smaller sum was divided by the larger sum and multiplied by 100 to determine the percentage of inter-observer agreement. Mean IOA was 98.7%, with a range of 75-100%. Inter-observer agreement was

calculated to be over 80% for all sessions with the exception of one. Of 102 sessions with IOA, 95 were calculated to have 100% agreement. After each session, the investigator reviewed the disagreements with the research assistants, with particular attention to operational definitions when IOA fell below 80%. Clerical errors such as putting an answer in an incorrect bin or not being able to hear the student clearly were often the source of disagreement.

Research Design

A single-subject research design was used to measure the effects of the treatment on the individual students. Single-subject designs, by definition, measure the individual variability of the student as opposed to a group of students. Group designs for students with autism pose unique challenges. Students with autism often manifest the disorder in very unique ways; therefore, being able to randomly choose from a population and assign them to equal and heterogeneous groups is compromised. A single-subject design allows the researcher to examine the individual performance of students using previous performance (baseline measures) as a control (Sidman, 1960).
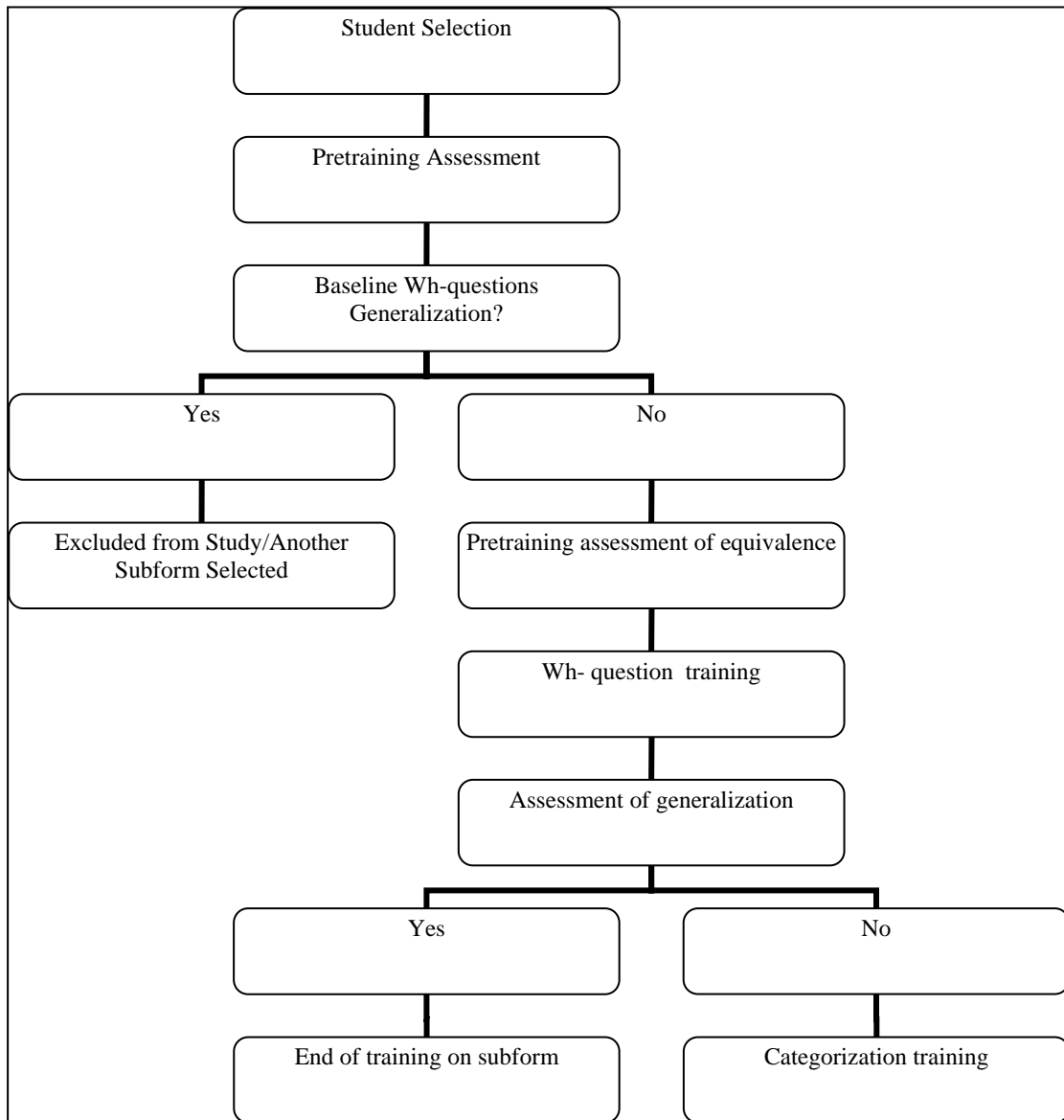
A multiple probe design across students (Kennedy, 2005; Tawney & Gast, 1984) was used to examine the relationship between relational responding, present level of verbal behavior, and the generalization of "wh-" questions. Within each data set, a single baseline probe consisting of 15 trials was conducted for each of the three students; subsequently, baseline was continued for Student 1 until three stable or downward trending data points were collected. Categorization tests consisting of sets of 10 and naming tests consisting of 15 trials were conducted for all three students before

instruction commenced. "wh-"question instruction was then conducted for Student 1 until the student emitted 8/10 correct responses over three consecutive sets of 10 trials.

Once criterion of 8/10 correct over three consecutive sessions was met for teaching "wh-" questions for Student 1, baseline probes were conducted with the remaining students in each data set, and continued for Student 2 until data were stable and there was at least one more data point than collected for Subject 1. A concurrent baseline probe was taken with Student 3. Once criterion was met for "wh-" question instruction with Subject 2, baseline data were taken for Condition 3 in which there was at least one more data point than collected for Subject 2

After "wh-" question instruction was completed for Student 1, generalization sessions consisting of 10 trials were conducted until data were stable or criteria of 7/10 correct responses over three consecutive sessions was met. These sessions were conducted concurrently with baseline sessions for Student 2. If the student did not meet generalization criterion of 7/10 correct over three sessions, categorization instruction commenced. A flowchart depicting the instructional sequence for study participant is presented in Figure 8.

Figure 8. Instructional sequence for students.


```
                          ┌─────────────────────────┐
                          │    Student Selection     │
                          └─────────────────────────┘
                                      │
                          ┌─────────────────────────┐
                          │  Pretraining Assessment  │
                          └─────────────────────────┘
                                      │
                          ┌─────────────────────────┐
                          │   Baseline Wh-questions  │
                          │     Generalization?      │
                          └─────────────────────────┘
                          ┌──────────┴──────────┐
                 ┌────────────────┐      ┌────────────────┐
                 │      Yes       │      │       No       │
                 └────────────────┘      └────────────────┘
                          │                      │
        ┌────────────────────────┐   ┌──────────────────────────────────┐
        │ Excluded from Study/    │   │ Pretraining assessment of         │
        │ Another Subform Selected│   │ equivalence                       │
        └────────────────────────┘   └──────────────────────────────────┘
                                                 │
                                     ┌──────────────────────────┐
                                     │   Wh- question  training  │
                                     └──────────────────────────┘
                                                 │
                                     ┌──────────────────────────┐
                                     │ Assessment of generalization│
                                     └──────────────────────────┘
                                     ┌───────────┴───────────┐
                          ┌────────────────┐      ┌────────────────┐
                          │      Yes       │      │       No       │
                          └────────────────┘      └────────────────┘
                                  │                       │
                     ┌──────────────────────┐  ┌──────────────────────┐
                     │ End of training on    │  │ Categorization training│
                     │ subform               │  │                        │
                     └──────────────────────┘  └──────────────────────┘
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Chapter 4: Results

In this chapter, the results of the study are summarized. The chapter will be organized into several sections. First, descriptive analysis results for all students are described. Second, data for baseline, training, generalization, and subsequent instruction are presented for School 1 and for School 2. The chapter ends with the results as they relate to each of the research questions presented in Chapters 2 and 3.

Descriptive Analysis Results

A descriptive analysis was conducted for each student in order to assess students' existing verbal repertoires. Students in School 1, were observed in the classroom and antecedents, behaviors, and consequences were scored using the OBSERVE computer program. Students in School 2 were videotaped. Patterns of antecedents, behaviors and consequences were considered indicative of particular verbal operants. Data were also taken of the conditions under which each verbal operant were emitted. Conditional probability of verbal operants under each condition were calculated and graphed. Students engaged in some spontaneous verbal behavior as well as some prompted verbal behavior.

Joon. Joon was observed for 5 hours during descriptive analysis. Graphs of Joon's descriptive analysis are presented in Figures 9-14. According to Joon's descriptive analysis data, he emitted many more tacts than mands. The majority of these tacts and mands, however, were prompted (defined as following no more than 5 seconds after adult verbal behavior) or observed in situations contrived to teach verbal behavior such as morning snack. Joon rarely emitted any intraverbals.

Figure 9. Joon descriptive analysis manding data.
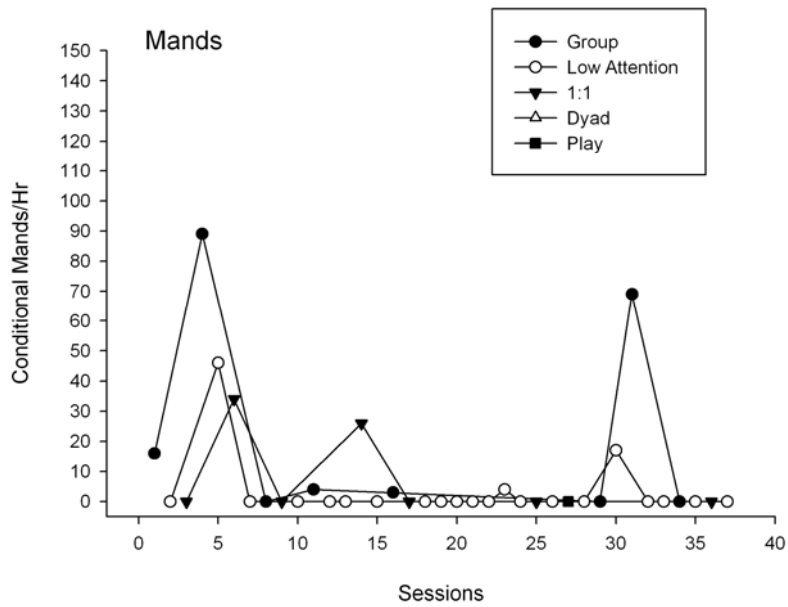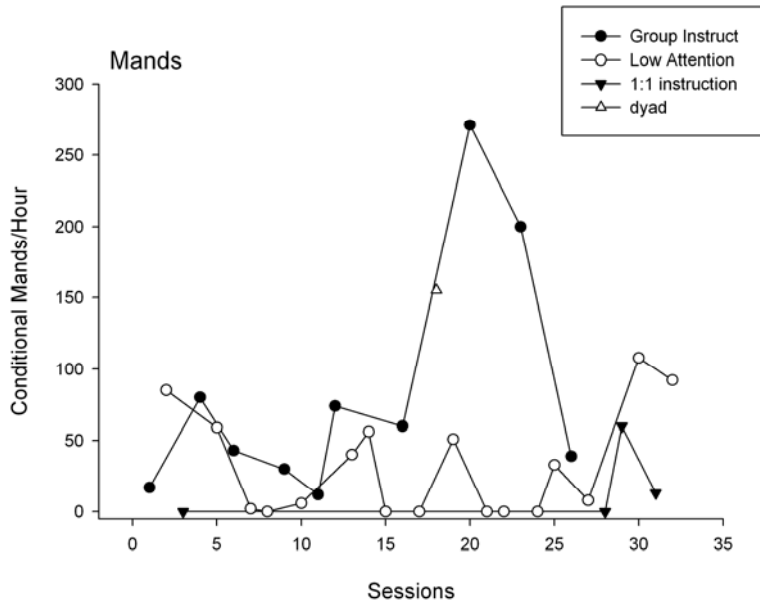

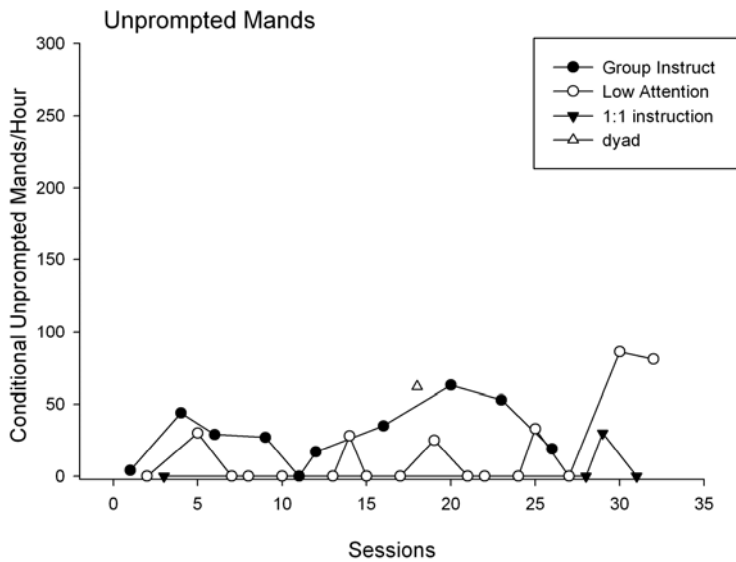*Figure 10.* Joon descriptive analysis unprompted mands.
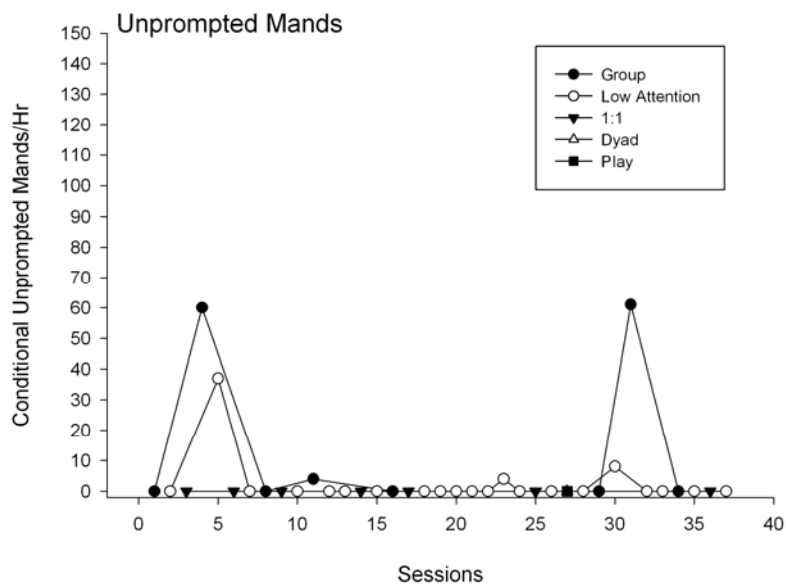
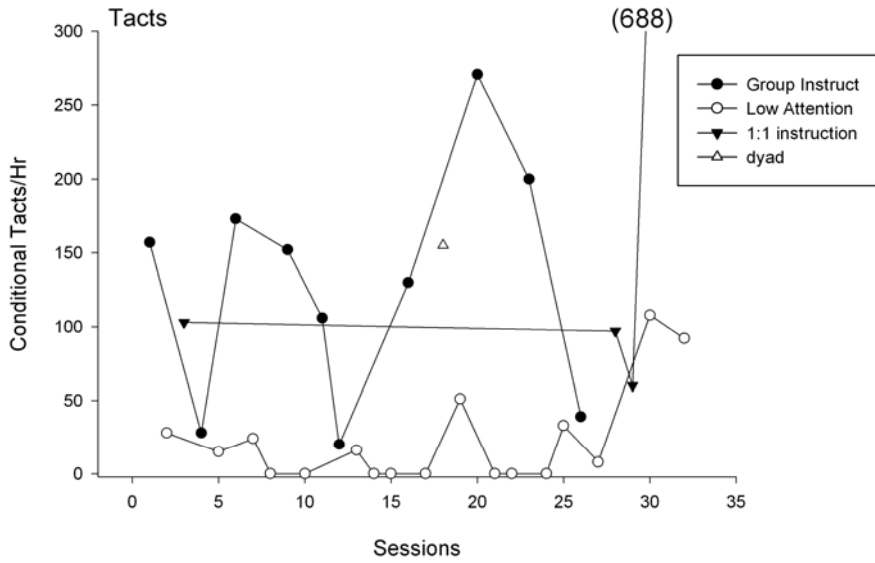*Figure 11*. Joon descriptive analysis tacts.
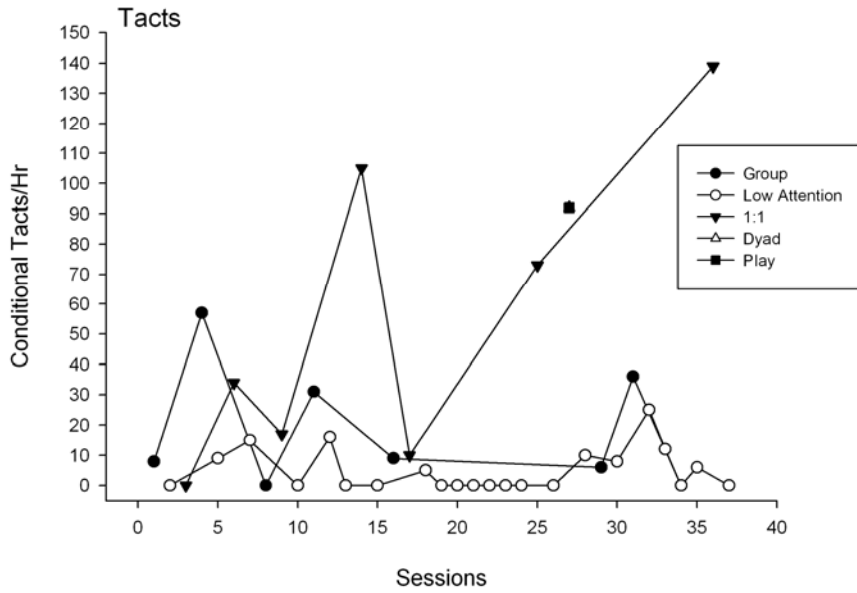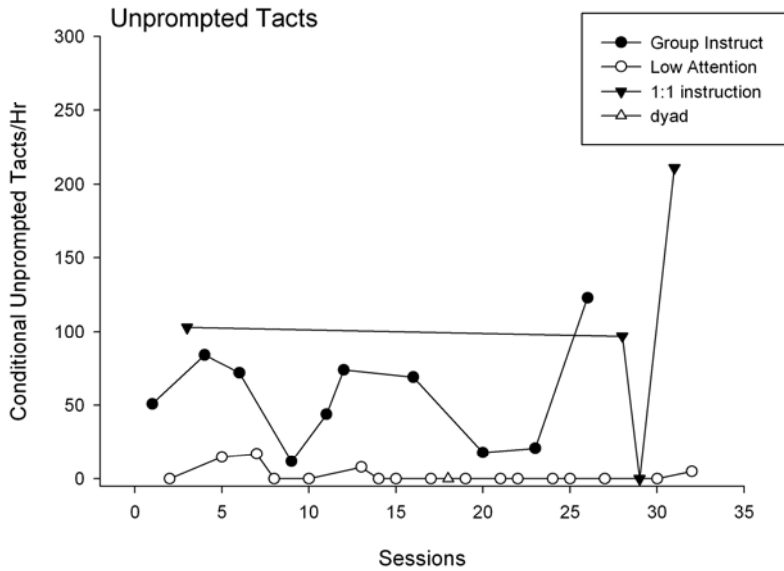

Figure 12. Joon descriptive analysis unprompted tacts.
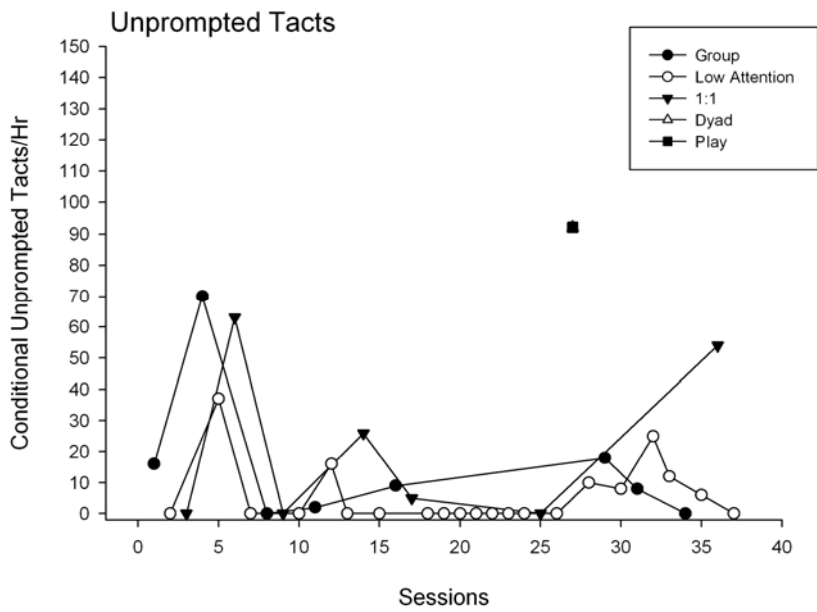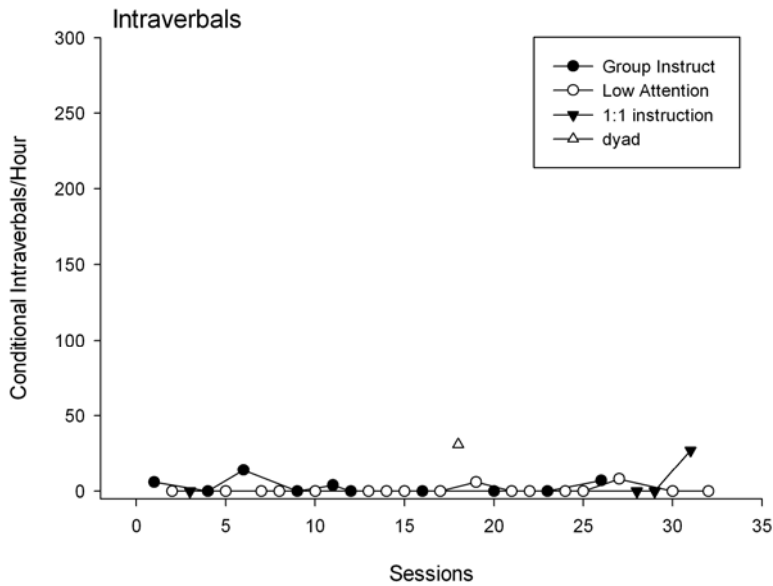
Figure 13. Joon descriptive analysis intraverbals.
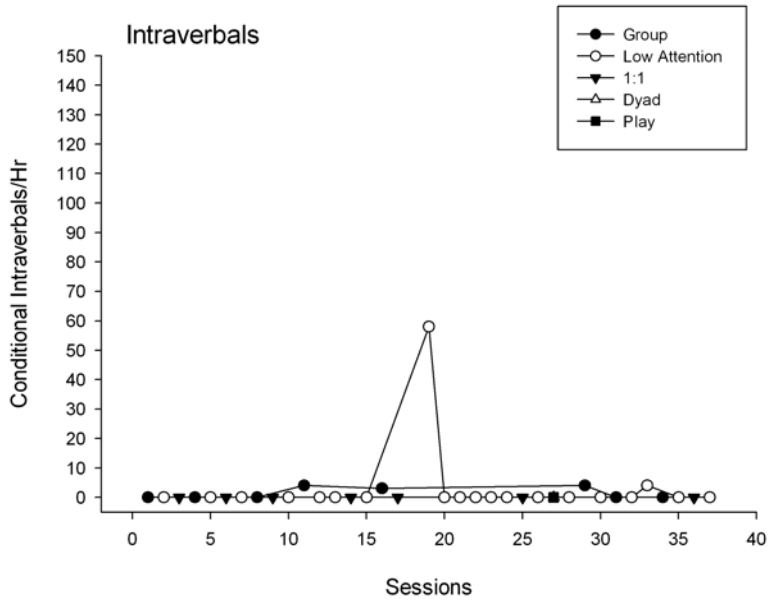
Figure 14. Joon descriptive analysis unprompted intraverbals.
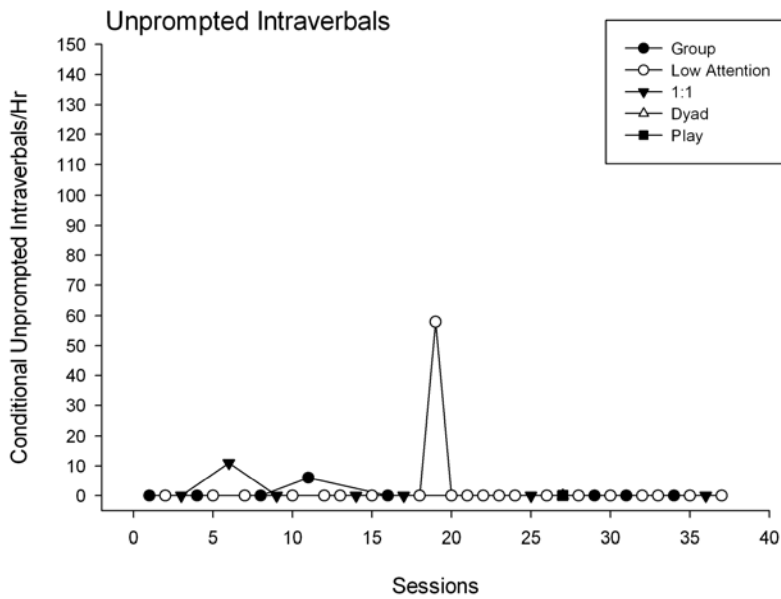
Allen. Descriptive analysis data were taken for 4.7 hours for Allen. During descriptive analysis, Allen emitted many more prompted mands and tacts than unprompted. As with Dino and Joon, most of the verbal behavior seen is during group instruction as opposed to other situations. However, Allen engaged in a moderate

number of tacts during 1:1 and dyadic instruction as well. He emitted very little

intraverbal behavior. Allen's descriptive analysis results are presented in Figures 15-20

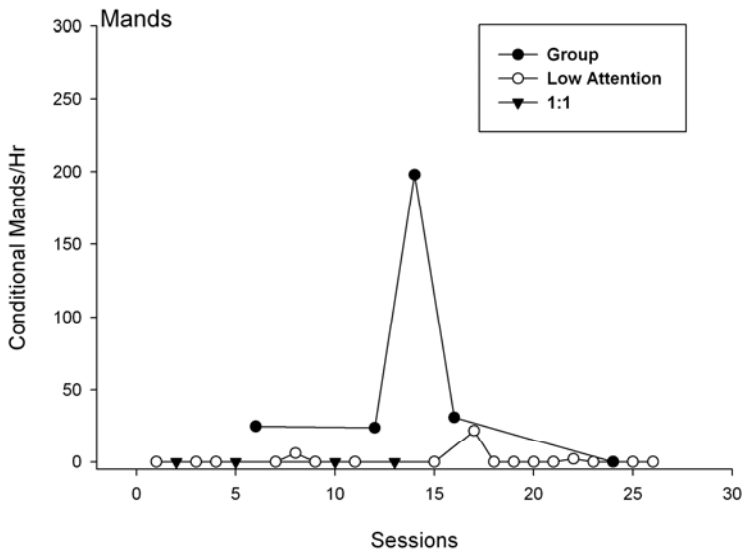*Figure 15.* Allen descriptive analysis mands.

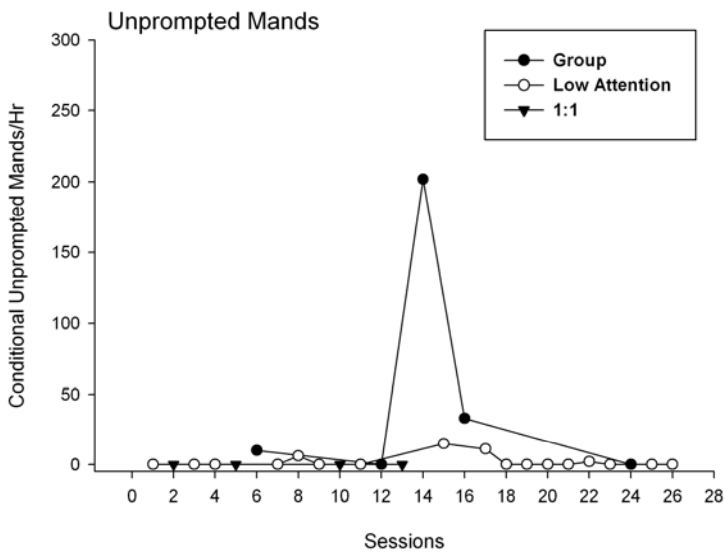*Figure16.* Allen descriptive analysis unprompted mands.

Figure 17. Allen descriptive analysis tacts

Figure 18. Allen descriptive analysis unprompted tacts.

Figure 19. Allen descriptive analysis intraverbals

Figure 20. Allen descriptive analysis unprompted intraverbals.
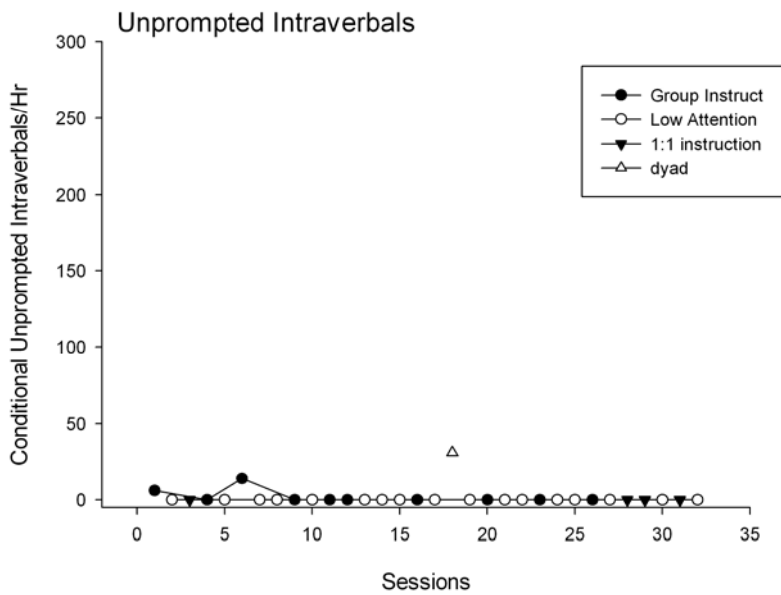
Dino. Descriptive analysis data were taken with Dino for 4.09 hours. Dino

engaged in very little verbal behavior during descriptive analysis, with the exception of

one high point in Low Attention where tacting was observed to be over 300/hr. He also

engaged in one session of unprompted manding. As with Joon, this occurred during a

contrived snacktime situation where the objective of the lesson was training of mands. He

did not engage in any spontaneous intraverbal behavior during observation. Dino's

Descriptive Analysis data are presented in Figures 21-25.

Figure 21. Dino descriptive analysis mands

Figure 22. Dino descriptive analysis unprompted mands.
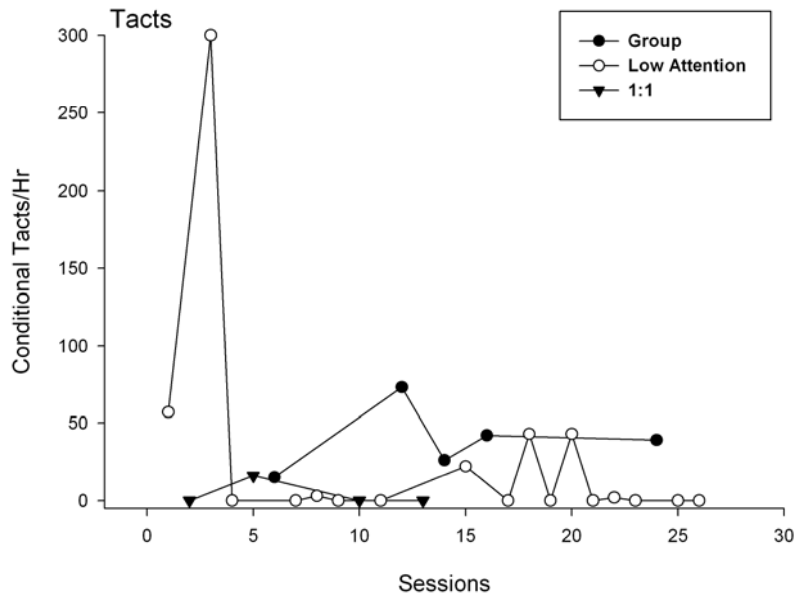
Figure 23. Dino descriptive analysis tacts.

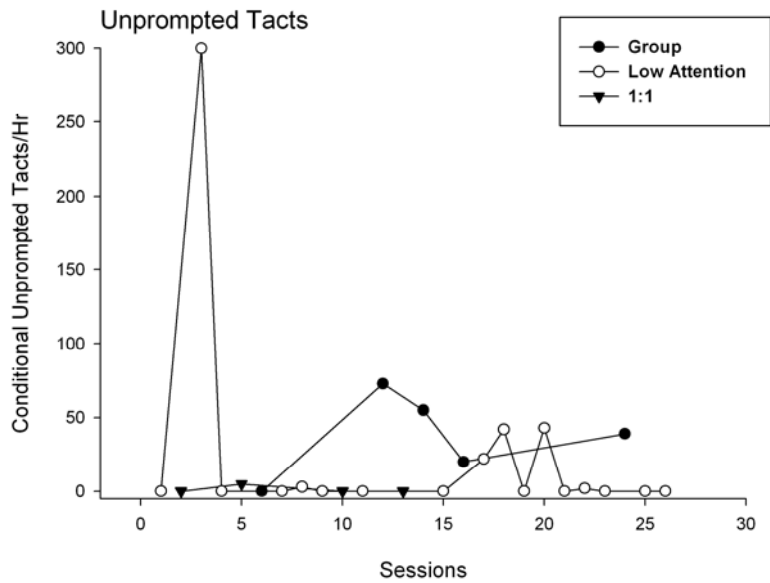*Figure 24.* Dino descriptive analysis unprompted tacts.

Figure 25. Dino descriptive analysis intraverbals.
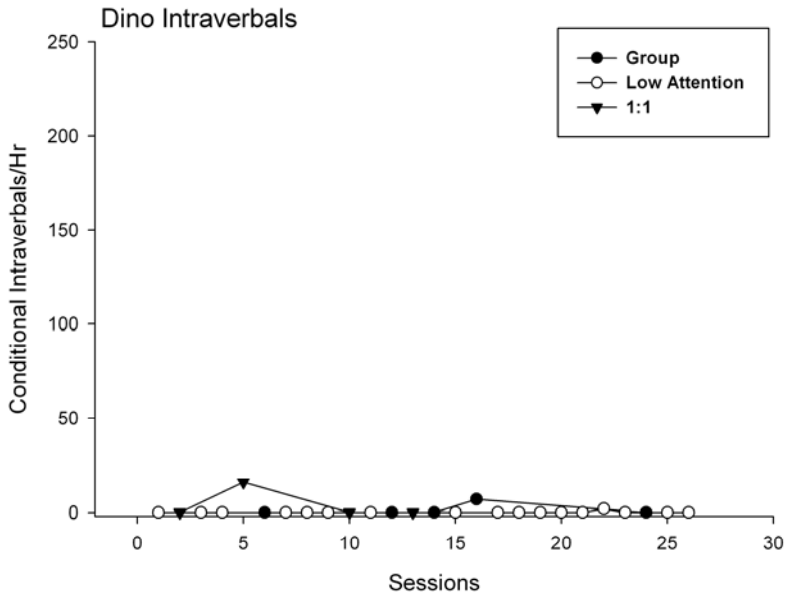

Dino Intraverbals

Simon. 4.09 hours of descriptive analysis videotape were analyzed for Simon. He

engaged in the highest number of intraverbals, both prompted and unprompted, of the

students in School 2. High mean intraverbals, however, may be an artifact of four high

points in the 1:1 condition. Simon emitted a high number of tacts; however, mands were

very low. Most mands were emitted during the 1:1 condition in the overall data; however,

more unprompted mands were observed in the low attention condition. The majority of

tacts emitted by Simon were prompted. Descriptive analysis data for Simon are presented

in Figures 26-31.

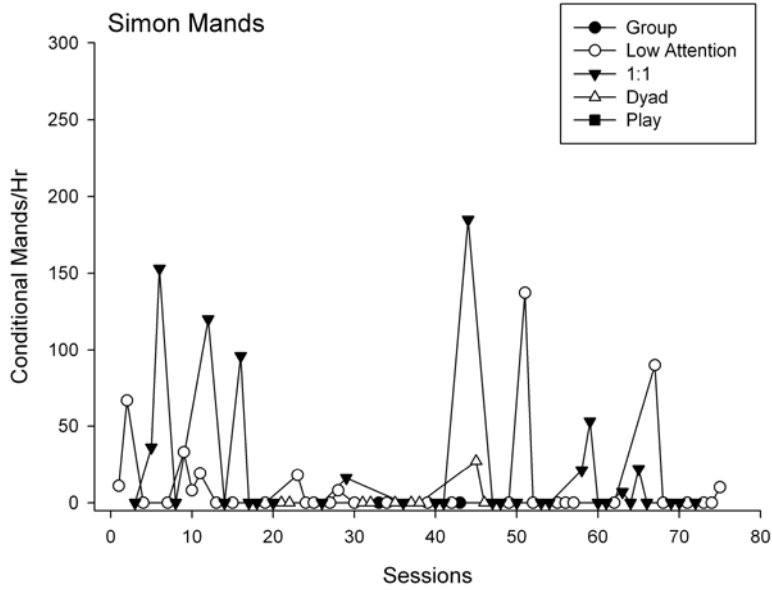*Figure 26.* Simon descriptive analysis mands.

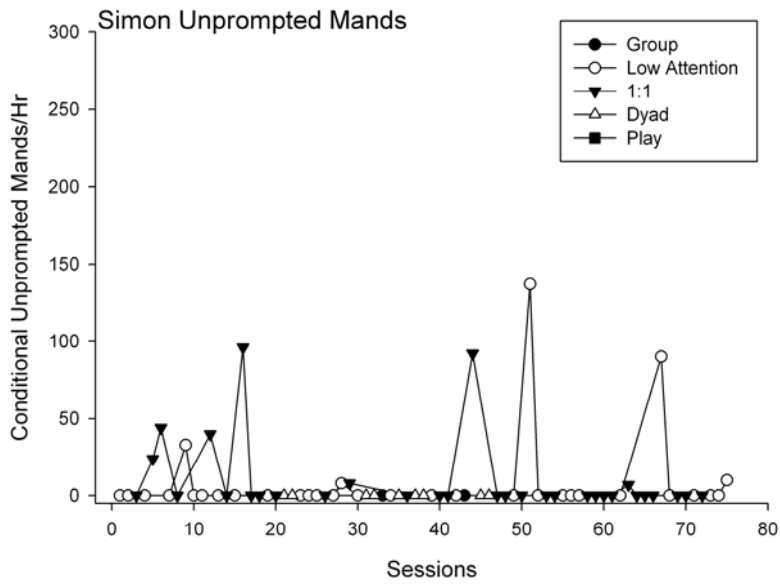*Figure 27.* Simon descriptive analysis unprompted mands.
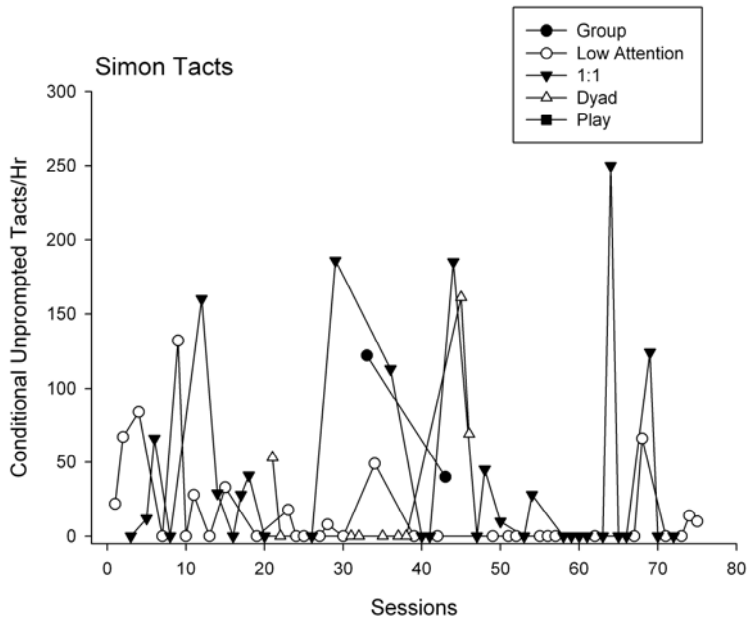
Figure 28. Simon descriptive analysis tacts.
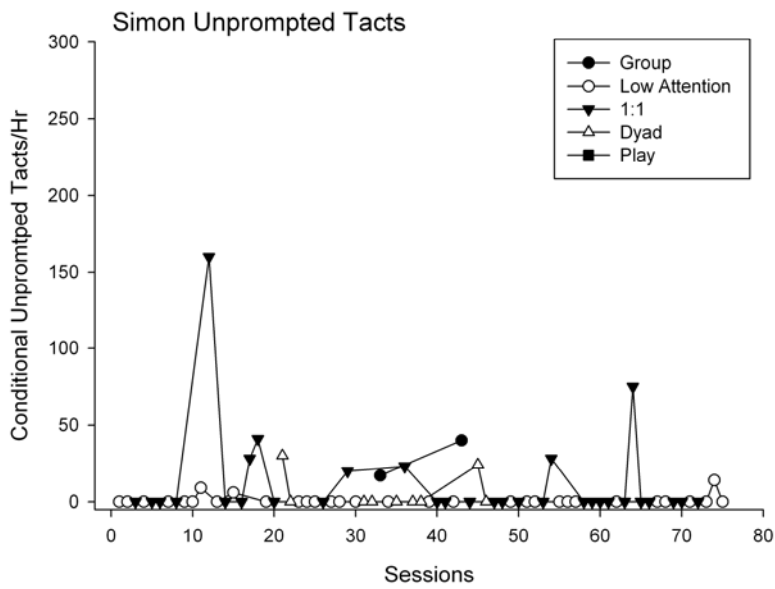

Figure 29. Simon descriptive analysis unprompted tacts.

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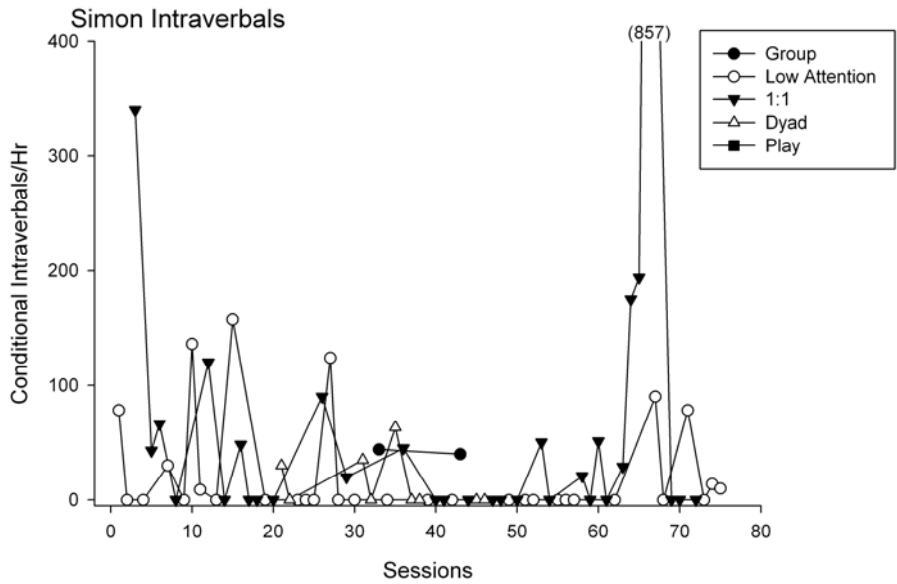*Figure 30.* Simon descriptive analysis intraverbals.

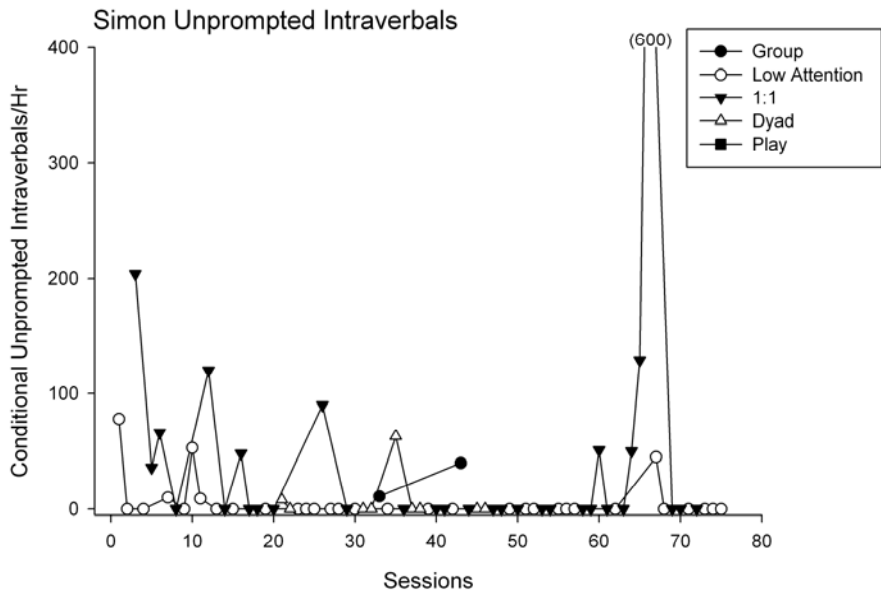*Figure 31*. Simon descriptive analysis unprompted intraverbals.

Colin. 4 hours of videotape were analyzed for Colin. Colin engaged in few total intraverbals and no prompted intraverbals.   Descriptive analysis graphs for Colin are presented in Figures 32-36. Colin emitted a large amount of unprompted tacts, the majority of which were emitted during group instruction. Answering questions about

stories were specifically targeted in group instruction. His rate of manding was low; 64% of mands were prompted. Colin was observed to mand the most in 1:1 situations. No unprompted intraverbals were observed for Colin; therefore, no graph is presented.
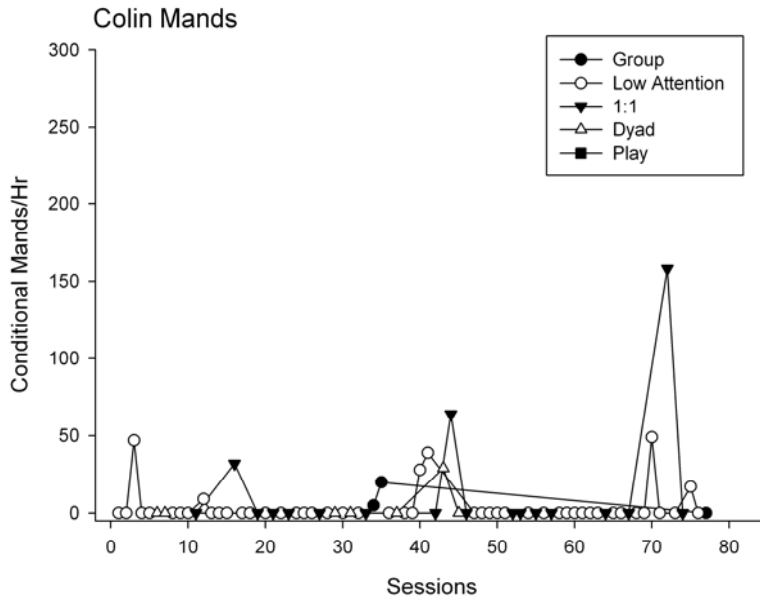
Figure 32. Colin descriptive analysis mands

Figure 33. Colin descriptive analysis unprompted mands.

Figure 34. Colin descriptive analysis tacts.
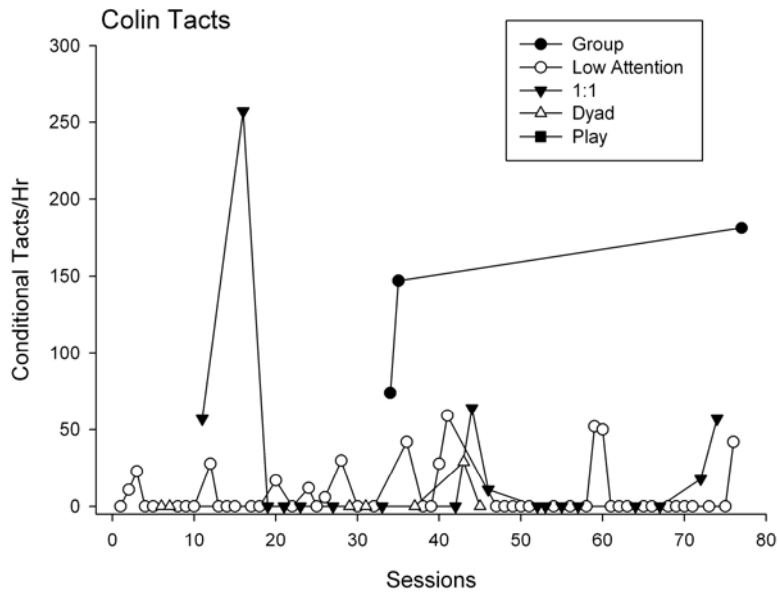
Figure 35. Colin descriptive analysis unprompted tacts.

Figure 36. Colin descriptive analysis intraverbals.
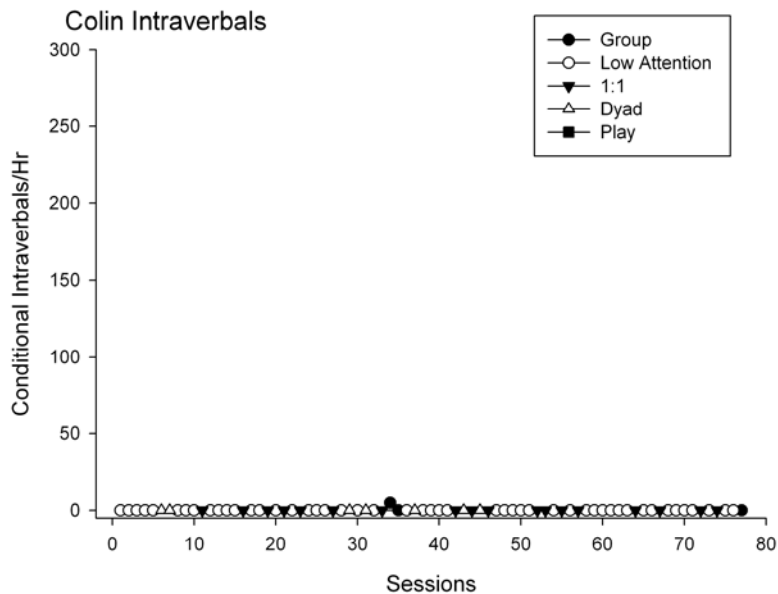
Darren. Darren was videotaped for 4.15 hours during descriptive analysis. He was observed mostly in a 1:1 condition. Due to Darren's severe problem behavior, a staff member was dedicated to him during the entire school day.   Darren emitted both total and unprompted mands at a high rate; manding was a skill targeted specifically in Darren's behavior support plan. Mean tacting was also high; however, this may have been an artifact of two sessions higher than 500/hr. In contrast, few intraverbals were seen; these consisted mostly of greetings.   Descriptive analysis results are presented in Figures 37-42.

Figure 37. Darren descriptive analysis mands.
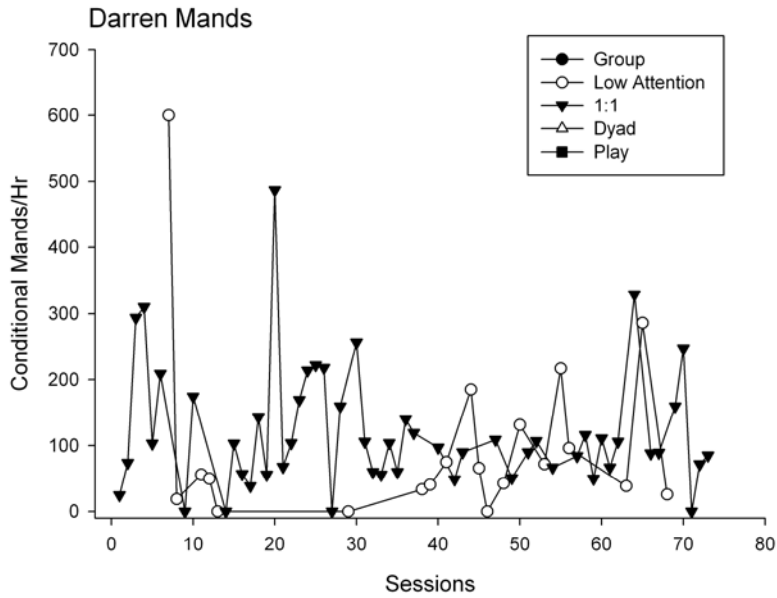
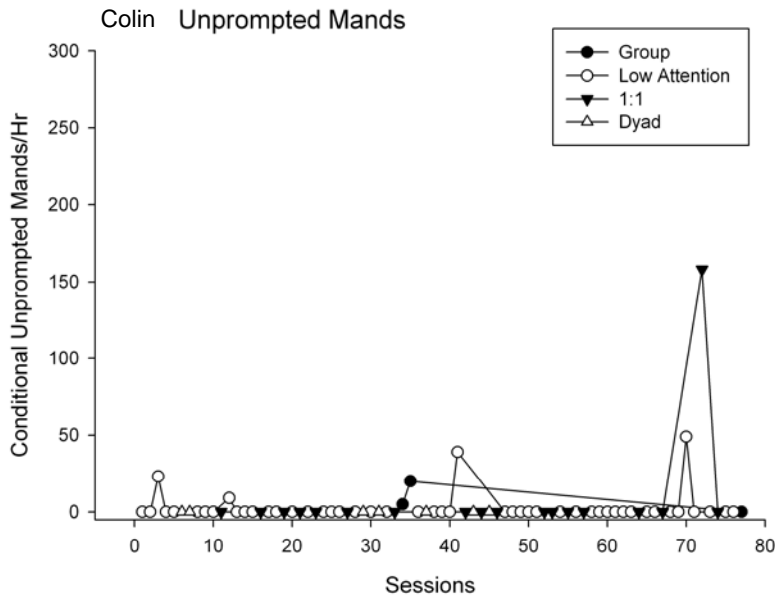*Figure 38.* Darren descriptive analysis unprompted mands.
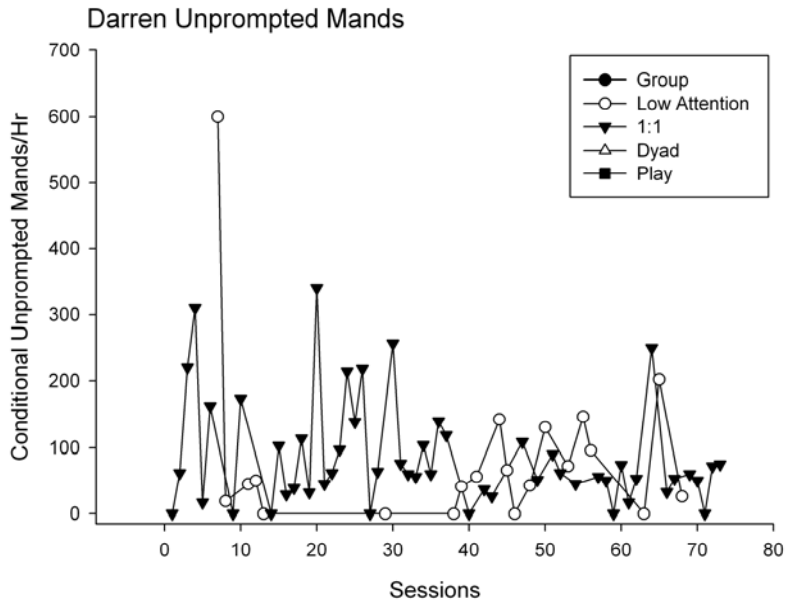
Figure 39. Darren descriptive analysis tacts.

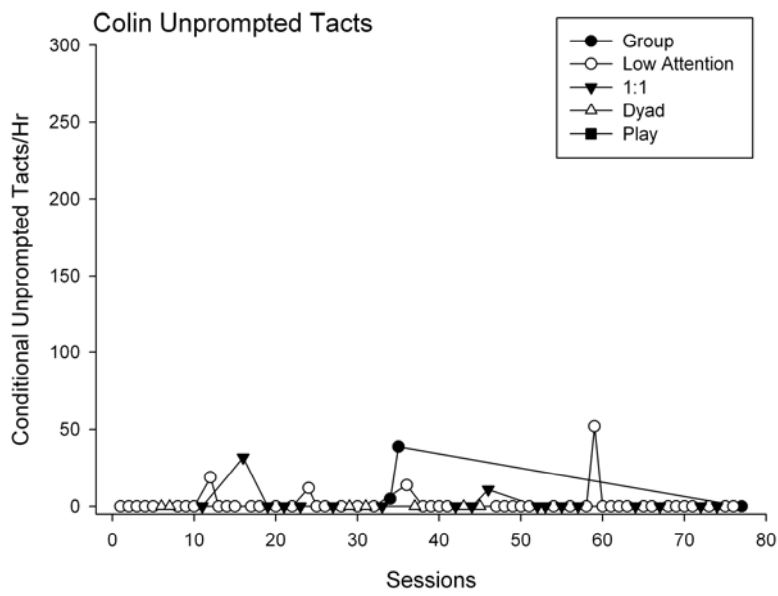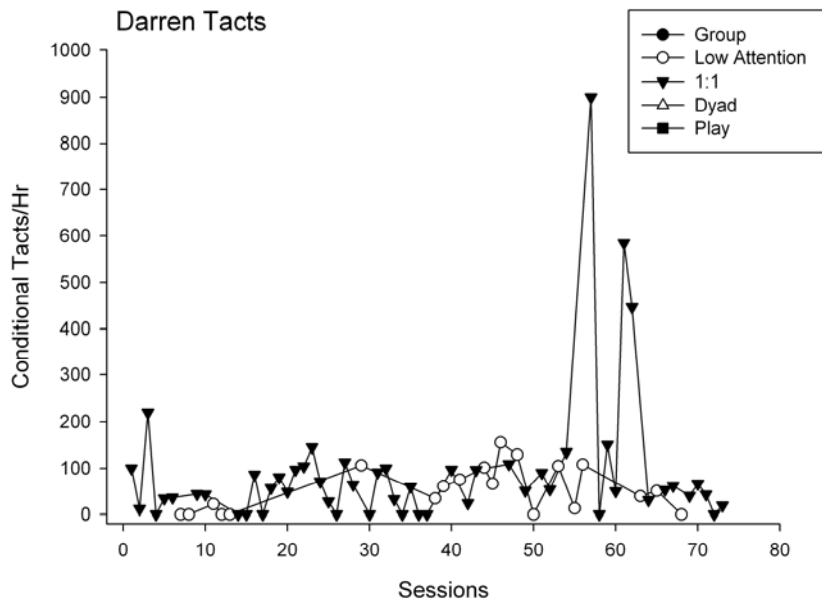
Figure 40. Darren descriptive analysis unprompted tacts.
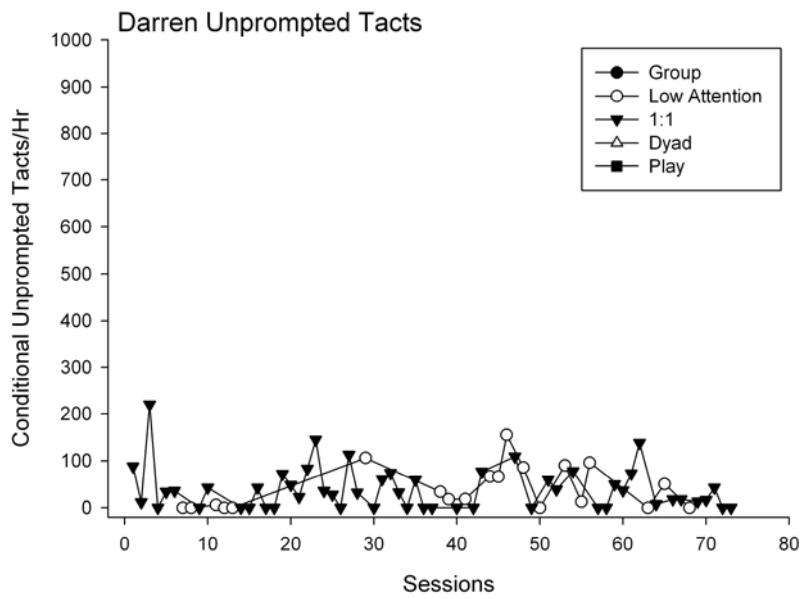
Figure 41. Darren descriptive analysis intraverbals.
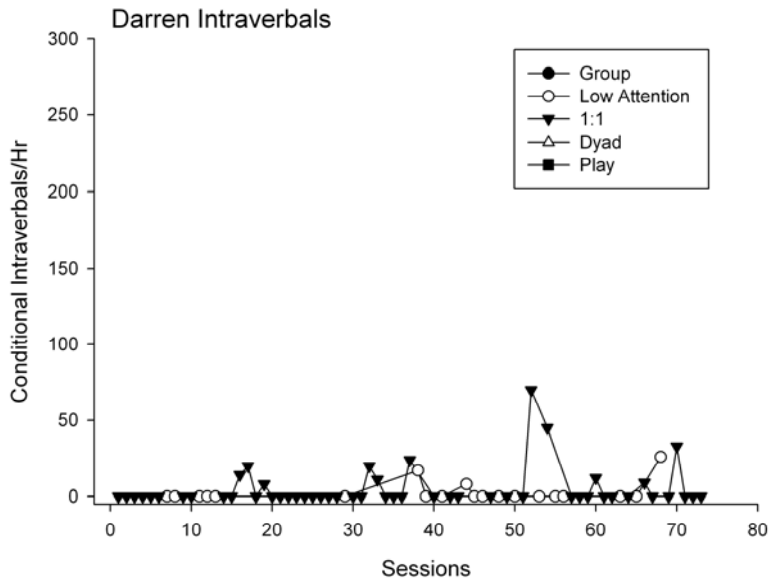
Figure 42. Darren descriptive analysis unprompted intraverbals.
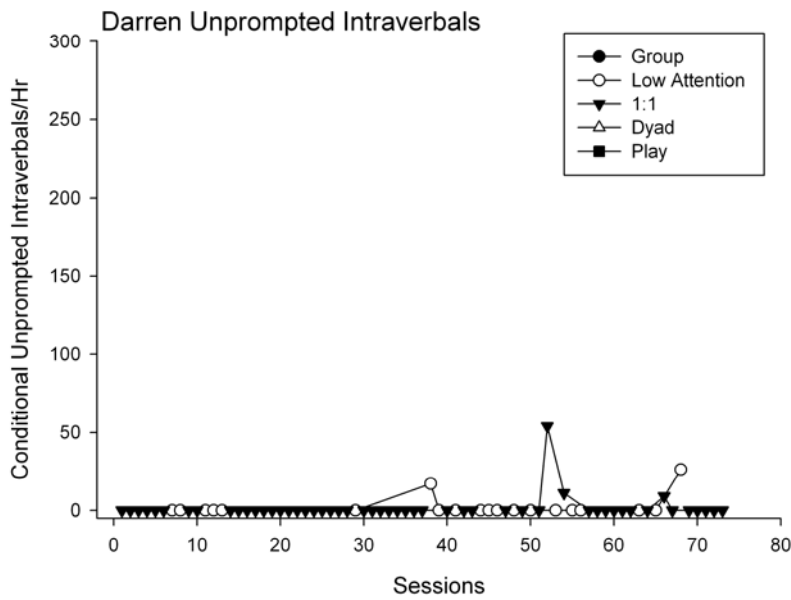
School 1 Results

    Matching baselines. There was considerable variability across and within

participants with regard to matching similar pictures representing the same stimulus class.

Joon's mean baseline matching performance was 70% (range 60%-90%), Dino's was

17% (range 13%-20%), and Allen's was 33% (range 20%-40%). A graph of matching

baselines is presented in Figure 43.

Figure 43. Matching performance School 1
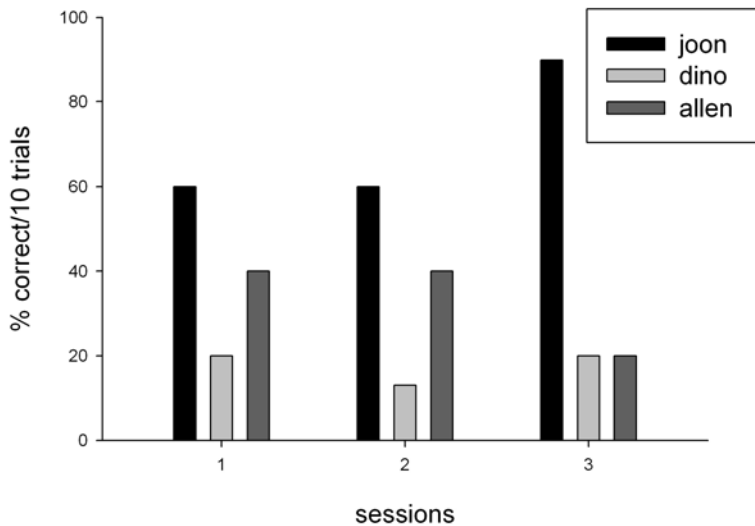
Naming baseline. With the exception of one session with Dino, participants

correctly receptively identified stimuli for a high percentage of sessions. Joon's mean

naming performance was 77%, with a range of 73%-80%, while Dino and Allen had

mean performance on naming trials of 75% (range 67%-80%) and 84% (range 80%-

93%), respectively. A graph of receptive naming performance for School 1 is presented

in Figure 44.

Figure 44. Naming performance for School 1.
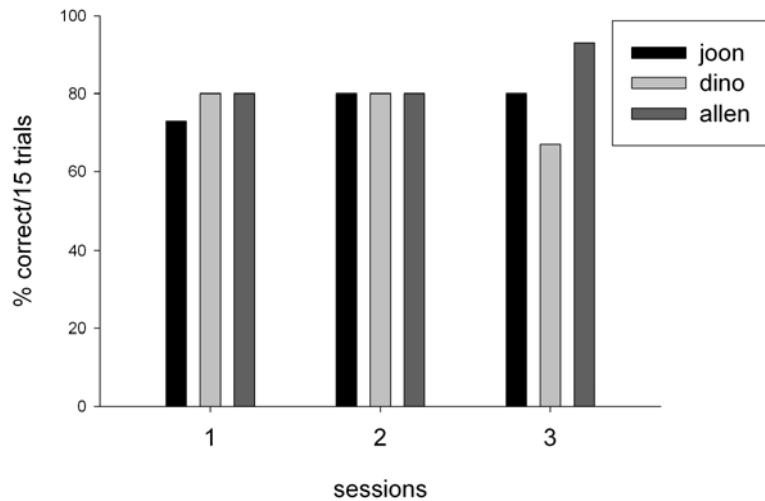
Question answering baseline. A graph of question answering, baseline, training, generalization, and matching training is presented in Figure 45. Students consistently scored low during baseline sessions on question answering. Joon's mean baseline performance was 34%, with a range of 23%-47%. Mean question answering for Allen was 8%, with a range of 0%-20. Mean question answering for Dino was 9.25%, with a range of 0%-27%.

Figure 45. Baseline and training data for School 1.
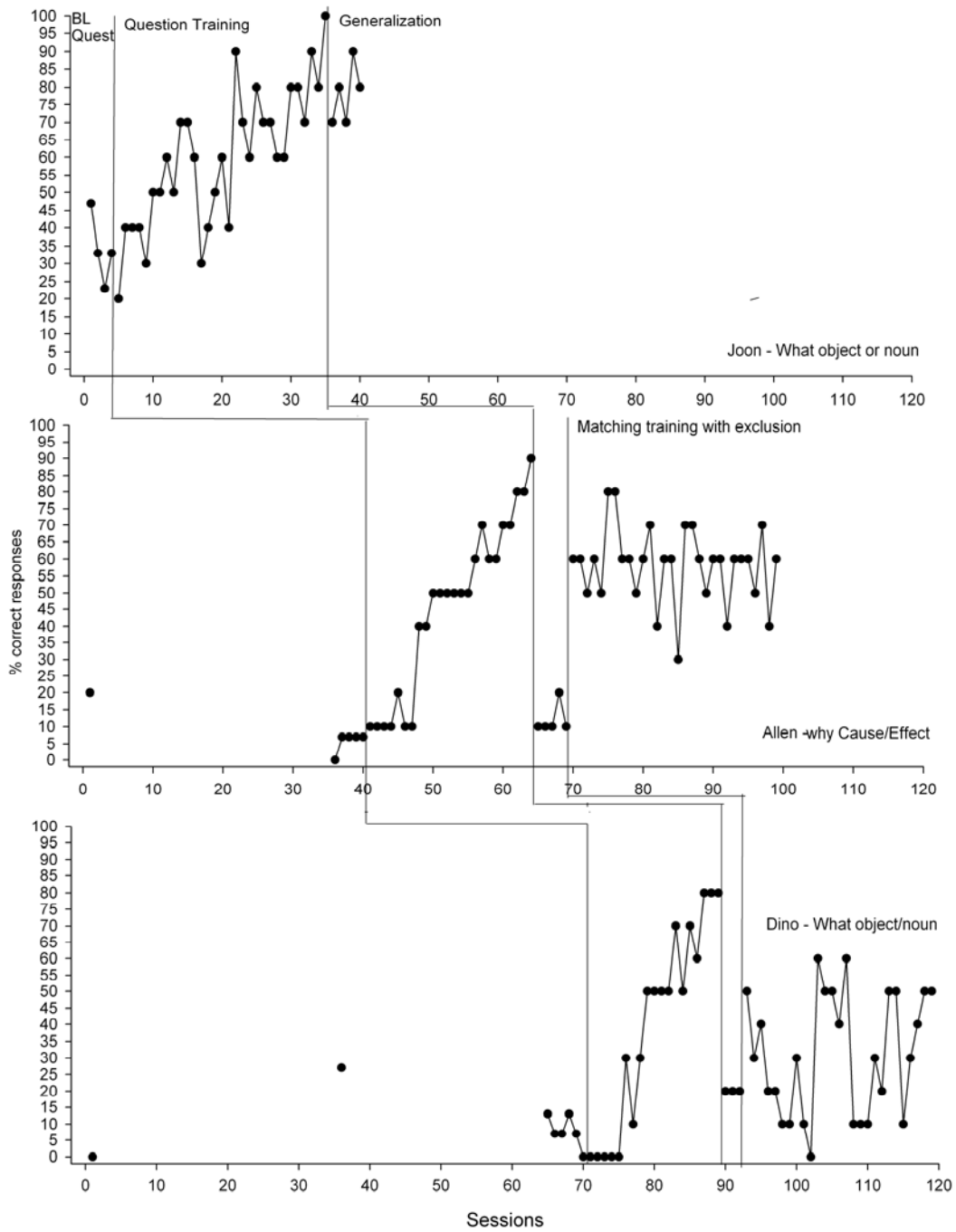
Question training. Each student showed a gradual increase in correct responding

until reaching criterion of 8/10 correct over three consecutive sessions. The average

number of trials to criterion was 24 with Joon reaching criterion in 30 sessions, Allen in 23, and Dino in 18 sessions.

Generalization trials. Joon reached generalization criterion of 7/10 correct over three sessions in 4 sessions, with a mean performance of 78% correct (range 70%-90%). The study was terminated for Joon at that time as no further remedial training was necessary. Allen's generalization performance was 12% over 3 sessions (range 10%-20%); Dino scored 20% for all generalization probes. Therefore, they began matching training.

Matching training. Neither Allen nor Dino reached criterion of 8/10 correct over three consecutive sessions for matching training. Allen's mean matching training performance was 60% (range: 50%-80%). After 29 matching training sessions, the study was terminated for Allen. Dino's mean matching performance was 58% (range: 30%-80%) across 26 sessions. The study was also terminated for Dino at this point. None of the participants engaged in subsequent generalization trials, naming training, or remedial training.

One student (Joon) in School 1 was able to generalize to novel "wh-" questions after training was completed. His average correct responding during generalization was 78% (range 70%-90%). He also had the highest average matching performance of the three students.

School 2 Results

Matching baseline. The data for matching in School 1 is presented in Figure 46. Simon's mean matching performance was 23% correct, with a range of 20%-30%. Colin

correctly matched 27% of stimuli (range 10%-40%) and Darren matched 43%, with a range of 30%-60% correct.

Figure 46. Matching performance School 2.
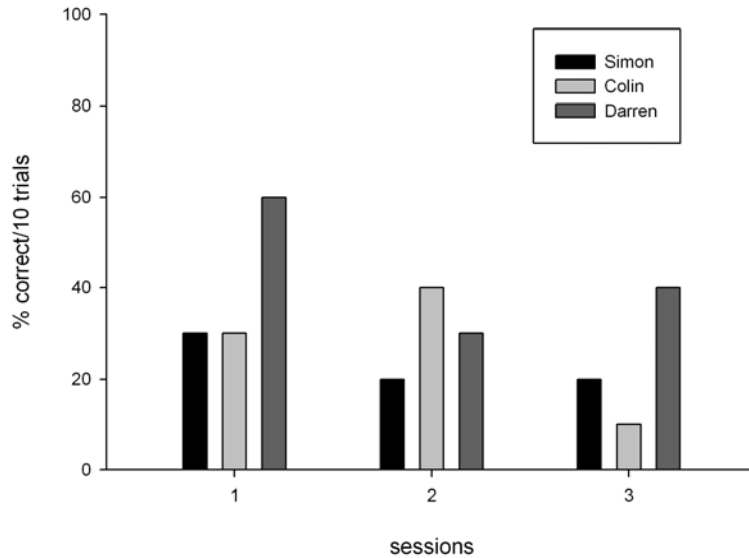
     Naming baseline. A graph of naming performance is presented in Figure 47. (research question 2 – also related to research question 1). Simon's average correct responding on naming trials was 88% (range 80%-93%) while Colin's mean naming performance was 84%, with a range of 80%-93%. Darren's performance was lower, averaging 58%, with a range of 53-67%.

Figure 47. Naming performance School 2.
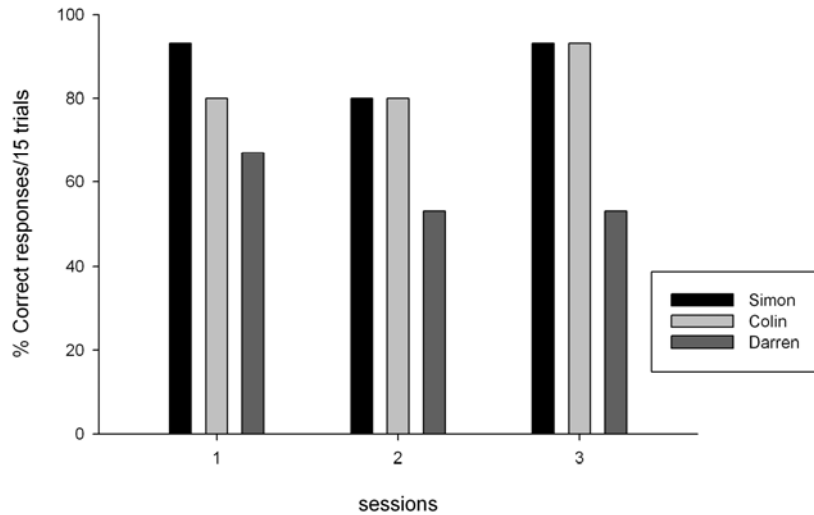
Question answering baseline. A graph of baseline question answering, question training, generalization probes, and matching training is presented in Figure 48. Simon participated in 3 baseline sessions. Mean question answering for Simon was 5% (range 0%-15%). Colin participated in six baseline sessions and his mean baseline performance was 27% (range 15%-40%). Darren participated in seven baseline sessions and he answered 0% of baseline questions correctly.

Figure 48. Baseline, question training, generalization, and matching training for School
2.
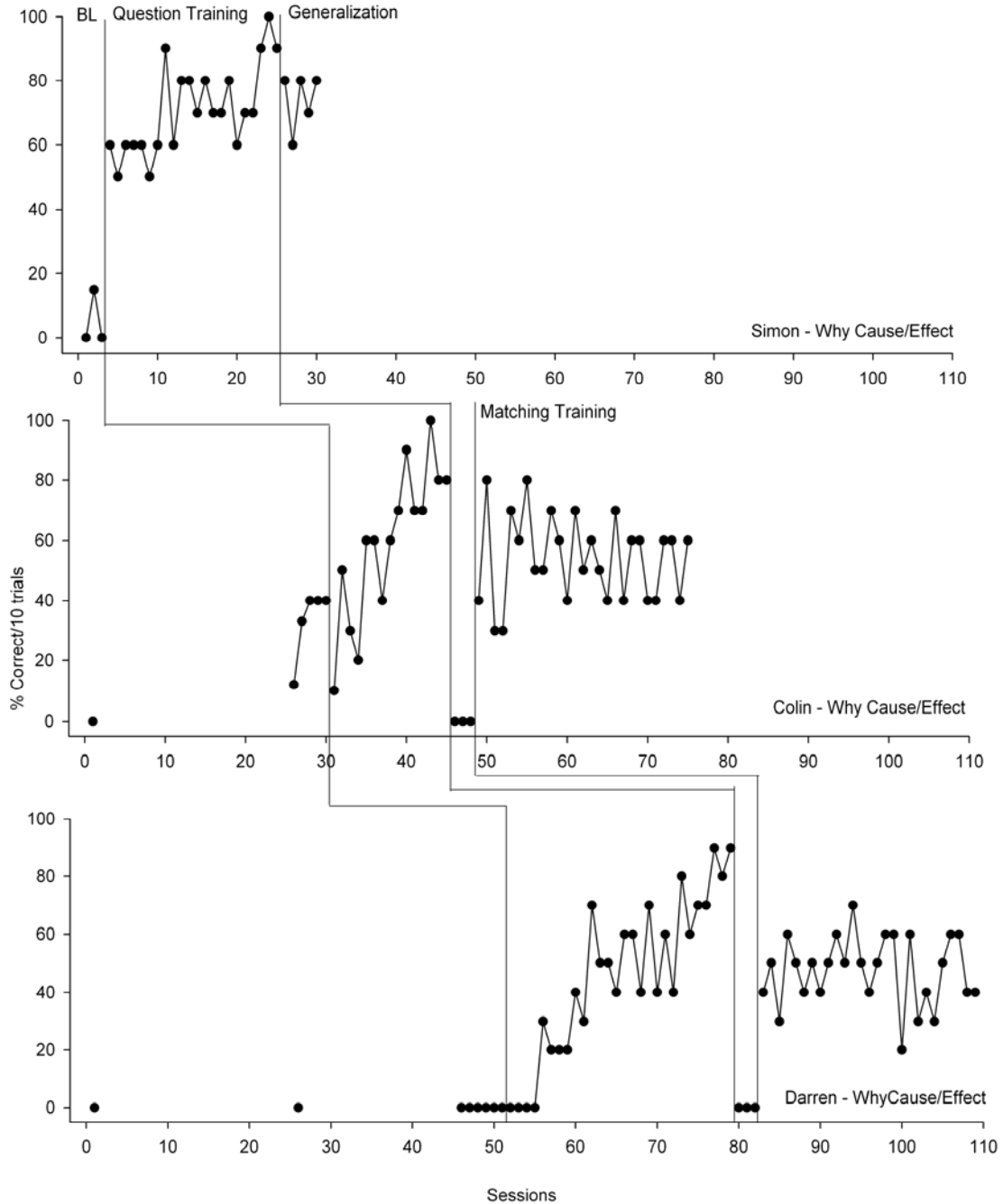
Question training. All students in School 2 reached the criterion of 8/10 correct

answers over 3 consecutive training sessions. Data showed a steady increase for all three

participants. The mean number of sessions to criterion was 21.3. Simon reached criterion in 21 sessions, Colin in 14 sessions, and Darren in 29 sessions.

Generalization. Only Simon reached criterion of 7/10 correct over three sessions during generalization probes. His mean performance on generalization probes was 74% over 5 trials (range: 60%-80%). Simon's participation in the study was terminated at this point. Neither of the other two participants answered any generalization questions correctly (Research question 2).

Matching training. As with School 1, neither remaining participant reached criterion of 8/10 correct over three consecutive sessions during matching training sessions. Colin averaged 54% correct on training trials (range: 30%-80%) and Darren averaged 47.4% (range: 20%-70%). Matching training with exclusion was implemented for these two students; however, criterion was not reached with either participant after 27 matching training sessions. As with School 1, the investigation was terminated for both students. Generalization after training was not assessed for either participant, and no other remediation sessions were conducted.

Results and Research Questions

Data were collected in this investigation to answer the following questions:

1. Does teaching matching and receptive naming of actions correlation to visual stimuli to students with autism increase the probability of generalized answering of "wh-" questions?

2. Do students with autism who show relational responding formation also show greater levels of generalized "wh-" question answering?

3. Do students with autism with lower verbal repertoires have more difficulty deriving relations than those with more advanced verbal repertoires?

Results from both schools are presented in the following section as they relate to each of the three research questions.

Does teaching matching and receptive naming of actions correlating to visual stimuli to students with autism increase the probability of generalized answering of "wh-" questions (Research question 1)? Students who did not generalize to novel questions after question training were taught to match pictures depicting similar stimuli with different stimulus characteristics. 4/6 students in the study did not generalize to novel "wh-" questions after direct training, and were exposed to the matching training condition. Mean responding of students exposed to matching training was 41.35%; none of the participants' reached criterion of 8/10 correct over three consecutive sessions. Trends in the matching training condition were either stable or unstable; there were no upward nor downward trends observed. Therefore, the study was terminated for each participant at this point. Generalization was not tested after matching training and naming training was not implemented because none of the students reached criterion on the matching training trials.

Do students with autism who show relational responding formation also show greater levels of generalized "wh-" question answering (Research Question 2)? Two students, one in each school, showed generalization to novel "wh-" questions. Joon showed the highest baseline matching performance across the two groups, with a mean performance of 70% (range 60%-90%). Simon, who also showed generalization to novel stimuli, averaged 23% correct on baseline matching trials (range 20%-30%).

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Darren, Colin, Dino, and Allen showed little generalization of "wh-" questions to novel stimuli. Allen had a mean baseline matching performance of 33% (range 20%-40%) *on why – cause and effect* stimuli, and Dino had an average of 17% (range 13%-20%) correct in baseline matching trials. Darren's mean performance on baseline matching was 43% (range 40%-60%), and Colin's mean matching percentage was 26.7% (range 10%-30%). Although Joon showed the highest matching percentages and generalization for School 1, these results were not replicated with School 2. Simon's mean matching performance was the lowest of the three participants.

Baseline naming performance was comparable across participants, with the exception of Darren. The two participants who generalized to novel "wh-" questions did not differ in their mean baseline naming performance. Joon's mean performance was 77.6%, and Simon's was 88.6%. Allen's baseline naming averaged 84.3% and Dino's mean naming baseline was 75.6%. Simon's average correct responding on naming trials was 88% (range 80%-93%) while Colin's mean naming performance was 84%, with a range of 80%-93%. Darren's performance was lower, averaging 58%, with a range of 53-67%.

Do students with autism with lower verbal repertoires have more difficulty deriving relations than those with more advanced verbal repertoires (Research Question 3)? Descriptive analysis data were collected to determine the level of verbal repertoires for each student, and CARS were completed on each student to determine overall level of severity. Joon and Simon, the two students who generalized to novel "wh-" questions, had CARS scores of 36.5 (mild/moderately autistic) and 43 (severely autistic), respectively. Both students had lower mean mands than mean tacts. Joon's mean overall mands were 4.80/h and mean prompted mands of 5.99/h. Overall mean tacts for Joon

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were 25.82/h and prompted tacts were 13.98/h. Simon's mean overall mands were 9.42/h and mean prompted mands were 4.60/h. Mean overall tacts were calculated as 42.24/h and prompted mean tacts 11.78/h.   Simon, however, had very high mean levels of intraverbals (36.52/h overall; 20.76/h prompted). Joon's intraverbals were very low.

The students who did not generalize did not differ in their CARS scores. Dino's CARS score was lower than Joon or Allen (32 – mild/moderately autistic); Allen had a similar CARS score than Joon (37 – severely autistic); however, Allen emitted many more mands, tacts, and intraverbals than the other students in School 1. Mean mands, tacts and intraverbals were calculated to be 72.15/h, 135.42/h. and 10.23/h. Unprompted mands, tacts, and intraverbals were calculated as 16.65, 40.55, and 8.25. A notable exception was unprompted intraverbals. Dino's mean unprompted intraverbals was .13, whereas Joon's intraverbals were .88. Neither Dino nor Allen emitted generalized responding to novel questions nor responded to categorization training.

Colin's CARS score (46) was higher than Simon's; however, Darren's CARS score was lowest at 34. Darren also emitted the highest mean number of mands across the two schools (111.22/h overall; 86.62/h unprompted). Colin emitted a higher mean number of tacts as opposed to mands; however, the mean number of unprompted tacts was much lower than his overall tacts (43.02/h; 4.76/h). Colin did not emit any unprompted intraverbals.

Summary

Six males from two schools participated in the current investigation. Participants were diagnosed with autism, and received services in segregated settings. All participants had CARS scores in the mild to severe ranges of severity. Participants in

both schools were observed to emit more tacts than mands (with the exception of

Darren). With the exception of Simon, participants emitted fewer intraverbals than

mands and tacts, and many of these utterances were prompted. Five of the six

participants were able to receptively identify the answer to the question reliably in a field

of two; Darren's scores, however, were much lower. Baseline matching was low for all

students with the exception of Joon.

All students were taught to answer "wh-" questions to 80% criterion over three

consecutive sessions in the presence of a visual stimulus. Two participants generalized to

70% criterion over three sessions. Matching training with exclusion was implemented

for the students who did not generalize. No participant reached criterion on matching

training with exclusion; therefore, the study was terminated. Generalization was not

assessed and naming instruction was not completed.

Chapter 5: Discussion

In this chapter, the results of the present study are interpreted. First, the implications of the results of this study, both applied and theoretical, are discussed. Second, results are discussed and interpreted as they relate to each of the research questions presented in Chapters 1-4. Integrations and extensions of existing literature are presented. Third, the limitations of the study are discussed. Recommendations for future practice are set forth as well as directions for future research.

Applied and Theoretical Implications of Research

One of the markers of ASD is the difficulty using language for conversational means. The inability to use conventional language has been blamed for increased problem behavior, high parental stress, and lowered social interactions (E. G. Carr & Durand, 1985; Lord & McGee, 2001). Teaching children with ASD to use conventional language and communicative acts should be a priority in any educational program to help ameliorate such problems. Answering "wh-" questions is considered to be a key skill for conversation (Greer & Keohane, 2006; Jahr, 2001). All of the students in this study were taught to answer "wh-" questions, which increased an important core communication skill. Questions remain regarding effective procedures for generalization of "wh-" question answering to novel targets.

Multiple exemplar training as a tool for increasing generalized question answering. As the numbers of children diagnosed with ASD rise (Centers for Disease Control, 2007), procedures for teaching children with autism and insuring generalization will continue to be important. The main purpose of this study was to identify methods by which students could be taught to answer novel "wh-" questions. Matson (1996)

identified generalization as the most neglected area of research; almost 20 years later, this is still true. One method for programming the generalization of learned skills is multiple exemplar training, in which a subset of a class is chosen for training. If a sufficient and representative number of exemplars are trained, students should be able to generalize to novel targets (Alberto & Troutman, 2003). When teaching self-help or vocational skills, choosing exemplars is relatively easy. For example, a teacher can choose a number of coats with different fasteners, colors, and weights. Most likely, the skill of putting on a coat will generalize.

Language and communicative competence, however, is much more difficult. Stimuli, responses, and consequences rarely happen the same way twice; therefore, choosing appropriate exemplars becomes much more difficult. In this study, the investigator was the first to attempt to use a variety of stimuli (magazine pictures, natural context stimuli, and storybook pictures) as the initial training stimuli to evoke the correct answers to "wh-" questions as well as generalized responding to novel questions. Using different types of visual stimuli for training was effective for increasing generalization of "wh-" questions for only two out of six students. It seems that choosing different types of stimuli to train question answering may not be sufficient for all students to generalize to novel questions. Therefore, questions remain regarding the correct selection of exemplars for training to increase generalization of "wh-" questions.

Identifying developmental patterns in the verbal behavior of children with autism. Many individuals are espousing Skinner's Analysis of Verbal Behavior as a theoretical model of intervention. Procedures continue to be refined over time, and there seems to be some overlap between theory and practice. For example, the investigator recently spoke

with a parent who was told by a leading consultant that her child should be emitting 200 mands/day. While there are many articles regarding how to teach children with autism verbal operants, there are no articles available in which the verbal behavior of children with autism are assessed in the absence of direct instruction and environmental manipulation. This study used descriptive analysis (Lalli et al., 1993) to assess the verbal behavior skills that students with autism emit on a regular basis to see if there are any prerequisite verbal operants that might need to be in place before teaching children to answer "wh-" questions. Knowing about prerequisite skills would increase the quality of instruction by identifying an effective order of instruction (Greer & Keohane, 2006). The students who generalized to novel "wh-" questions seemed to emit more tacts in relation to mands. The students who did not generalize either emitted more mands than tacts or an equal number of tacts and mands throughout observation. Replication of these procedures in future studies is needed. Results may lead to more developmentally appropriate behavioral curriculum choices for students with autism.

The utility of RFT for creating effective communication instruction. A relatively new theory of language and cognition is relational frame theory (Hayes, Barnes-Holmes et al., 2001b). Relational frame theorists believe that individuals are able to use language generatively because they are able to categorize stimuli through arbitrary means, and that these stimuli grow and change over time.

Most RFT studies are conducted through a Matching to Sample procedure in controlled environments (e.g., Y. Barnes-Holmes, Barnes-Holmes, & McHugh, 2004; Y. Barnes-Holmes, Barnes-Holmes, Roche, & Smeets, 2001; Hayes & Bissett, 1998). Few studies have been conducted in applied environments and with applied skills. In this

study, the investigator attempted to expand the applied RFT literature by examining whether teaching children categorization strategies in combination with multiple exemplar training increased the generalized answering of novel "wh-" questions, and, in turn, increased these students' communicative competence. Students who did not generalize to novel "wh-" questions after training were exposed to a matching-to-sample procedure where they were required to match nonidentical yet similar stimuli. An equal number of exclusion training trials, where students were required to place a picture with a nonidentical and unrelated stimulus, were interspersed throughout the training

Having students match nonidentical stimuli and interspersing exclusion training was not effective for the students who did not generalize to novel "wh-" questions after training. Although this matching procedure was not effective in teaching children to relate stimuli to one another, it may be possible that refinements to the matching procedure may show it to be effective in future studies. Controlling for extraneous stimuli, such as background images in pictures, to reduce overselective responding and removing exclusion training from the procedures may have produced more positive results. Selecting fewer questions from each subcomponent and training more exemplars per question may have resulted in increased generalized responding. It is still unclear whether RFT has applied implications for communication training.

Major Findings

Multiple exemplar training, where natural context, magazine picture and storybook stimuli were assigned to a "wh-" question, was effective in teaching all of the students in the present study to answer "wh-" questions. All of the students gradually improved their ability to answer "wh-" questions in the presence of a visual stimulus and

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eventually reached criterion of 8/10 correct responses over 3 consecutive sessions. The steady increase of correct responding is consistent with the training results found in Secan, et al. (1989) even though those authors used only pictures as referents. Therefore, using natural context, storybook pictures, and magazine pictures as training stimuli increased the number of questions each student was able to answer.

Only two out of six students, one from each school, were then able to generalize to novel "wh-" questions, suggesting that the topography of the exemplars alone was not necessarily sufficient for evoking generalized question answering.

Looking at the results of the descriptive analysis, there seems to be a relationship between the ratio of tacts to mands and generalization of "wh-"question answering. Both Joon and Simon had high levels of tacting and lower levels of manding when compared to the other participants in this study. It is possible that individuals who have larger tacting repertoires, and tact more than mand, are more likely to generalize "wh-" question answering. Therefore, there is a possibility that there is a developmental pattern of verbal behavior that moves from primarily mands to primarily tacts.

The data are inconclusive as to whether procedures derived from RFT are viable for teaching generalized responding to students with autism. Of the individuals who did not generalize, none reached criterion of 8/10 over three consecutive sessions on matching, averaging between 50% and 60%. The study was terminated for each of the students due to lack of progress. Therefore, generalization tests after matching training were not conducted.

Research Questions

This study was undertaken to answer three research questions: does teaching matching and receptive naming of actions correlating to visual stimuli to students with autism increase the probability of generalized answering of "wh-" questions? Do students with autism who show relational responding formation also show greater levels of generalized "wh-" question answering and do students with autism with lower verbal repertoires have more difficulty deriving relations than those with more advanced verbal repertoires? In this section, each of these questions is discussed in detail.

Does teaching matching and receptive naming of actions correlating to visual stimuli to students with autism increase the probability of generalized answering of "wh-" questions? Two students in each of the schools selected for the present study did not generalize to novel "wh" questions. Of these students, none reached criterion of 8/10 correct over three consecutive sessions on matching training, averaging about 50%-60% correct responding. Therefore, matching training with exclusion was not an effective remediation methodology for increasing generalized "wh-" question answering.

In the original proposal, once the student independently categorized to criterion, defined as 8/10 correct responses over three consecutive sessions, reassessment of generalization was planned. If students did not generalize after matching training, naming/symmetry training (i.e., receptive identification of correct answers) would have been the next phase. If naming training was ineffective in evoking generalized "wh-" question answering, students would have been exposed to a combination of interspersed naming and matching trials in an effort to increase generalized responding.

These phases of the study were not conducted, however, due to lack of progress on categorization training. Therefore, it is not known if teaching receptive naming would have been more effective in promoting generalization of novel "wh-"questions than matching. It is possible that that higher levels of generalization might have been observed if receptive naming was trained before categorization training. However, it seems unlikely that naming/symmetry training would have made a difference in generalization. With the exception of Darren, all students showed high levels of correct baseline naming performance, so it is unlikely that symmetry instruction would have been more effective for generalized responding. This is an area for future investigation.

Results of the training and generalization probes were compared to the ABLLS data. On the ABLLS, none of the students were reported to have mastered the difference between "same" and "different." In the baseline phase of this part of the study, students were only asked to "put with same." It is possible that the exclusion training did not, in fact, increase the discrimination between classes, but instead lead to more confusion. When the data were examined for trial-by-trial responding, there was no pattern to suggest that students were able to answer "put with same" questions and unable to answer "put with different." It seems that the students were not able to differentiate between "same" and "different" trials. If students were able to discriminate and did not know "different," it would be expected that the students would score well on the "same" trials and less accurately on the "different" trials.

Do students with autism who show relational responding formation also show greater levels of generalized "wh-" question answering? One student at each school generalized to novel "wh-" questions. Joon had the highest matching performance of the

three students in School 1, suggesting that matching performance did indeed relate to generalize "wh-" question answering. These results, however, were not replicated in School 2. Simon's matching performance was considerably lower than Joon's. The four students who did not generalize also had low matching performances, with the exception of Darren's first baseline matching trial. Therefore, the relationship between prior matching performance and generalization is inconclusive. More research is needed before conclusions can be made.

Darren and Dino engaged in a high rate of escape-maintained problem behavior throughout the day, and these problem behaviors were often seen during matching instruction. Darren engaged in head hitting and aggression that was addressed through a rich schedule of reinforcement for calm responding, honoring mands (at the beginning of the study, mands were reinforced on a CRF schedule; as the study progressed, the schedule was faded to an FR3), and at one adult assisting Darren at all times. Dino frequently fell to the floor, threw the training stimuli, and eloped from the classroom. Various management procedures were in place during the study, including using a token system, escape extinction, and repeated prompting. Both Dino and Darren displayed more variable responding during matching training; this variability may have been an artifact of their escape-maintained responding.

Do students with autism with lower verbal repertoires have more difficulty deriving relations than those with more advanced verbal repertoires? None of the students who were exposed to the matching to sample training reached 80% criterion over 3 consecutive sessions, suggesting that they were not able to derive relations from the matching to sample procedure. Relations were taught through a matching to sample

procedure if generalization did not occur after question training. Baseline data were collected on matching performance to compare to students who were able to successfully generalize "wh-" questions. One of the students who generalized had higher matching to sample performance than his peers; the second student had much lower matching to sample performance. Therefore, there does not seem to be a relationship between matching to sample and verbal competence.

There were some differences in the descriptive analysis between individuals who generalized "wh-" question answering and their peers, however. Joon and Simon both showed many more unprompted tacts than mands. Allen also showed a high number of unprompted tacts in relationship to mands. It is important to note that the question form needed to be changed for Allen due to high levels of responding in baseline. Dino and Colin showed a relatively equivalent ratio of tacts and mands, and Darren showed a higher number of mands than tacts. It seems that spontaneous tacting and generalized "wh-" question answering are in the same or closely related response classes. This might suggest that teachers include "wh-" question answering on IEPs only for students who tend to spontaneously tact as opposed to mand, and that there is a developmental progression of verbal operants. That is, early learners may primarily mand. As learners progress, tacts may become the primary verbal operant. Advanced learners may progress from emitting primarily tacts to intraverbals. More research, both with children with autism and children with typical development, may illuminate these patterns in more detail. A search of the literature did not reveal any empirical articles on the developmental patterns of verbal behavior; this is an area for future research.

The strongest generalization data in the literature was shown by Jahr (2001), who did not use visual stimuli to evoke responding. These data provide preliminary support to Greer and Keohane's (2006) suggestion that students who rely on visual cues and prompting are not ready to learn "wh-" question answering. Therefore, it is possible that "wh-" question answering as a goal should be taught as an intraverbal response as opposed to a tact. For example, in the context of play, a teacher might ask a question such as "why do you go to the library?" as opposed to in the context of the library itself or showing the student a picture of a book. It is possible that the visual cues interfere with learning the concept of question answering as opposed to enhancing it. It is interesting to note that in this study there is no evidence of a relationship between the rate of intraverbals and generalization, however. Joon, who generalized to novel stimuli, also had the lowest level of spontaneous intraverbal behavior.

When results of training, generalization, and descriptive analysis are compared to ABLLS results, a few interesting patterns emerge. Students in School 1 show better imitation. Their mean verbal behavior, however, was lower than that of students in School 2. Joon and Simon, who showed generalization to novel "wh-" questions, had both mastered skills G2 and G4 on the ABLLS. These skills are the ability to label 100 or more common objects and 100 or more pictures of common objects. This provides more evidence that a spontaneous tacting repertoire is most likely directly related to generalized "wh-" question answering and should be considered a prerequisite to teaching "wh-" question answering. Joon scored the highest in matching baselines and also showed high levels of generalization. His CARS scores, overall ABLLS results, or descriptive analysis results did not clearly differ from the other students in the study.

Therefore, there does not seem to be a relationship between matching to sample behavior and overall measures of communication and symptomatology.

The majority of information on levels of verbal functioning came from investigator-administered tools as opposed to standardized testing data. Results of training and categorization instruction were compared to the ABLLS results, CARS scores, and descriptive analysis to determine whether there was a relationship between these instruments.

Integration of the Current Study with Published Literature

This study was undertaken to attempt to apply Relational Frame Theory or RFT (Hayes, Barnes-Holmes et al., 2001b) to the communication training of children with autism. Relational Frame Theory is an extension of stimulus equivalence (Sidman, 1994). Relational Frame Theory and equivalence theories suggest that when relations between a set of stimuli are trained that associated relations emerge without training. In the basic literature, the authors of several studies utilized a matching to sample procedure to increase relations between stimuli (e.g., Y. Barnes-Holmes, D. Barnes-Holmes, B. Roche, & P. M. Smeets, 2001; McIlvane, Dube, Kledaras, Ienacco, & Stoddard, 1990; Sidman, Wynne, Maguire, & Barnes, 1989; Sigurdardottir et al., 1990). Applied studies of equivalence and RFT have included teaching basic sight word vocabularies, factual skills, and basic manding repertoires (e.g., D. Carr & Felce, 2000; Rehfeldt & Root, 2005). The connection between RFT and higher-level functional communication skills, such as answering "wh-" questions, has not been studied. Most applied research has been conducted with procedures that mimic basic studies and are carried out in well-controlled conditions. Few studies have been conducted in situations such as classrooms.

This study attempted to use a matching to sample procedure to increase generalized "wh-" question answering when such responding did not occur after initial question training. It was hoped that the use of a matching to sample procedure would increase the relations between the stimuli and "wh-" question, therefore increasing the ability to answer "wh-" questions. In the present study, students with autism were taught to match different stimuli, each depicting the answer to the questions being asked. For example, if a magazine picture was associated with the answer to a particular "wh-" question, a storybook picture or natural context item was chosen to match. Students were subsequently asked to "put with same".

In order to enhance discrimination, the authors of several studies used exclusion training in addition to matching to sample procedures (D. Carr, 2003; McIlvane et al., 1984). When training exclusion, students are taught to match examples as well as nonexamples of the class. The present study utilized exclusion training to determine whether it would enhance discrimination of classes, and, in turn, increase generalized "wh-" question answering. During exclusion trials, students were asked to "put with different." "Same" and "different" trials were conducted concurrently within each session.

For the four students in the study who did not generalize after training "wh-" questions, matching to sample with exclusion was not effective in teaching discriminations between stimuli. The individuals who did not generalize had low levels of matching to sample performance in training. It is possible, however, that lack of performance may have been an artifact of the addition of exclusion training. None of the students had "same/different" as a mastered skill on the ABLLS, suggesting that

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exclusion training does not enhance discrimination for students with less advanced skills. Instead, it seems to have confused the students. Most likely, matching to sample training without exclusion would have been more effective in teaching discrimination, because students did not seem to be able to discriminate between same and different. More study is needed to determine whether matching to sample is effective in forming stimulus classes which result in generalized "wh-" question answering.

A secondary goal of the present study was to extend the findings of Secan, et al. (1989). Secan, et al. (1989) utilized a combination of magazine pictures, storybook pictures, and natural context questions to train generalized "wh-" question answering when magazine picture training alone was not effective. This study utilized the three different forms of exemplars as a primary, as opposed to a remedial, training procedure.

Utilizing the three different types of stimuli, students were able to acquire "wh-" question answering. However, this procedure did not seem to increase generalized responding. In addition, students in the current study took many more sessions to reach criterion of 8/10 correct over three consecutive sessions than those in Secan, et al. (1989). The students in this study, however, seemed to have lower verbal skills than the ones identified in Secan, et al. (1989). In both Secan, et al. (1989) and Krantz et al. (1981), students had higher verbal abilities than those in the present study. This was also true of the participants in Krantz et al. (1981) and Jahr (2001). Greer, Stolfi, et al. (2005) taught students to match identical pictures to pictures while naming the correct response. This procedure increased pointing, tacting, and answering "what is it?" questions. As in Secan, et al. (1989) and Jahr (2001), students had the ability to mand, tact, and engage in intraverbal behavior. It may be that prerequisite skills are more important variables in

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acquisition and generalization as opposed to specific teaching procedures. Therefore, future research should investigate whether "wh-" question answering should be considered for children with well-developed tacting repertoires and emerging intraverbal behavior.

In the literature, selection of exemplars as well as the amount of stimuli per class is variable. Therefore, the failure of training in this study may not be a failure of constructs of RFT and multiple exemplar training, but a failure to choose appropriate exemplars. In Rehfeldt and Root (2004), students were taught to relate pictures, name, text, and natural context items to each other to increase manding using picture cards, for a total of four different exemplars per class. In the present study, one additional stimulus was associated with each question. Therefore, it is possible that relations between the questions were not formed. Adding additional stimuli per question as opposed to training a larger number of questions may have been a more effective strategy than the one used in the present study.

The pictures and natural context items used in this study were not systematically chosen for their complexity; therefore, questions remain as to whether students may have been responding to some uncontrolled dimension of the stimuli presented. Some stimuli may have been more complex than others, leading students to respond overselectively to the training stimuli. A post-hoc analysis of the complexity of the stimuli and the affects of this rating on both trials to criterion and generalization should be examined.

Krantz et al. (1981) suggested that defining question subforms as separate stimulus classes was important to generalization. It is possible that narrowly defining the classes in this study was also responsible for the generalization shown by the two

students in this study. Only one subform per student, however, was instructed. Greer et al. (2005) related matching pictures to pictures while naming each stimulus. Pointing to the same stimuli and tacting these stimuli were tested. Generalization to novel targets was not assessed. Therefore, it is possible that each question is in fact its own class. In order to assess whether each subform is, indeed, its own independent class, it would be necessary to design a study across the subforms within each question. Therefore, it is unclear whether the definition of subforms is a factor in generalization to novel "wh-" questions. In the few examples of applied relational framing, classes were defined much more narrowly.

Limitations to the Current Study

The results of this study should be interpreted with caution. There are many limitations to this study that might influence the results. These include: the lack of standardized language scores, changes to the proposed study, participant selection, and the limitation of informant assessments. The limitations of the descriptive analysis and generalization trials are also discussed.

Participant selection and the limitation of informant assessments. Students were selected from School 2 without the benefit of pre-instruction observation, limiting the conclusions drawn. The teachers in School 2 nominated students based upon descriptions given to them by the investigator. It is possible that teacher bias may have affected which students were selected for the current study.

Anecdotal observations of students as well as the descriptive analysis of verbal behavior suggest that the students in School 2 were emitting more prompted and unprompted verbal responses than the individuals in School 1. The CARS scores for

School 1, however, were lower than those for School 2, suggesting that students at School 1 had less severe autism than those of School 2. While the CARS has been shown to have good reliability and validity, its interrater reliability is somewhat low at .75 (Schopler & Reichler, 1980). Therefore, it is possible that the biases of the informant may have influenced the data collected on the CARS.

The ABLLS from School 1 also suggested that students at School 1 had more verbal behavior skills than individuals from School 2. Therefore, any comparisons across schools should be done with caution. It is also possible that skills beyond the ones analyzed may have had an impact upon responding; specifically, the visual performance component, reading component, generalized responding, and math domains. Staff from School 2 declined to finish the ABLLS beyond those reported, citing time constraints. Therefore, there may have been some other related skills not assessed that might have been identified by a complete ABLLS.

Lack of standardized assessment data. In the proposed study, the investigator planned to review standardized assessments used to create IEP goals. However, little standardized data were available for the students. In School 1, two of the students had recent GARS and Leiter Scores, assessments of overall achievement and functioning. The remaining student did not have any global tests of functioning. The most recent standardized speech-language assessments for the students in School 1 were completed by individuals in their preschool placements or infants and toddlers.

In School 2, an open-ended assessment tool was used to assess speech-language goals, and all IEP goals were based upon existing discrete trial data. The contents of the

open-ended tool were not available to the investigator. Therefore, it was not possible to determine levels of functioning from pre-existing standardized assessment data.

A standardized informant assessment of verbal behavior, the Verbal Behavior Assessment Scale also known as the VerBAS (Duker, 1999) was to be completed by teachers and classroom staff. After several unsuccessful attempts to contact the author and other investigators who had used the VerBAS to receive information about scoring and interpretation, the investigator decided to abandon the use of the VerBAS. It is possible that the VerBAS would provide more information on present levels of functioning. It is important to note, though, that the VerBAS is also an informant assessment, and results may have been affected by informant bias.

Limitations to descriptive assessment. This investigation was the first to use descriptive analysis to determine the verbal behavior of children with autism. This assessment showed valuable information; however, during assessment the limitations to Skinner's Analysis of Verbal behavior became clear. Skinner (1957) stated that most of our utterances are impure; that is, most utterances act on the environment in multiple ways. For example, Darren often emitted requests such as "I want the red swing." Topographically, this utterance would look like a mand. The consequence of this statement, however, was often praise such as "good asking!" without the reinforcer being delivered. Therefore, this statement acted upon the environment as a tact of a private event (i.e., Darren was commenting on his want). Prizant and Schuler (1987) suggested that there are two parts to a communicative act: intent and function. In Skinner's analysis of verbal behavior, it is difficult to calculate and study intent of an utterance through observable behavior. While private events (such as intent) are an important part

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of Skinner's theory, they are not easily quantified or measured.   Therefore, the assessment of verbal operants is somewhat incomplete.

Future descriptive assessments should also take into account the specific environmental conditions that evoke responding. In School 1 and School 2,   the utterances of students were observed to be stereotypic and/or evoked by very narrow stimuli. For example, the majority of mands were emitted by students in School 1 during snack, when mands were directly targeted. Mands were rarely seen in other conditions. In School 2, mands typically consisted of requests for reinforcers (video, outside) in response to completion of work. Motivating operations are environmental events that make the antecedent stimuli more salient and the reinforcers more potent.(Laraway et al., 2003; Sundberg, 1998) Identifying the motivational operations that evoke particular verbal operants may provide more information on the intent of verbal utterances and provide a more complete analysis of each child's verbal behavior.

A descriptive assessment also does not take into account the topography of the response. Students from both schools were observed to have difficulties with generalized grammar and syntax. Joon would often begin his mands during snack with "yes, Joon." The investigator observed that this was how the teacher and paraprofessionals often called upon students. Therefore, a descriptive analysis should be accompanied by a linguistic analysis such as Mean Length of Utterance or MLU (Brown, 1973) and detailed descriptions of the setting and activities that may have control over responding.

Changes to the proposed study. In the proposed study, two students who were identified as having more advanced language skills and two students with less advanced language skills were to be selected for the study. The research design was to be a

multiple probe across question forms. These four students were selected for the study and the descriptive analysis was completed.

The parents of the two students with more advanced verbal skills, however, elected to withdraw from the study, citing time constraints. Therefore, a multiple probe design across subjects was implemented with the three students added from School 2. If the design were implemented as proposed, stronger conclusions would most likely have been possible because results would have been replicated within students. Six replications of training results across question forms with individuals with more advanced verbal repertoires could have been compared against the same number of replications with individuals with less advanced repertoires.

Limitations to the generalization procedure. In generalization trials, 10 novel questions were generated, stimuli were assigned to the questions, and each question/stimuli combination was presented to the student   Novel items were used as well. However, baseline data on these generalization stimuli were not taken. Therefore, it is possible that the students were familiar with the questions as well as the answers to the questions from previous teaching. Future research should include a baseline measure of generalization as well as teaching stimuli.

With the exception of Simon, there was no immediate change in level between baseline and "wh-" question training. The lack of immediate level change lowers the strength of the conclusions that can be drawn. Other environmental factors not identified in this study may have influenced the steady increase in the data (Kennedy, 2005; Tawney & Gast, 1984).

During training, the students in this study had almost twice the number of trials to criterion of 8/10 correct over three consecutive sessions than those in the study conducted by Secan, Egel and Tilley (1989). Upon examination of the subject descriptions in the earlier study, several interesting differences emerge. The subjects in the study by Secan, Egel and Tilley (1989) were described as being able to spontaneously answer greetings and give personal information, suggesting that they had a higher intraverbal repertoire than the individuals in this study. Simon had the highest rate of intraverbals in the descriptive analysis and also had the largest change in level from baseline, suggesting that the ability to emit spontaneous intraverbals may strengthen acquisition of "wh-" question answering.

Recommendations for Practice

Despite the limitations of this study, some preliminary recommendations for practice can be made. These are: the consideration of prerequisite skills for teaching "wh-" question answering, the continuation of considering multiple sources of information when writing IEP goals, and the importance of objective data collection when evaluating the development of children with autism.

When writing IEP or discrete trial goals, the results of this study suggest that students should have some specific prerequisite skills or behavioral cusps (Greer & Keohane, 2006) before teaching "wh-" questions. Teachers should carefully consider whether students are engaging in high levels of spontaneous commenting before considering "wh-" question answering goals, possibly using the methods described by Williams et al. (2005). The rate of tacts should outnumber the rate of mands. Teachers should also consider waiting to teach "wh-" questions until students are able to engage in

spontaneous early intraverbal behavior such as greetings and answering personal information.

All of the students in the study had math and language IEP goals that suggested that matching to sample skills and same/different discriminations had been mastered. Number sense, or the ability to recognize quantity, is considered to be a prerequisite for spatial relations such as time, counting, and computation. "Same" is considered to be a component skill of number sense and computation. Matching to sample is the most common method by which same are taught, and most behavioral teaching curricula treat matching to sample as an early skill taught before linguistic skills. However, concepts such as "less" and "different" develop much later, but are usually mastered in kindergarten or first grade (van der Walle, 1994). The students in this study were not able to differentiate between "same" and "different"; however, each had some sort of computational or time skill on his/her IEP. The teacher in School 1 stated anecdotally that the students included in this study were struggling with math concepts. Therefore, it is possible that explicit teaching of spatial relations such as same and different should be introduced before computational skills in behavioral curricula.

The current re-authorization of IDEA ("Individuals with Disabilities Education Improvement Act of 2004," 2004) states that multiple sources of evidence should be considered when determining IEP goals. Some parents and practitioners are advocating IEPs based upon the ABLLS as the primary source of goal setting ("JP v School Board of Hanover County VA," 2006; Partington & Sundberg, 1998). When comparing the ABLLS results to the CARS, descriptive analysis, and generalization results, it becomes clear that the ABLLS, as the CARS, is subject to the biases of the individual completing

the assessment. Therefore, it is important that the results of the ABLLS be accompanied by objective data that quickly and efficiently tests the domains listed by the ABLLS.

A brief descriptive analysis of verbal behavior would be a good companion to informant assessment. Scoring a student's verbal behavior across several days could be done conveniently. However, this assessment should be accompanied by more traditional assessment of the student's linguistic competence as well.

Recommendations for Replications and Future Research

This study raises many future research topics and considerations for replication. These include: more investigation into the applications and extensions of relational frame theory, analysis of students' spontaneous verbal behavior, and the development of verbal behavior in students with autism. This study begins to answer some questions about the verbal behavior of students with autism; however, much is left to learn.

This study was the first to use a variety of exemplars to teach children "wh-" question answering. Storybook pictures, magazine pictures, and natural context questions were all used to increase students' ability to answer generative "wh-" questions. One stimuli, however, was associated with each student. Only two stimuli were assigned during matching training, and matching training was conducted in a small field. It is possible that this did not result in true multiple exemplar training, but instead trained several examples of "wh-" question answers. Future research questions include the assignment of multiple stimuli to one question and using matching and sorting to create larger classes than the ones that were attempted in this investigation (Hayes, 2006).

Future replications of this study should include careful consideration of the characteristics of the participants. In this study, the students with the most successful

outcomes also engaged in spontaneous tacting behavior. Students selected for participation in future replications of this study should emit frequent spontaneous tacts. Investigators should consider comparing individuals with more advanced spontaneous verbal repertoires as opposed to individuals with less advanced spontaneous verbal repertoires in future studies, in alignment with the original research study.

Answering questions about a picture can be considered a tact; therefore, it is possible that question answering and spontaneous tacting may be in the same response class. A response class is a set of responses that evoke similar contingencies (Catania, 1998). In the case of spontaneous tacting and answering "wh-" questions, students emit a comment about a stimulus within their environment. This response typically evokes some sort of social reinforcer such as praise. Therefore, it is possible that spontaneous tacting and answering "wh-" questions are related in some way. Teaching spontaneous tacting before teaching students to answer "wh-" questions might increase the likelihood that generalization may occur to novel "wh-" questions. Future research should address the relationship between spontaneous tacting and generalized "wh-" question answering.

It is also possible that students may have been more successful if exclusion training was not used or if students were selected that mastered the distinction between "same" and "different". None of the students were able to differentiate between "same" and "different", and it was clear that this hindered the acquisition of a matching response. Therefore, future research and replications should address the use of matching to sample without exclusion to determine whether this method is more effective in creating stimulus classes and subsequently results in generalization of wh- question answering.

Conversely, research studies should address whether "same" and "different" instruction should receive more attention in behavioral curricula.

Naming training was not implemented in this study; therefore, it is unknown whether receptively training the names of items would increase generalized responding. While a relationship between expressive responding, baseline receptive responding, and generalization was not shown in this study, there is still a possibility that teaching children to receptively identify items, possibly combined with matching training, and might lead to increased expressive responding.

It is possible that the choice of exemplars might have led to confusion, and that controlling for the extraneous stimuli might have led to stronger results. Individuals with autism often respond overselectively; therefore, it is possible that students were responding to a dimension of the stimuli not identified by the investigator (Barthold & Egel, 2001). Line drawings or stimuli with plain backgrounds might have been more effective (or conversely, more limiting) training stimuli. The effect of the complexity of the stimuli on generalized responding is an area of future study.

In addition, the descriptive analysis of verbal behavior should be replicated and refined. Procedures for addressing intent should be investigated. Evaluation of the motivating operations, as well as specific antecedents, behaviors, and consequences may help to identify the intent of verbal utterances and therefore increase the validity of assessment. Contriving motivating operations to compare verbal behavior across environments and students might lead to more information about what verbal operants children emit in the absence of direct teaching. For example, a classroom in which students are typically instructed in a 1:1 setting might be asked to implement some group

instruction to determine whether the students respond differently to group instruction. Descriptive analyses of typically developing children would provide comparative information about the development of verbal operants in children. In addition, descriptive analysis should be combined with traditional linguistic assessments.

The setting and methods of the study might have also contributed to the lack of generalization. The investigator used a traditional discrete trial model of instruction to teach "wh-" question answering. In this model, one target behavior is instructed at a time, typically in a sitting of 5-15 trials. In order to promote generalization, stimuli, responses, and reinforcers are varied (Lovaas, 1981).

Newer models of instruction, such as intervention based upon Skinner's analysis of Verbal Behavior, utilize a mixed approach, in which many different target skills are presented in each sitting. For example, the first trial in a sitting might focus on the student tacting a picture. The second trial might involve motor imitation, a third trial question answering, and a fourth might involve manding for a preferred item (Sundberg & Partington, 1998). Many Verbal Behavior programs include Natural Environment Teaching, in which verbal operants are taught within a specific activity (Carbone, 2003). It is possible that interspersing other teaching targets or teaching thematically might lead to more generalized responding to "wh-" questions. Future research should compare generalization of skills using a mixed and thematic approach to a more traditional discrete trial approach.

The investigator of this study sought to apply Relational Frame Theory to increase "wh-" question answering by children with autism. In this study, six students were taught to answer "wh-" questions using magazine pictures, storybook pictures, and natural

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context questions as visual stimuli. For two out of six students, training was sufficient for facilitating generalization to novel "wh-" questions. These students were observed to have more spontaneous tacting repertoires than the students who did not generalize. The remaining four students were exposed to matching training, where students were instructed to match related stimuli with each other. An equal number of exclusion trials, where students were instructed to match nonrelated stimuli, were interspersed during matching training. None of the four students were able to learn the matching responses to criterion of 8/10 correct over three consecutive sessions.

Based upon the results of this study, practitioners might consider answering "wh-" questions as a goal only for individuals with existing spontaneous tacting repertoires. Individuals conducting future replications and extensions of this study might consider eliminating exclusion training from the procedures, take into account existing spontaneous verbal behavior of potential participants, and carefully consider the quality of visual stimuli selected.

Appendix A: Teacher Consent Form

Teacher Consent Form

Project Title	*Factors affecting the Generalization of "wh-" question answering by children with autism.*
Why is this research being done?	*This is a research project being conducted by Andrew L. Egel and Christine Hoffner Barthold at the University of Maryland, College Park .The purpose of the research is to determine what perquisite skills are necessary to increase the likelihood that students with autism will learn to answer a variety of "wh-" questions (e.g., "what is the child doing?") and to see if learning categorization strategies can increase generalization of question answering. We are inviting Children with autism spectrum disorders and "wh-" question answering goals on their IEPs. We are asking you to provide additional information about the children.*
What will I be asked to do?	*The research will take place in the classroom as well as other settings he/she will normally be in during his/her school day. Before intervention, we will review the participants' special education data (e.g., IEP data, evaluations) to obtain background information on your child and confirm his/her autism diagnosis. The purpose of this study is to determine whether teaching categorization increases the participants' ability to answer questions that he/she has never been asked before. We will need you to fill out two short assessment forms (the Childhood Autism Rating Scale and the Verbal Behavior Assessment Form). Each takes approximately 20 minutes to complete. We will also be asking to see data you have already collected on the participants, such as IEP data and reinforcer preference assessments.*
What about confidentiality?	*We will do our best to keep personal information confidential. To help protect your confidentiality: (1) your name and/or the participants' names will not be included on any collected data; (2) a code will be placed on any collected data; (3) through the use of an identification key, the researcher will be able to link your survey to your identity; and (4) only the researcher will have access to the identification key. If we write a report or article about this research project, your identity will be protected to the maximum extent possible.* *Your information may be shared with representatives of the University of Maryland, College Park or governmental authorities if you or someone else is in danger or if we are required to do so by law.*
What are the risks	*The only known risk to the children participating is the chance that*

of this research?	*the intervention is not effective.*
What are the benefits of this research?	*Although no direct benefits can be promised for the participants,, there may be general improvement in your understanding of how young children with autism spectrum disorders communicate and play.*
Do I have to be in this research? Can I stop participating at any time?	*Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized or lose any benefits to which you otherwise qualify.*
What if I have questions?	*This research is being conducted by **Andrew L. Egel and Christine H. Barthold, Department of Special Education** at the University of Maryland, College Park. If you have any questions about the research study itself, please contact Andrew L.Egel at 1308 Benjamin Bldg., University of Maryland, College Park, MD 20742, by phone at 301-405-6487, or by email at aegel@umd.edu.]* *If you have questions about your rights as a research subject or wish to report a research-related injury, please contact:* **Institutional Review Board Office, University of Maryland, College Park, Maryland, 20742; (e-mail) irb@deans.umd.edu; (telephone) 301-405-0678** *This research has been reviewed according to the University of Maryland, College Park IRB procedures for research involving human subjects.*
Project Title	*Factors affecting the Generalization of "wh-" question answering by children with autism.*
Statement of Age of Subject and Consent	*Your signature indicates that: you are at least 18 years of age; the research has been explained to you; your questions have been fully answered; and you freely and voluntarily choose to participate in this research project.*
Signature and Date	**NAME OF TEACHER**	
	SIGNATURE OF TEACHER	
	DATE	

Appendix B: Research Assistant Confidentiality Agreement

Research Assistant Confidentiality Agreement

As a research assistant on the research project "Factors Affecting the Generalization of "Wh-Question Answering by Children with Autism", I agree to keep confidential all observations of children within the classrooms.

To help protect confidentiality, a code will be used on all materials so that participants' names will not be available on any material with which you come in contact. I will not speak about observations of the children participating or other students in the classroom/school to any one other than the Principal or Student Investigator.

Information may be shared with representatives of the University of Maryland, College Park or governmental authorities if you or someone else is in danger or if we are required to do so by law.

Project Title	*Factors affecting the Generalization of "wh-" question answering by children with autism.*	
Statement of Age of Subject and Consent	*Your signature indicates that:* 1. *you are at least 18 years of age;* 2. *the research has been fully explained to you;* 3. *you agree with the confidentiality protections outline above* 4. *your questions have been fully answered; and* 5. *you freely and voluntarily choose to participate in this research project.*	
Signature and Date	**NAME OF ASSISTANT**	
	SIGNATURE OF ASSISTANT	
	DATE	

Appendix C: "Wh-" Baseline Procedures Rubric

Baseline Questioning Procedures Rubric

Instructions: Please check off the box if the instructor was observed doing the following procedures. If not, please leave that box blank.

☐   Instructor compiled needed materials before calling student to instructional area (pictures, storybook, questions, reinforcers)

For each trial (record data separately for each trial):

Instructor presented visual stimulus to student (natural context, picture, or storybook

picture)

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

☐ ☐ ☐

Instructor insured that student was oriented to the stimulus before asking question.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

☐ ☐ ☐

Instructor asked question which corresponded to the stimulus presented.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

☐ ☐ ☐

☐   Questions were presented in random order.
☐   Feedback was given for on-task behavior ONLY (no contingent feedback or error correction)

Total Number of Checks (must have a minimum of 30):	

Appendix D: Baseline Categorization Procedures Rubric

Baseline Categorization Procedures Rubric

Instructions: Please check off the box if the instructor was observed doing the following tasks. If not, please leave that box blank.

☐   Instructor compiled needed materials before calling student to instructional area (pictures, storybook, questions, reinforcers)

For each trial (i.e., record data separately for each trial):

Instructor placed comparison stimuli and distracter stimuli in front of the student.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

Instructor handed matching stimuli to student.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

Instructor gave the cue "put with same" and did not name the item.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

☐   Questions were presented in random order.
☐   Feedback was given for on-task behavior ONLY (no contingent feedback or error correction)
☐   Each member of the class was used as comparison and matching stimuli.

Total Number of Checks (must have a minimum of 31):	

Appendix E. Baseline naming procedures rubric.

Baseline Naming Procedures Rubric

Instructions: Please check off the box if the instructor was observed doing the following tasks. If not, please leave that box blank.

☐   Instructor compiled needed materials before calling student to instructional area (pictures, storybook, questions, reinforcers)

For each trial (i.e., record data separately for each trial):

Instructor placed comparison stimuli and distracter stimuli in front of the student.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

☐ ☐ ☐ ☐ ☐

Instructor asks student to "give me (name of comparison stimulus)".

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

☐ ☐ ☐ ☐ ☐

☐   Questions were presented in random order.
☐   Feedback was given for on-task behavior ONLY (no contingent feedback or error correction)

Total Number of Checks (must have a minimum of 30):	

Appendix F. "Wh-"question instruction procedures rubric.

Question Training Procedures Rubric

Instructions: Please check off the box if the instructor was observed doing the following tasks. If not, please leave that box blank.

☐   Instructor compiled needed materials before calling student to instructional area (pictures, storybook, questions, reinforcers)

For each trial (i.e., record data separately for each trial):

Instructor presented visual stimulus to student (natural context, picture, or storybook picture)

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

Instructor insured that student was oriented to the stimulus before asking question.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

Instructor asked question which corresponded to the stimulus presented.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

If student answered correctly (i.e., as per operational definition of correct response), instructor provided appropriate reinforcement and social praise

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

If student did not answer correctly or provided no response within 5 seconds of the prompt, the asked the question, modeled the response, and re-stated the question.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

If student answered correctly (i.e., as per operational definition of correct response), instructor provided appropriate reinforcement and social praise.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

If student did not answer correctly or provided no response within 5 seconds of the

prompt, the asked the question, modeled the response, and terminated the trial.

☐　　☐　　☐　　☐　　☐　　☐　　☐　　☐　　☐　　☐

☐　　Questions were presented in random order.

Total Number of Checks (must have a minimum of 65):	

Appendix G. Generalization trials procedures rubric.

Generalization Trials Procedures Rubric

Instructions: Please check off the box if the instructor was observed doing the following tasks. If not, please leave that box blank.

☐   Instructor compiled needed materials before calling student to instructional area (pictures, storybook, questions, reinforcers)

For each trial (i.e., record data separately for each trial):

Instructor presented visual stimulus to student (natural context, picture, or storybook

picture)

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

Instructor insured that student was oriented to the stimulus before asking question.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

Instructor asked question which corresponded to the stimulus presented.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

☐   Questions were presented in random order.
☐   Feedback was given for on-task behavior ONLY (no contingent feedback or error correction)

Total Number of Checks (must have a minimum of 30):	

Appendix H. Categorization Instruction Procedures Rubric.

Categorization Instruction Procedures Rubric
Instructions: Please check off the box if the instructor was observed doing the following tasks. If not, please leave that box blank.

☐   Instructor compiled needed materials before calling student to instructional area (pictures, storybook, questions, reinforcers)

For each trial (i.e., record data separately for each trial):
Instructor placed comparison stimuli and distracter stimuli in front of the student.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

Instructor handed matching stimuli to student.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

For matching trials: instructor gave the cue "put with same"/"which one am I

doing?" and did not name the item.

☐   ☐   ☐   ☐   ☐

For exclusion trials: instructor gave the cue "put with different"/"which one am I

NOT doing?" and did not name the item.

☐   ☐   ☐   ☐   ☐

If student answered correctly (i.e., as per operational definition of correct response),

instructor provided appropriate reinforcement and social praise

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

If student did not answer correctly or provided no response within 5 seconds of the

question, a gestural prompt was given and the prompt re-stated.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

If student did not answer correctly or provided no response within 5 seconds of the

question, a modeled prompt was given and the prompt re-stated.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

If student did not answer correctly or provided no response within 5 seconds of the

prompt, the instructor physically prompted the response and terminated the trial.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

☐ Questions were presented in random order.
☐ Each member of the class was used as comparison and matching stimuli.

Total Number of Checks (must have a minimum of 75):	

Appendix I: Parental Permission Form

Parental Permission Form

Project Title	*Factors affecting the Generalization of "wh-" question answering by children with autism.*
Why is this research being done?	*This is a research project being conducted by Andrew L. Egel and Christine Hoffner Barthold at the University of Maryland, College Park. The purpose of the research is to determine what prerequisite skills are necessary to increase the likelihood that students with autism will learn to answer a variety of "wh-" questions (e.g., "what is the child doing?") and to see if learning categorization strategies can increase generalization of question answering. We are inviting your child to participate in this research because he/she is attending and autism classroom and has "wh-" question answering on his/her IEP.*
What will I be asked to do?	*The research will take place in your child's classroom as well as other settings he/she will normally be in during his/her school day. Before intervention, we will review your child's special education data (e.g., IEP data, evaluations) to obtain background information on your child and confirm his/her autism diagnosis. We will assess his/her current language level as well as observe him/her in non-instructional settings such as lunchtime. We will also assess his or her skill in answering "wh" questions and ability to categorize similar objects. If your child has difficulty answering "wh-" questions, we will then teach your child to answer a variety of these questions and test whether these learned skills generalize to new questions. If not, your child will be taught a categorization strategy. These sessions will also be viewed by trained research assistants in order to assess whether procedures and data collection are accurate. The purpose of this study is to determine whether teaching categorization increases your child's ability to answer questions that he/she has never been asked before.*
What about confidentiality?	*We will do our best to keep your personal information*

	confidential. To help protect your confidentiality: (1) your name or your child's name will not be included on any collected data; (2) a code will be placed on any collected data; (3) through the use of an identification key, the researcher will be able to link your survey to your identity; and (4) only the researcher will have access to the identification key. If we write a report or article about this research project, your identity will be protected to the maximum extent possible. *Your information may be shared with representatives of the University of Maryland, College Park or governmental authorities if you or someone else is in danger or if we are required to do so by law.*
What are the risks of this research?	*The only known risk to my child is the chance that the intervention is not effective.*
What are the benefits of this research?	*Although no direct benefits can be promised for my child, there may be general improvement in special educators understanding of how young children with autism spectrum disorders communicate and play.*
Do I have to be in this research? **Can I stop participating at any time?**	*Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized or lose any benefits to which you otherwise qualify.*
What if I have questions?	*This research is being conducted by **Andrew L. Egel and Christine H. Barthold, Department of Special Education** at the University of Maryland, College Park. If you have any questions about the research study itself, please contact Andrew L. Egel at 1308 Benjamin Bldg., University of Maryland, College Park, MD 20742, by phone at 301-405-6487, or by email at aegel@umd.edu.* *If you have questions about your rights as a research subject or wish to report a research-related injury, please contact:* **Institutional Review Board Office, University of Maryland, College Park, Maryland, 20742; (e-mail) irb@deans.umd.edu; (telephone) 301-405-0678** *This research has been reviewed according to the University of Maryland, College Park IRB procedures for research involving human subjects.*

Project Title	*Factors affecting the Generalization of "wh-" question answering by children with autism.*
Statement of Age of Subject and Consent	*Your signature indicates that: you are at least 18 years of age; the research has been explained to you; your questions have been fully answered; and you freely and voluntarily choose to participate in this research project.*

Signature and Date	NAME OF SUBJECT	
	SIGNATURE OF PARENT/GUARDIAN	
	DATE	

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