The Effects of Naming Experiences and Properties of Visual Stimuli on Language Acquisition and the Relationship between Curiosity and Naming

Sarah Elizabeth Orlans

Submitted in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy
under the Executive Committee
of the Graduate School of Arts and Sciences

COLUMBIA UNIVERSITY

2017

ABSTRACT

The Effects of Naming Experiences and Properties of Visual Stimuli on Language Acquisition and the Relationship between Curiosity and Naming

Sarah Elizabeth Orlans

Children typically acquire language rapidly during their first few years of life. Their rates and levels of proficiency vary, but it is clear that the development of one's language repertoire impacts academic outcomes and future success across many domains. There are both genetic and environmental factors that affect and contribute to one's development. For children whose vocal verbal behavior is less well developed, it is imperative that we continue to develop and implement tactics and procedures to intervene in order to accelerate their language development. Researchers have identified Naming as a critical verbal developmental capability that allows one to learn language incidentally. Are there different types of Naming capabilities? Do properties of stimuli affect language acquisition? Does the Naming repertoire relate to children's level of curiosity about the world around them? In the 3 experiments that follow, I examined the effects of 2 types of Naming experiences and varying properties of visual stimuli on measures of Naming. In Experiments 2 and 3, I also conducted measures of curiosity to assess the possibility of a relationship between Naming and question asking. In my first experiment there were 31 participants. I investigated the effects of match-to-sample and exclusion Naming experiences on incidental acquisition of listener and speaker responses in both adults without disabilities and youth with disabilities. I examined the differences between the 2 age groups and Naming experiences. The adult means of listener and speaker responses were greater than the youth means. All adults met criterion for Naming with the match-to-sample experience, and 9 of 14 adults also achieved criterion levels with the unfamiliar stimuli following the exclusion Naming experience. The adult group's results showed that the group's Naming repertoire was fairly balanced for listener responses across the Naming experiences with minimal variability, and its speaker repertoire was not as balanced. The youth group's results demonstrated similar levels of variability across both topographies. The effect of the Naming experience was significant for speaker responses. In the second experiment, I implemented an intervention to try to establish unfamiliar stimuli as reinforcers to test its effects on the 2 types of Naming probes and curiosity measures in 6 elementary age children with disabilities. There were some effects from the treatment, but following 2 intervention conditions none of the participants met criteria for Naming. The participants' numbers of accurate listener responses were greater than their speaker responses. In Experiment 3, I conducted tests for curiosity and Naming with sets of stimuli that had varying levels of familiarity and complexity for 9 preschool age children with and without disabilities. As with the first 2 experiments, the numbers of listener responses for participants were greater than their speaker responses, and there was more variability in the speaker responses compared to the listener responses. The results suggested that the type of Naming experience or the familiarity level of the visual stimuli alone did not appear to influence the dependent variables, but rather that there may be an interaction among the independent variables. The means of responses were greater with more familiar stimuli following match-to-sample experiences whereas the means were greater with less familiar stimuli following the exclusionary Naming experiences. The results of the 3 experiments affirmed the independence of the listener and speaker components of Naming and suggest that the demonstration of Naming with unknown, unfamiliar types of stimuli may be a type of Naming capability that may not be present in all individuals who demonstrate Naming with unknown, familiar stimuli.

TABLE OF CONTENTS

LIST OF TABLES

Table Page

LIST OF FIGURES

ACKNOWLEDGEMENTS

I would like to express my sincere appreciation and deepest gratitude to Dr. Greer, my advisor and sponsor, for his encouragement in helping me successfully navigate this doctoral journey. He imparted a spirit of enthusiasm for careful research and thoughtful scholarship, and inspired me with his dedication to the science of teaching, while still leaving time for us to chat about personal matters. Without his guidance and persistent help, this dissertation would not have been possible. I would also like to thank my committee members, Dr. Dudek, Dr. Jahromi, Dr. Gautreaux, and Dr. O'Connell, who so kindly agreed to serve on my committee. Your support and feedback, both in preparation for and during my final defense, strengthened my confidence during the final weeks and provided me with valuable feedback moving forward. Your dedication to the field and to our future young students is inspiring.

Although I am originally from the D.C. area, I spent a good deal of time in other areas of this country and abroad and, in those travels, encountered several important mentors whom I'd like to acknowledge at this time. I hold dear the memory of Dr. Robert Sussman, professor of Physical Anthropology at Washington University in St. Louis, with whom I studied as an undergraduate. He was a compelling teacher and dedicated researcher in the field of human and primate behavior. He guided me toward the study of animal behavior at the St. Louis Zoo's Research Department as an Animal Behavior Research Intern. Those years were phenomenal, and I was endlessly amazing by the quality of care and the genuineness of those I met during my years in St. Louis. I would also like to acknowledge another professor from Washington University, Dr. Leonard Green, who got me started (and hooked!) on ABA. One spring he needed a few students who majored in psychology to be trained to provide ABA services for young children with autism and their families. I happily volunteered to do so, and enjoyed every

minute, including trying to figure out how to best teach and motivate the young children. Although I lost contact with several of those families years ago, Rebecca and her son, Daniel, will forever have a piece of my heart. Some years later I discovered the ABA program offered at Teachers College, and it seemed a perfect fit with my interests and my vision for my future.

Words cannot begin to express my gratitude for the special friends I've come to treasure along this journey. Chris, I can't believe how quickly the years have flown by since our late night study sessions at Olin Library at Wash U! No matter how much time elapses between visits, it always feels like we've never skipped a beat. Joanne, I would not have made it through these years without your positive outlook and amazing problem solving skills. We've had some crazy late (not fun) nights back in the day trying to crank out our lesson plans and research summaries before dawn. I wouldn't have wanted to sail through those amazing day-to-day experiences with anyone else but you, Rosie (Joanne)! To Lisa, Alison, Sunny, and Kimberly, I have such fond memories of our days together in the Masters Program. I would not have made it this far without your friendships and unfailing support. We have been through so much over the years, personally and professionally. You each are so very special to me. I can't wait to be able see your beautiful faces on more a more regular basis.

I have been truly blessed to work with so many phenomenal men, women, and children in the many schools in which I've worked over my years. There are so many talented staff and school community members to acknowledge: related services providers, specials teachers, teaching assistants, master's students, student teachers, temporary subs, special education teachers, custodial staff, new administrators, general education teachers, wonderful students, and their amazing parents. There are more of these quality people than I could ever name or thank in this brief review.

I do want to be sure to highlight some of the amazing teaching staff, though, whom I found to be particularity supportive. They contributed energy to our world by sharing their positive outlooks on life and by consistently demonstrating proactive behavior within and outside of our classroom, which for those who know me know I love ☺. These individuals hold such a special place in my heart for their deep, genuine love of all of our children and a deep pleasure in contributing to their education.

I've known you for years Amanda, and oh, how I adore you! You are an incredible lady with so many things going for you. I want nothing but the best for you! While I felt giddy with happiness those times you worked in my class, I know you are meant for bigger and better things, and wish them for you, as long as you still hang out with me! Maria, you have been there for me through thick and thin, and for years and years. I don't know what I would do without our morning phone calls and your advice! Noeleen, those years teaching together in the same room were amazing. I never wanted those years to end! You were an invaluable sounding board for me, and I feel so extraordinarily lucky to have had the opportunities to work with you and other terrific teaching assistants over the years. You were my rock, Noeleen, and I knew we could do anything and everything we needed to do with our minds working together. I loved our weekly spirit attire at Cottage Lane with Maria adding her own artistic touches to our delicious morning Dunkin Donut treats. You are such a kind hearted, genuine soul, and I am grateful to be able to consider you a friend.

For several years it seemed like we just kept adding endlessly positive, upbeat people to our team. Nadia, I am mesmerized by how you do all that you do and with such grace and humility. You help me to always try to think on the bright side of things. Erin, you and Nadia often remind me of each other, not based on your interests or appearance, but by your pure and optimistic outlooks on life, your cheerful demeanors, your “glass half full” attitudes on life, and your dedication to tackle any challenge. You have always been such an amazing and supportive team player, and one of the first people to jump in and help in any situation.

Of course I must acknowledge and appreciate my wonderful family members who have stuck by me through the thick and thin, through life’s ups and downs. These family members include my brother, Josh, sister-in-law, Dawn, my niece, Circe, my parents Barbara and Daryl as well as Mel and Barbara, my cherished grandmother, and more awesome cousins and extended family members than I can ever fully list. Josh, you endlessly impress me with your knowledge, determination, and heart. I truly appreciate all your words of wisdom and kind ear. To my parents, you have done more for me over my lifetime than I could ever adequately express. You have always been there to help put things in perspective and support me through the late work nights and tough times. William, I am forever in awe of your patience, love, and endless support of me over the years. Your “pep” talks to help me get over hurdles along the way meant more to me than you will ever know.

There are so many unpredictable twists and turns in the paths of my life, many of them too difficult to overcome alone. I knew I could always count on my family, my fiancé, and close friends to see me through these more stressful times. I appreciated your patience, when I had to cancel gatherings, work late, or miss out on social gatherings or family events to work on my dissertation. You have all been so tremendously supportive.

I thank you all for playing such a significant role in bringing me to this day. You’ve contributed so greatly to deepening the values I cherish: the importance of living life fully and with integrity, cherishing family and friends, and always working to the best of my ability. I try to follow the “golden rule” by treating others the way I would want and expect someone to treat me. I believe it's important to always do my best, in all areas of one's life, even if no one is watching! I constantly tell my students to do their "most," and, as I continue along this journey of life, I plan to do the best that I can for myself and others without sacrificing the values I hold dear.

DEDICATION

Dedicated to my beloved grandmother, Mrs. Mildred Marin, who endlessly supports me (and most people she meets!) and to the loving memory of my grandfather, Dr. James Marin. I promised you I would finish my degree, Grandpa. You two provided, and Grandma continues to provide, our family with a shining example of how to love, how to learn, how to support, how to treat others, and so much more. We are forever grateful for you and your impact on our family. Love you to the moon and back.

CHAPTER I

INTRODUCTION AND REVIEW OF LITERATURE

Introduction

Most young children acquire their first language successfully and rapidly in their early years of life, but some children demonstrate slower rates of language growth. While it is evident that there is substantial variability among infants and children in the emergence of vocal verbal language and in their levels of language proficiency (Weisleder & Fernald, 2013), their achievement of vocal verbal developmental milestones has been shown to be strongly related to outcomes later in childhood and adulthood (Gillberg & Steffenburg, 1987; Howlin, Goode, Hutton, & Rutter, 2004; Venter, Lord, & Schopler, 1992; Walker, Greenwood, Hart, & Carta, 1994). McKean et al. (2015) noted that well-developed language skills "provide the foundational knowledge upon which literacy and other academic skills are built" (p. 2).

The results of research have demonstrated that there are variables that can affect language acquisition, such as genetic factors (Oliver & Plomin, 2007), early language environment (Hoff, 2003), socioeconomic status (Walker et al., 1994), parents' quantity of verbal engagement with their infant (Fernald & Weisleder, 2015), parental roles in joint attention interactions (Tomasello & Farrar, 1986; Tomasello & Todd, 1983), child responses during joint attention (Desrochers, Morissette, & Ricard, 1995; Mundy, Kasari, Sigman, & Ruskin, 1995; Ulvund & Smith, 1996; Willoughby, Mundy, & Claussen, 1997), parental input (Hart & Risley, 1995; Huttenlocher, Haight, Bryk, Seltzer & Lyons, 1991; Weizman & Snow, 2001), frequency effects of vocally presented words (Rice, Oetting, Marquis, Bode & Pae, 1994; Schwartz & Terrell, 1983), and diversity of caregivers' vocal communication (Huttenlocher, Waterfall, Vasilyeva, Vevea, & Hedges, 2010).

Since one's vocal verbal repertoire is predictive of one's future academic success (Alexander, Entwisle, & Horsey, 1997), it is incumbent upon parents, educators, caregivers, and community members to identify the most effective strategies to facilitate verbal learning and to intervene to narrow the gap between children with less or poorly developed language and those with more well-developed language abilities. In the absence of these important verbal skills, children are at increased risk of literacy difficulties (Catts, Fey, Tomblin, & Zhang, 2002), academic failure (Johnson, Beitchman, & Brownlie, 2010; Tomblin, 2008), social and emotional difficulties (Durkin & Conti-Ramsden, 2010) and, as adults, of unemployment (Law, Rush, Schoon, & Parsons, 2009) and poor mental health (Schoon, Parsons, Rush, & Law, 2010).

In the literature review that follows, I will summarize theories and research related to language acquisition, emergent novel relations, learning by exclusion, and curiosity. I will then outline three experiments that I conducted to examine the effects of two different Naming experiences and properties of visual stimuli on untaught listener and speaker responses. In Experiment 1, I investigated the effects of match-to sample (MTS) Naming experiences and exclusion Naming experiences on listener and speaker responses for two groups: adults without disabilities and youth with disabilities. For Experiment 2, I utilized a multiple probe design that was delayed across two triads of participants to test the effectiveness of a repeated stimulus pairing observation procedure on establishing unfamiliar (contrived), unknown stimuli as reinforcers. Prior to interventions and post-interventions, I conducted probe assessments of Naming with unfamiliar stimuli across the two types of Naming experiences and probe assessments to measure levels of curiosity in the participants. In the third experiment, I again tested for levels of curiosity and the presence of Naming following MTS and exclusion Naming experiences. In Experiment 3, though, I also tested across multiple sets of unknown visual stimuli that varied in levels of familiarity and complexity to examine if there were any differences in the participants' acquisition of the untaught responses as a result of the stimuli's familiarity or complexity.

Views on Language Development

The natural evolution of language and the degree to which external interventions can influence its natural expression has been the subject of much debate over the years. Harris (1992) reflected on the powerful potential to influence language development, when she said:

> If there are no environmental influences on early development, then little can be done to help the child whose first steps into language are faltering. But, if the speed with which children develop language is subject to some external influence, then there are likely to be opportunities for successful intervention (Harris, 1992, p. xi).

Harris (1992) went on to emphasize the differing views on the relationship between one's language experience and language development. The origins of this dispute may be traced back to the seventeenth and eighteenth century works of Leibniz, Berkley, and Locke (Harris, 1992). (Harris, 1992; Kuhl, 2000; Snyder & Lindstedt, 1985) as they further investigated the complexity of language and the variables that underlie its development. The latter half of the 1900s "produced a revolution in our understanding of language and its acquisition" (Kuhl, 2000, p. 11850). This revolution and the resulting debate over the origins of language reflects the strongly contrasting views of the nativists, most notably represented by Chomsky, and the learning theorists, as represented by Skinner (Kuhl, 2000). The year 1957 was a significant year in drawing attention to the field of language acquisition, with the publication of two pivotal texts:

Skinner's book entitled *Verbal Behavior* and Chomsky's work entitled *Syntactic Structure*. These landmark publications laid the groundwork for the growing controversy that ensued between the behaviorists and nativists, respectively.

Pinker (1995) noted that the "scientific study of language acquisition began around the same time as the birth of cognitive science" in the mid-20th century and that the "historical catalyst was Noam Chomsky's review of B.F. Skinner's Verbal Behavior" (p. 137). The two individuals at the center of this controversy, one from the discipline of linguistics and the other from behaviorism, differed in their accounts of language acquisition and development. Chomsky supported the position that reinforcement-based learning had little effect on children's abilities to acquire language (Kuhl, 2000). He maintained that experiences were insufficient to explain the acquisition of language (Harris, 1992). Rather, Chomsky proposed the presence of an innate mechanism in children that allowed them to develop an understanding of language with minimal linguistic experience (Harris, 1992). Nativists attributed the human acquisition of vocal behavior, or language, to the species' genetics and biological structure (Sundberg, Michael, Partington, & Sundberg, 1996). Chomsky suggested that there was an innate language device that specified parameters for language, such as a universal grammar and phonetics (Kuhl, 2000). Nativists believed in a child's innate knowledge of language and that the development of language was a result of the "maturation of the language module, and language input triggered (or set the parameters for) a particular pattern from among those innately provided" (Kuhl, 2000, p. 11850). Chomsky precluded the possibility of a significant role for reinforcement in language development and criticized Skinner for ignoring the importance of syntactic knowledge in language (Harris, 1992).

Chomsky argued that language was not a repertoire of responses but, rather, was based on the presence of what he termed a universal grammar (Pinker, 1994). Additionally, Chomsky rejected the significant role of reinforcement in language acquisition (Harris, 1992). He believed that "children must innately be equipped with a plan common to the grammars of all languages, a Universal Grammar, that tells them how to distill the syntactic patterns out of the speech of their parents" (Pinker, 1994, p. 9). Chomsky (1959) firmly believed that "children acquire a good deal of their verbal and nonverbal behavior by casual observation and imitation of adults and other children" (p. 42). Chomsky (1986) referred to this universal grammar as a "characterization of the genetically determined language faculty" and as a "language acquisition device" (p. 3).

Chomsky (1986) believed that the acquisition of language was an innate element of the human mind. Others supported Chomsky's universal perspective on language acquisition as well. For example, Pinker (1994) stated that "the ubiquity of complex language among human beings is a gripping discovery and, for many observers, compelling proof that language is innate" (p. 19). It would follow, therefore, that linguistic structures did not have to be taught to individuals because they are part of an inborn system of knowledge.

Chomsky's theory on the origins of human language within the field of linguistics did not have unanimous support. For example, in 1990 Pinker and Bloom suggested that language may have evolved through a process of natural selection (Holden, 2004), and Holden (2004) noted that Chomsky's theory did not address the way in which language ability developed in humans.

Skinner (1957) challenged Chomsky's conception of language as having innate and universal structures, stating that "the 'languages' studied by the linguist are the reinforcing practices of verbal communities" (p. 461). He observed that linguists often investigate the practices of the society or group as opposed to the verbal behavior of the individual (Skinner, 1957). Skinner felt that innate information was unnecessary (Kuhl, 2000). Rather he believed that developmental transformations were the result of contingencies (Kuhl, 2000). Unlike some linguists, behaviorists believed language to be verbal behavior that could be quantified and observed (Snyder & Lindstedt, 1985) and viewed language as behavior that is mediated and reinforced by individuals in their verbal environment. In *Verbal Behavior* (1957), Skinner outlined his theory of learning. From his perspective, language was an operant that developed in individuals "as a function of external reinforcement and shaping" (Kuhl, 2000, p. 11850).

Skinner's paradigm is clearly distinct from Chomsky's perspective. While Chomsky held that individuals entered the world with innate sets of principles that predispose them to learn language, Skinner, by contrast, maintained that language development in children was dependent "upon environmental events through the conditioning of their verbal operants with reinforcers" (Snyder & Lindstedt, 1985, p. 18). Skinner supported the claim that children learn language through operant conditioning. For example, when a young child begins to produce early sounds that approximate sounds of its parents, some of those vocal productions are followed by parental attention and approval, which reinforces the preceding sounds (Harris, 1992). Although one most often thinks of vocal verbal behavior, verbal behavior has many diverse forms that include written language, sign language, typing, Morse code, gestures, and pointing. Greer and Ross (2008) appreciated the "magnitude of the importance of Skinner's treatment of language as behavior" (p. xi) following the completion of their studies of children with language delays. Experiences in the first years of life have been shown to be exceptionally influential, especially in relation to the development of language.

Moerk (1986, 1989, 1990) concluded, based on his analyses, that there was no need for an innate linguistic knowledge construct. Rather, Moerk (1990) embraced the position that the acquisition of language can be thoroughly and completely explained through learning. Hoff (2006) noted that typically developing children raised in normal environments develop language. She acknowledged the presence of individual and group differences in language development, which she attributed to the "co-occurring variation in environmental support and language development" (Hoff, 2006, p. 76). Hoff (2006) observed that children's environments offer the prerequisites for language acquisition but noted that these environments vary in how and to what extent they support language development. This variation affects the rate at which language develops in individuals (Hoff, 2006). Children whose experiences provided increased opportunities for quality communication appeared to have a faster rate of vocabulary acquisition than those who had fewer and less rich opportunities (Hart & Risley, 1995; Hoff, 2006). Hoff (2006) concluded,

> The relation of children's social environments to their language development has suggested the outlines of how the language acquisition mechanism makes use of environmental support, resulting in the universal acquisition of language, but along different developmental paths, at varying rates, and with varying outcomes depending on the nature of the communicative experiences and the language model provided (p. 79).

Sundberg et al. (1996) reviewed the results of Hart and Risley's 1995 study, in which the authors examined the experiences and interactions between children and caregivers as well as their effects upon language development. Sundberg et al. (1996) determined that a key variable in language acquisition appears to be the frequency of caregivers' emissions of verbal operants in the presence of their children. They suggested that this outcome might be due, in part, to the presence of more opportunities for "positive stimulus-stimulus pairing and the establishment and maintenance of behavior through automatic reinforcement" (Sundberg et al., 1996, p. 37).

Adamson (1995) and Messer (1994) also documented the relation between language input from caregivers and early vocabulary acquisition.

Significance of the Echoic Operant in Language Development

The class of verbal relations known as the echoic "appears relatively early in human infant's acquisition of speech" (Catania, 2007, p. 241). Infants emit vocal sounds early in life. Sundberg et al. (1996) stated that behaviorists identify several critical variables within an infant's environment that affect the emergence of babbling and noted that Bijou and Baer (1965) considered the variables to include both respondent and operant conditioning. The child's earliest vocalizations are respondent behaviors and random movements of muscles (Bijou & Baer, 1965). These respondents often develop into operant behaviors if they are immediately followed by reinforcement (Sundberg et al., 1996). These early vocal sounds "eventually develop into words that function to affect the behavior of a listener who mediates the environment for the infant" (Greer & Ross, 2008, p. 114). Before sounds acquire verbal functions, the young child's sounds result in automatic reinforcement derived from the baby just hearing the production of the sounds (Greer & Ross, 2008; Sundberg et al., 1996).

As infants develop, they begin to discriminate between sounds. Mehler et al. (1988) noted "infants discriminate a wide variety of phonetic contrasts soon after birth" (p. 144). These researchers (Mehler et al., 1988) studied French and American infants to determine if the infants were able to distinguish utterances in their native languages from those in foreign languages. The results of this study (Mehler et al., 1988) demonstrated that the infants, some merely just a few days old, had the capacity to discriminate between utterances from their own language and an unfamiliar language.

Skinner (1957) described the process that initiates the start of a child's echoic repertoire. The child's first attempts at echoic responses may be relatively inaccurate. However, the caregiver reinforces these early efforts to maintain the child's echoic behavior, allowing opportunities for improvement in matching the antecedent stimuli (Skinner, 1957). Caregivers eventually begin to differentially reinforce the young child's sounds that more closely approximate words by more emphatically reacting to the versions that are more accurate (Drash, High, & Tudor, 1999).

Catania (2007) explained the echoic verbal operant and provided the example of a young child repeating his/her parent's statement of "mama." He noted that the young child's response was considered to be an echoic because the child emitted it in response to the parent's vocal verbal antecedent and also "the phonemes of the child's utterance have a one-to-one correspondence to those of the parent's" (Catania, 2007, p. 241). This example would only be an instance of an echoic if it was shown to clearly not be parroting behavior. The echoic repertoire is developed through educational reinforcement since it is beneficial to adults in the child's environment, such as teachers and parents (Skinner, 1957). Daly (1987) noted "echoic behavior allows rapid teaching of new vocabulary through imitation [sic]" (p. 68). Once an individual has echoic responses in his/her repertoire they can be utilized to "evoke new units of response upon which other types of reinforcement may then be made contingent" and short-circuit "the process of progressive approximation" (Skinner, 1957, p. 56). The child eventually emits each echoic because there is a history of the delivery of reinforcement from a listener following an emission of an echoic, as distinct from the early babbling sounds of infants which are automatically reinforcing and do not have a verbal function (Greer & Ross, 2008).

Skinner (1957) identified and described six speaker verbal operants. One of these defined operants was the echoic. Skinner (1957) noted that echoic behavior "is under the control of verbal stimuli" and that "the response generates a sound-pattern similar to that of the stimulus" (p. 55). An echoic is a hear-say response, and it has point-to-point correspondence with the controlling stimuli that leads to an effect on the listener as a mediator (Greer & Ross, 2008). The vocal verbal stimulus immediately precedes the echoic response and is maintained by various reinforcement contingencies (Greer & Ross, 2008; Skinner, 1957).

Skinner (1957) stated that echoic behavior does "not depend on or demonstrate any instinct or faculty of imitation" (p. 59). Echoic behavior is not imitation but rather represents a "hear-say" response. The echoic is one type of verbal operant and is under the control of verbal stimuli. The echoic response has a point-to-point correspondence with the antecedent stimulus. Therefore, the response has a sound pattern similar to that of the stimulus. There is a history of the echoic, an example of emulation, producing an effect on the environment. The audience reinforces the response, which makes it a verbal response.

The echoic is not an example of imitation because an individual is not imitating the muscle movements that are involved in emitting the sounds. The individual's echoic responses are emulations of the result since the individual produces the responses without observing the specific process involved in the sound production. For example, when a teacher vocally emits the tact "chair" and the student echoes "chair," the student cannot see what muscle movements are involved in creating the vocal verbal response "chair." The student, therefore, emits an emulation as a result of hearing the teacher's statement, "chair." The echoic response is a "hear-say" response, not a "see-do" response. By contrast, when one uses sign language one learns logographic symbols; the signs are "see and do" responses since one can see the production of the signs and then learns and replicates the product. Therefore, when one learns sign language, the learner develops new signs through imitation.

The echoic response is an example of one type of verbal operant as described by Skinner (1957). Following an emission of this operant, the listener mediates the response, which reinforces the echoic behavior. The type of reinforcement that follows the echoic will determine its function. Echoics can be considered to have verbal functions in that they can potentially acquire some reinforcement from a listener, whereas Skinner did not consider a parrot-type response to be an example of verbal behavior. Skinner (1957) noted that a verbal behavior was one that other persons mediated and reinforced. These verbal behaviors affect the environment through another person's behavior. Their reinforcement value is, therefore, indirect. Parrot responses are automatically reinforcing to the individual and do not have a verbal function. The production of this type of response automatically reinforces the behavior of the individual; a listener does not mediate an occurrence of parroting. Therefore, parroting is not a true verbal operant.

Studies Involving Echoics

Several research studies have been conducted involving echoics. Some have examined the use of echoics in the transfer of stimulus control procedures to develop other verbal operants (Drash et al., 1999; Finkel & Williams, 2001). Researchers have also studied echoic responses in relation to educational programs (Daly, 1987; Williams & Greer, 1993), the development of echoic repertoires through a stimulus-stimulus pairing procedure (Sundberg et al., 1996; Yoon & Bennett, 2000), the use of chaining to develop more complex echoics (Tarbox, Madrid, Aguilar, Jacobo, & Schiff, 2009), auditory matching tasks' effects on the emission of verbal operants (Marion et al., 2003), the effects of an auditory matching procedure on echoic responses

(Chavez-Brown, 2005; Choi, 2012), the role of social reinforcement using rapid motor imitation (Ross & Greer, 2003; Tsiouri & Greer, 2003; Tsiouri & Greer, 2007), as well as the use of an auditory matching procedure on the listener component of Naming, echoic responses and tact responses (Speckman-Collins, Park, & Greer, 2007).

Daly (1987) and Williams and Greer (1993) conducted experiments that investigated the relationship of verbal operants to curricula. In these two aforementioned studies, the researchers measured the numbers of echoic responses as one of their dependent variables. Daly (1987) analyzed the responses of 13 student participants during the implementation of two reading methods and compared the verbal operants, including echoic operants, emitted in each condition. Her results indicated that participants' responses consisted of greater proportions of echoic operants in the language experiences approach in comparison to the Mastery Learning programs. Additionally, Daly (1987) found that the type of responses with the highest percentage in the Mastery Learning method was textual behavior, whereas the topographies with the highest percentages in the language learning experience were textual-intraverbal responses and echoic responses.

Williams and Greer (1993) examined the effectiveness of a verbal behavior-based curriculum and a linguistic-based curriculum on communicative responses in three adolescents diagnosed with developmental disabilities. Williams and Greer (1993) utilized the echoic-to-mand and the echoic-to-tact procedures during the verbal behavior-based curriculum conditions, in which the student had to emit a set number of correct echoic responses before the presentations of opportunities for independent responses. Brief states of deprivation, establishing operations, were present during the verbal behavior curriculum conditions, and the participant immediately received the specified target stimulus following a correct mand response. The consequence for a correct mand in the linguistic-based curriculum was praise or prosthetic reinforcement, whereas the consequence during the verbal behavior curriculum conditions was the item or activity itself that was specified by the participant's mand. Williams and Greer (1993) implemented training once several mands and tacts were in the student's repertoire. Greer and Ross (2008) stated, "the autoclitic has several functions; it may specify, locate, quantify, qualify, negate/affirm, or indicate possession…For mands, the autoclitic functions to gain a specific reinforcer" (p. 127). The autoclitics were trained through vocal models and then added to the mands or tacts. The results of Williams and Greer's 1993 study showed that the participants acquired greater numbers of words following the training through the verbal behavior-based curriculum in comparison to the linguistic-based curriculum.

Drash et al. (1999) conducted a study that utilized mand training to develop echoic responses in three nonverbal young boys diagnosed with autism spectrum disorder. The experimenters used the participants' mand repertoires to assist in establishing their echoic responses, as opposed to focusing on further developing mand repertoires. At the start of the study (Drash et al., 1999), the participants were described as language delayed. They did not emit any functional language, and were unable to imitate consistently. Experimenters examined the effects of mand training in a variety of ways. They recorded data on the percentage of mands, the percentage of echoics, the percentage of tacts, the percentage of error responses, and the percentage of inappropriate and no responses emitted by each participant. The results of the study by Drash et al. (1999) showed that developing the mand repertoire in the nonverbal participants led to the creation of echoic repertoires in the children, which were nonexistent at the start of the study. In addition, two of the participants emitted tacts following the establishment of their mand responses.

Finkel and Williams (2001) used a multiple baseline design across behaviors to compare the effects of echoic prompts and textual prompts on the intraverbal responses of a six-year-old boy diagnosed with autism spectrum disorder. They collected data on the number of appropriate full sentence responses, the number of appropriate partial responses, and the number of incorrect responses or no responses to questions. They faded the prompts during the intervention in order to attempt to decrease the participant's level of dependence on the prompts. The results of the study (Finkel & Williams, 2001) demonstrated that both types of prompts were beneficial, but that the use of the textual prompts was more effective than the echoic prompts in increasing the intraverbal behavior of the participant.

Ross and Greer (2003) investigated the effects of utilizing a rapid, generalized motor imitation tactic and mand training procedures on the attainment of vocal speech by five children diagnosed with autism spectrum disorder. These children did not have functional vocal communication, echoics, or a generalized imitation repertoire prior to the study. In this study, the mand (echoic to mand) procedure, as in Williams and Greer's 1993 study, alone was ineffective in inducing vocal emulations with the participants during baseline. Ross and Greer (2003) induced echoic mands and independent mands through the use of a rapid motor imitation sequence interspersed with the echoic-to-mand procedure under deprivation conditions. The rapid motor imitation sequence was faded so that the participants had opportunities to imitate the teacher's vocal model and eventually to independently mand. The results of their study (Ross & Greer, 2003) found that the use of rapid imitations of modeled motor behaviors before opportunities to imitate vocal models increased mands in the participants more than the implementation of mand training alone.

Tsiouri and Greer (2003) replicated the aforementioned study by Ross and Greer (2003). Tsiouri and Greer (2003) conducted two experiments in which they examined the effectiveness of the rapid motor imitation sequence to evoke echoic and independent mands as well as echoic and independent tacts in three young children who did not have vocal verbal behavior prior to the study. In an earlier study, Williams and Greer (1993) had previously utilized echoic-to-mand and echoic-to-tact procedures along with the rapid motor imitation. The results of the experiments (Ross & Greer, 2003; Tsiouri & Greer, 2003) showed that the rapid motor sequence was successful in inducing echoic and independent mands and tacts. It also demonstrated a functional relationship between the rapid motor imitation antecedent combined with the teaching procedure for mands and tacts and the induction of speaker behavior in the participants.

In several studies researchers implemented stimulus-stimulus pairing procedures to evaluate their effects on conditioning stimuli as reinforcers. Some of these studies tested the effects of the pairing procedure on vocal behavior by pairing sounds made by an instructor or experimenter with preferred items or events. There is some evidence from these experiments that the application of an automatic reinforcement procedure can expand vocal behavior and, potentially, facilitate the expansion of echoic and mand behaviors (Miguel, Carr, & Michael, 2002; Sundberg et al., 1996; Yoon & Bennett, 2000). Yoon and Bennett (2000) conducted two such experiments to evaluate the effects of a stimulus-stimulus pairing procedure on conditioning vocal sounds as reinforcers in four preschool age children with language and communication delays. Yoon and Bennett (2000) paired the target behavior, which was a specific vocal sound, with various forms of physical interaction. The results of their experiments indicated that the participants' target vocal sounds acquired "a reinforcement function through the pairing procedure….these findings indicate that vocalizations of participants with communication delays can come under the control of stimulus-stimulus pairing procedures” (Yoon & Bennett, 2000, p. 86). The results of the Yoon and Bennett (2000) study showed an immediate, though brief, increase in the emission of the target sounds.

Chaining is another teaching procedure that has been utilized to affect vocal verbal behavior. Many behaviors can be broken down into a behavior chain or sequence of components using task analysis (Slocum & Tiger, 2011). The instructional process of teaching the sequence of steps that forms a more complex behavior or “chain” is referred to as chaining. Three main types of chaining include whole task training, forward training, and backwards training (Slocum & Tiger, 2011). Whole or total task training involves teaching the entire sequence of the chain as a single component without breaking the chain down into steps, whereas the forward chaining instructional method begins with teaching the initial or first step in the task analysis to mastery and then cumulatively adding the steps in the sequence until the individual learns the full chain. The backwards chaining procedure starts in the reverse order of forward chaining, with the individual initially learning the last behavior in the series, then the next to last step along with the last behavior, and then continuing to teach earlier components in the sequence. Instructors may adapt or adjust the starting point of teaching the chains if the learner has a step(s) in repertoire.

Tarbox et al. (2009) mentioned that, “although a significant amount of research has been done on how to establish basic echoics, little research has evaluated procedures for expanding the complexity of echoics in children with autism” (p. 901). The experimenters assessed the effectiveness of a modified chaining procedure to develop the complexity of the three participants’ echoic repertoires. Tarbox et al. (2009) used a multiple baseline design across behaviors to examine the effects of their intervention on three young children with autism.

Tarbox et al. (2009) found that the chaining procedure was successful in increasing the lengths of echoic utterances in the participants following the intervention.

Marion et al. (2003), Chavez-Brown (2005), and Speckman-Collins et al. (2007) examined the effects of auditory MTS instruction on verbal operants. Marion et al. (2003) stated that “before attempting to teach such verbal operants to individuals with autism or developmental disabilities, it may be beneficial to teach some auditory discriminations as bridging skills” (p. 91). Marion et al. (2003) conducted a study to assess the relationship between the Assessment of Basic Learning Abilities (ABLA) test, auditory matching tasks, and verbal operants in 38 individuals with developmental disabilities. The experimenters found that the discrimination skill was a more accurate predictor of the participants’ tests of verbal operants than their levels of functioning. The participants who completed the auditory matching tasks scored higher on the verbal assessments.

Chavez-Brown (2005) and Speckman-Collins et al. (2007) implemented an auditory matching protocol similar to the one described by Greer and Ross (2008). Greer and Ross (2008) stated that the “protocol has been found to be effective in evoking first instances of echoics and significantly improved pronunciation for children whose pronunciation is poor” (p. 91). Speckman-Collins et al. (2007) examined the effects of an auditory matching procedure on the listener component of Naming, the speaker component of Naming, and on full echoics in preschool students with disabilities. Prior to the Speckman-Collins et al. study in 2007, Chavez-Brown (2005) utilized an auditory matching procedure to test its effects on verbal behavior and focused on echoic responses of preschool-age children. As the participants progressed through the procedure, the auditory matching tasks became increasingly more complex. Following the experimenter’s presentation of each antecedent, which included the adult pressing the sample button and two comparison buttons, the participant was required to push the comparison button that matched the sample button. The procedure consisted of different phases: sound vs. no sound, sound vs. white noise, sound vs. sound, non-word vs. word, word vs. word, and novel word vs. novel word. The results of the study (Chavez-Brown, 2005) demonstrated that the participants' acquisition of the repertoire of auditory matching resulted in increased numbers of emitted full and partial echoics for the participants.

In addition to the body of research on the importance of verbal operants, with particular attention to echoics, research has also focused on improving the accuracy and complexity of echoic responses (Chavez-Brown, 2005; Daly, 1987; Drash et. al, 1999; Finkel & Williams, 2001; Marion et al., 2003; Speckman-Collins, et al., 2007; Sundberg et al., 1996; Tarbox et al., 2009; Williams & Greer, 1993; Yoon & Bennett, 2000). There is a significant amount of research on Naming and the induction of Naming (Fiorile & Greer, 2007; Gilic, 2005; Greer, Stolfi, Chavez-Brown, & Rivera-Valdes, 2005; Greer, Stolfi, & Pistoljevic, 2007; Horne & Lowe, 1996; Horne & Lowe, 1997). Speckman-Collins et al. (2007) utilized an auditory matching protocol to examine its effects on the listener component of Naming, and on echoics and tacts.

Sidman's Theory of Verbal Behavior and Stimulus Equivalence

The phenomenon of stimulus equivalence occurs when there are relations among stimuli: Different stimuli can produce the same or equivalent matching responses. In a series of studies, Sidman and colleagues (Sidman, 1971; Sidman & Cresson, 1973; Sidman & Tailby, 1982) utilized matching programs to teach discriminations to students with disabilities. They utilized an apparatus to deliver the auditory or visual antecedents (a variety of three-letter words) to the students, and the students were to select the appropriate corresponding stimuli. Students learned specific discriminations, and untaught discriminations were evident after the matching procedure. The researcher found that, in addition to the directly taught match responses, the matching procedure resulted in additional learning outcomes (Sidman, 1971). The results showed that new, untaught behaviors or relations emerged following the exposure to the match-to-sample procedures (Sidman, 1971; Sidman & Cresson, 1973; Sidman & Tailby, 1982). Sidman referred to these newly acquired responses as equivalence relations (Horne & Lowe, 1996). The dictated words, pictures that represented the words, and the printed words became equivalent stimuli for the students, demonstrating the emergence of the untaught relations (Sidman, 1971; Sidman & Cresson, 1973; Sidman & Tailby, 1982). Additionally, Sidman (1994) and Sidman and Tailby (1982) suggested that stimulus equivalence was the source of symbolic behavior. Sidman and Tailby (1982) suggested that stimuli are members of an equivalent class if conditional discrimination performance demonstrates three defining criteria: reflexivity, symmetry, and transitivity. Barnes-Holmes (1994) suggested that Sidman's perspective viewed stimulus equivalence as the most crucial relation, whereas Relational Frame Theory viewed stimulus equivalence as one relation among many.

Horne and Lowe's Theory of Naming

Horne and Lowe (1996) published a conceptual paper on their theory of Naming and discussed what they viewed as the experiences that led to the development of Naming in individuals. The acquisition of the developmental milestone of Naming enabled children to incidentally learn language (Horne & Lowe, 1996). The authors considered Naming to be an example of an emergent relation and identified it as a basic behavioral unit of verbal behavior (Horne & Lowe, 1996; Horne & Lowe, 1997). Horne and Lowe's (1996) theory addressed the role of the echoic within their theory of Naming and stated that the echoic is a crucial component in Naming. During early interactions between children and caregivers, Horne and Lowe (1996) noted that caregivers talk or point to objects in the children's environment. The children often echo the caregivers' response form and then the caregiver delivers reinforcement for the behavior, often in the form of praise. Following repeated experiences of emitting the echoic for a particular stimulus a child may then acquire the tact for the stimulus. At that point, the child can see the stimulus as well as emit the listener and speaker responses. Through their listener behavior and their echoic behavior, children learn the bidirectional relationship between stimuli and their listener/speaker behavior (Horne & Lowe, 1996). In summary, Horne and Lowe (1996) suggested that Naming develops through incidental reinforcement and that the caregiver's words/sounds function as conditioned stimuli.

Relational Frame Theory of Naming

Relational Frame Theory is a behavior analytic account of human language as well as stimulus equivalence (Barnes-Holmes, 2004). Relational Frame theorists view Naming as a frame of coordination or relational response (Hayes, Barnes-Holmes, & Roche, 2001). In the case of Naming, the stimuli may include the tact (for example "table") as well as the included cues. From this theoretical perspective, individuals acquire relational responding to words and their referents in a frame when the cues are present and have a history resulting in reinforcement following the emission of the appropriate symmetrical response. Relational Frame theorists, as outlined by Barnes-Holmes and Barnes-Holmes (2000), stated that this relational responding develops through histories of multiple exemplar training. The authors (Barnes-Holmes & Barnes-Holmes, 2000) described an example of derived Naming and stated that Naming was an early, critical relational frame. Once an individual comes into contact with multiple exemplar training, Naming comes under the control of specific cues. Relational Frame Theory views stimulus equivalence as one example of a type derived relation that develops from a history of relational responding (Barnes, 1994).

Verbal Behavior Development Theory

Research in verbal behavior and the verbal behavior development theory has drawn from aspects of Skinner's (1957) theory, Relational Frame Theory (Barnes-Holmes et al., 2004), as well as Horne and Lowe's (1995) theories and research. Greer and Speckman (2009) and Greer and Ross (2008) provided a theory of verbal behavior development and outline levels of verbal behavior. The Verbal Behavior Development Theory identifies milestones that are necessary for children's developmental progression (Greer & Keohane, 2005). These significant building blocks are ordered into a hierarchy of functional verbal developmental cusps. Greer and Speckman (2009) noted that this sequence involves the acquisition of developmental behavioral cusps and capabilities. The types of behavior developmental changes known as cusps are unique in that they allow an individual to come into contact with new environmental contingencies, which he/she was unable to contact before the acquisition of the cusp (Rosalez-Ruiz & Baer, 1997). Capabilities are a specific subset within developmental cusps (Greer & Speckman, 2009); the attainment of these milestones enables one to "be taught new relations, to learn multiple responses and multiple stimulus control from a single experience, to learn at a faster pace and to learn in ways they could not prior to the attainment of verbal developmental capabilities" (Greer & Speckman, 2009, p.1-2). After attaining a cusp, an individual's rate of learning increases, she can learn things that she could not learn before, and she can come into contact with different environmental contingencies (Greer & Speckman, 2009; Rosalez-Ruiz & Baer, 1997). Verbal developmental capabilities are cusps that, in addition to enabling the individual to enter into contact with new contingencies, also allow him/her to learn in new ways (Greer & Speckman, 2009). Some individuals acquire cusps and capabilities incidentally, whereas, the cusps can be induced through developmental interventions if they are absent from others' repertoires. Examples of higher order capabilities include: generalized imitation, observational learning, and Naming.

Naming as a Capability

One verbal developmental capability is Naming, which is a critical cusp in an individual's verbal development (Greer & Longano, 2010). Relational Frame Theory, Horne and Lowe's (1996) Naming Theory, and Verbal Behavior Development Theory all support the position that Naming must be in repertoire for behavior to be truly verbal. Horne and Lowe (1996) found Naming to be a fundamental stage in verbal behavior development that children typically acquire within the first two years of life. Acquisition of this crucial capability of Naming "appears to be the source of the explosion of language development and involves the integration of the initially separate listener and speaker responses" (Greer & Longano, 2010, p. 73). This capability is considered to be one type of higher order operant and is deemed to be a critical component of verbal development (Greer & Longano, 2010). It embodies a bi-directional capability, in which the individual acquires both the speaker and listener components without requiring direct instruction (Greer & Ross, 2008). Once Naming is in one's repertoire, the listener and speaker responses come under joint stimulus control. The acquisition of one component of the relation, either the speaker or listener component, establishes both relations. With Naming in repertoire, the individual can learn verbal operants such as tact, intraverbal, and listener responses without receiving direct instruction. This capability enables one to acquire verbal operants through incidental teaching. Therefore, once Naming is in repertoire, one's language can expand exponentially through his/her ability to learn during these incidental opportunities (Greer & Ross, 2008).

Typically developing children's vocabulary expands significantly at about three years of age and this appears to occur through incidental learning opportunities (Hart & Risley, 1996). Researchers have conducted studies with children who did not have the verbal developmental capability of Naming in repertoire to investigate potential sources for or instructional histories that lead to the acquisition of Naming (Fiorile & Greer, 2007; Greer et al., 2005).

Procedures for Inducing Naming

While most children acquire the capability of Naming without interventions, some children cannot independently attain the Naming repertoire and, therefore, the capability must be induced for them (Greer & Ross, 2008). Researchers have conducted studies with children who have not yet acquired the verbal developmental capability of Naming to investigate possible procedures that would enable them to gain this critical repertoire. Procedures that have been shown to result in the induction of Naming include: multiple exemplar instruction across listener and speaker responding (Fiorile & Greer, 2007; Gilic & Greer, 2011; Greer et al., 2005), intensive tact instruction (Pistoljevic, 2008), conditioning voice and visual stimuli as reinforcement for observing responses (Longano, 2008), as well as auditory matching (Choi, 2012; Speckman-Collins et al., 2007).

Multiple exemplar instruction. One established procedure that has been shown to induce Naming is multiple exemplar instruction (MEI). MEI can be used to bring independent responses under joint stimulus control as well as result in the development of abstraction (Gilic & Greer, 2011). MEI is one method of instruction that has produced the emergence of untaught verbal operants (Greer, Yuan, & Gautreaux, 2005; Nuzzolo-Gomez & Greer, 2004; Perez-

Gonzalez, Garcıa-Asenjo, Williams, & Carnerero, 2007). The procedure for MEI involves rotating different responses to a single stimulus so that the learner will eventually acquire the repertoire of learning multiple responses following instruction in just one response type (Greer & Ross, 2008). Experimenters have implemented this type of instruction, MEI, across establishing operations for tacts and mands (Greer, Nirgudkar, & Park, 2003), across listener and speaker responses (Fiorile & Greer, 2007; Gilic & Greer, 2011; Greer et al., 2005), across auditory and visual components of reading responses (Greer & Ross, 2008), to establish joint stimulus control when Naming joins print control for reading and writing (Greer & Ross, 2008; Reilly-Lawson, 2008), on the emergence of untaught verbal behavior (abstraction of suffixes as autoclitics) (Speckman-Collins & Greer, 2012), on the development of autoclitic frames for spatial relations (Luke, Greer, Singer-Dudek, & Keohane, 2011), as well as MEI across written and vocal spelling responses (Greer, Yuan, & Gautreaux, 2005). MEI to induce Naming is one procedure that has been utilized to bring the listener and speaker responses under joint stimulus control (Greer & Ross, 2008).

Multiple exemplar experiences have been noted to be one possible source that leads to the emergence of Naming (Fiorile & Greer, 2007; Greer et al., 2005). Many individuals come into contact with incidental multiple exemplar experiences, while others may encounter these responses through controlled multiple exemplar instruction. Once instructors determine that an individual does not have Naming in repertoire, they may choose to implement multiple exemplar instruction to induce Naming. This type of instruction involves selecting a set of novel stimuli and then rotating the learn units, also referred to as instructional trials, across the stimuli and the four topographies: match, point, tact, and intraverbal (Greer & Ross, 2008). This process continues with one set until the child masters the responses for all topographies. This method of rotating instruction across the topographies, speaker and listener, has been shown to induce Naming.

Multiple exemplar instruction across listener and speaker responses for transformation can be used to teach a child the Naming capability. Greer and Ross (2008) noted “one type of multiple exemplar instruction involves rotating match, point, pure tact, and impure tact responses to the same set of stimuli, resulting in untaught responses to novel stimuli” (p. 150). Greer et al. (2005) and Fiorile and Greer (2007) tested the effects of multiple exemplar instruction on the acquisition of the Naming repertoire in three preschool-aged children. Greer et al. (2005) suggested that Naming “is a critical developmental milestone in the acquisition of more complex verbal repertoires by children” (p. 132). They found that the data from their study showed “the emergence of joint stimulus control across listener and speaker repertoires for children for whom this control was not present prior to multiple exemplar instruction experiences” (Greer et al., 2005, p. 132).

In another study, Fiorile and Greer (2007) implemented the tactic of multiple exemplar instruction to induce Naming in four young children with autism. The participants did not have Naming in repertoire and did not have any tact responses for 2-dimensional or 3-dimensional stimuli. Fiorile and Greer (2007) first tested whether or not the Naming capability would emerge following tact instruction. The participants did not acquire Naming after they learned the tact repertoire. Experimenters then investigated the effects of multiple exemplar instruction on the acquisition of Naming. Similar to the results of Greer et al. (2005), the results from Fiorile and Greer’s (2007) study also showed that the Naming repertoire emerged for the participants subsequent to multiple exemplar instruction across speaker and listener responses.

Greer et al. (2007) compared the effects of multiple exemplar instruction and singular exemplar instruction on the acquisition of Naming for 2-dimensional stimuli in their study with 8 participants. Four children received training through multiple exemplar instruction and four received training using singular exemplar instruction. Untaught listener and speaker responses emerged for the participants who received multiple exemplar instruction. Participants did not acquire the Naming repertoire through the singular exemplar instruction alone. The children who received singular exemplar instruction later received multiple exemplar instruction and then they acquired Naming. In addition to multiple exemplar instruction, the Intensive Tact Protocol (Greer & Ross, 2008) is another tactic that has been shown to result in the acquisition of the Naming repertoire.

Intensive tact instruction. It is not unusual for children to benefit from extensive tact instruction before they are ready to acquire the Naming capability (Greer & Ross, 2008). "The tact repertoire," they explain, "requires intensive attention because it is foundational to subsequent verbal developmental stages and complex communication functions" (p.158).

Researchers have found that some children have acquired the Naming capability as a result of this intensive tact training (Pistoljevic, 2008). During this procedure, children learn tact responses for sets of stimuli and receive an additional 100 learn units each day. Children learn the tact responses for novel stimuli, and for some young people this intervention has joined their listener and speaker repertoires. This procedure may be comparable to how typically developing children first learn to label stimuli in their environments. Greer and Du (2010) examined the effects of an additional 100 learn units per day of generic instruction versus an extra 100 learn units of intensive tact instruction on the participants' verbal behavior. They (Greer & Du, 2010) found that the intensive tact instruction resulted in greater increases in emissions of spontaneous verbal operants in non-instructional settings compared to general academic instruction, demonstrating that the increased emission of verbal operants following intensive tact instruction was related to specific features of the intensive tact procedure rather than solely to an increase in instructional units.

Researchers have examined the effects of the intensive tact procedure on the emission of verbal operants and have shown that, in addition to the tact responses taught during instruction, participants emitted several other tacts that were in repertoire following the intervention. The results appeared to demonstrate that the intensive tact procedure affected the participants' recruitment of reinforcement from others through talking (Greer & Ross, 2008).

Schauffler and Greer (2006) tested the effects of intensive tact instruction on the emission of audience-accurate tacts and conversational units by two middle school students during non-instructional time at their school. They taught each participant to emit the correct tact operants for sets of novel stimuli, teaching 100 learn units of tact responses each day until the participant met criteria on 10 sets, each of which contained five stimuli. Following the attainment of criterion, Schauffler and Greer (2006) found that the numbers of accurate tacts and conversational units increased for the two participants and that the numbers of inaccurate tacts and conversational units decreased for one participant.

Pistoljevic and Greer (2006), Delgado and Oblak (2007), and Greer and Du (2010) examined the effects of intensive tact instruction on the emission of verbal operants across predetermined non-instructional settings for three young children with autism spectrum disorder (Pistoljevic & Greer, 2006), three children diagnosed with developmental delays (Delgado & Oblak, 2007), and three preschool to elementary-aged children with autism (Greer & Du, 2010). The participants emitted low levels of pure verbal operants in non-instructional settings before the start of the study. During the intensive tact instruction instructors presented 100 learn units of tact operants, in addition to the participants' average daily learn unit instruction. The results of both studies showed a functional relationship between the intensive tact instruction and the number of verbal operants emitted by each of the participants in non-instructional settings. The numbers of pure mands and tacts increased for all participants following the implementation of the procedure.

Additionally, Pistoljevic (2008) conducted two experiments to examine the effects of various interventions on the emergence of Naming in young children diagnosed with developmental disabilities. Similar to an earlier study conducted by Greer et al. (2007), Pistoljevic's Experiment 1 compared the effects of singular and multiple exemplar instruction on Naming for 2-dimensional and 3-dimensional stimuli (Pistoljevic, 2008). Experiment 2 investigated the effects of the Intensive Tact Protocol on Naming and the numbers of mands, tacts, sequelics, and "wh" questions emitted by the participants (Pistoljevic, 2008). The results of Experiment 1 showed that implementation of multiple exemplar instruction across listener and speaker responding resulted in the acquisition of Naming and that Naming for 3-dimensional stimuli generalized to 2-dimensional stimuli (Pistoljevic, 2008). The results of her second experiment demonstrated that the use of the Intensive Tact Protocol led to increased numbers of vocal verbal operants emitted by the participants as well as the induction of Naming in the children (Pistoljevic, 2008).

Greer and Ross (2008) observed, "In some cases mastering the auditory matching protocol has resulted in the emergence of some components of Naming" (p. 93). Speckman-Collins et al. (2007) utilized the auditory matching procedure that was implemented in Chavez-Brown's (2005) study to see if it affected the acquisition of the listener component of Naming, echoic responses, or tact responses in two preschool age children. The participants were 3 and 4 years of age with developmental disabilities. They conducted probe sessions prior to the study, and the data demonstrated that the participants did not have the listener or speaker component of Naming in repertoire. Experimenters then implemented the auditory matching instructional sequence during which the participants learned to match same sounds and same words. Speckman-Collins et al. (2007) found that following the participants' acquisition of auditory matching the participants attained the listener component of Naming.

Stimulus-stimulus pairing. Experimenters have induced Naming through stimulus-stimulus pairing and echoic responses during listener instruction (Longano, 2008). The stimulus-stimulus pairing enables the echoic to become a conditioned reinforcer if it was not already conditioned. Longano (2008) conducted research in which the child observed the stimuli and heard the tact responses for the stimuli during the implementation of the stimulus-stimulus pairing procedure. The procedure involving echoic responses during listener instruction required the child to echo the tact as he/she pointed to a stimulus or matched the stimuli.

Sources of Reinforcement for Naming

The capability of Naming is a result of a history of acquired conditioned reinforcement (Greer & Du, 2015; Greer & Longano, 2010; Greer & Longano, 2015). There have been several proposed sources for the reinforcement involved in the development of Naming. Greer and Longano (2010) noted that some of these potential sources for Naming might relate to the individuals' instructional histories, their experiences, and stimulus control. Some suggest the initial reinforcement is from the echoic, a history of differential reinforcement through multiple exemplar experiences, derived relations, stimulus-stimulus pairing (Pavlovian second-order conditioning) experiences, or potential conditioned reinforcement for the stimuli themselves

(Greer & Longano, 2010). Longano and Greer (2015) also noted the possibility of a history of social reinforcement for echoics as the source of Naming. Longano and Greer (2015) suggested that auditory and visual stimuli must function as reinforcers as well as “reinforce the separate observing responses simultaneously in order for echoic behavior to join listener and speaker repertoires and induce naming” (p. 100). Proponents of several theories have examined the significance of observing responses, listener responses, and the sources for emergent behavior (Greer & Speckman, 2009).

Fiorile and Greer (2007) acknowledged, “the Naming repertoire or capability constitutes a critical means for acquiring new tacts, mands and other verbal operants as well as listener responses without direct instruction” (p. 72). Typically developing children who acquire the Naming capability are then able to exponentially increase their learning capacity (Greer & Ross, 2008). Once a child has this higher-order operant in repertoire, he/she can come into contact with a response in one form and it will then emerge in another response form (Catania, 2007). Some children cannot independently attain the Naming repertoire, and, therefore, instructors may implement known procedures to induce the capability for these young people.

Curiosity

The concept of curiosity is an old and enigmatic paradigm within the study of human motivation (Silvia, 2012). Early conceptualizations of “curiosity” were generally philosophical and literary in nature and primarily non-scientific in their applications to human language (Voss & Keller, 1983). Curiosity was often associated with negative implications such as greed for new information, superficial knowledge, and pathological behavior. Individuals who were labeled “curious” were thought to be excessively proud and their interests were often identified as “illicit, dispute engendering, unknowable, or useless” (Harrison, 2001, p. 265). Voss and

Keller (1983) added that although the scientific definition and uses of the word curiosity had evolved to encompass more neutral connotations, societal members continued to associate negative features with this descriptive term for many years.

However, gradually, curiosity garnered more substantive scientific interest and the "want" to know, or curiosity, became associated with studies of learning (Deci & Ryan, 1993; Gruber, Gelman, & Ranganath, 2014; Kang et al., 2009; Reio Jr., Petrosko, Wiswell, & Thongsukmag, 2006), novel discoveries (Simon, 2001), job performance (Kashdan, Afram, Brown, Birnbeck, & Drvosvhanov, 2011; Reio & Callahan, 2004), advertising (Menon & Soman, 2002), interpersonal relationships (Kashdan & Roberts, 2004), social benefits (Kashdan et al., 2009), autonomy, self-acceptance (Deci & Ryan, 2000; Ryff, 1989), and increased happiness and enrichment in life (Hsee, Ruan, & Lu, 2015; Kashdan & Silvia, 2009).

Spielberger and Starr (1994) noted that in 1890 William James introduced curiosity into the psychological literature and that James regarded curiosity to be one of the primary instincts. James was influenced by Darwin's (1965) perspectives on evolution, which led him to suggest an instinct theory of curiosity, noting that one's attraction to novel stimuli demonstrated a form of adaptation in which new stimuli could facilitate survival, while one's fear of novel stimuli could also be considered adaptive since it offered a protective value in situations in which those stimuli might be dangerous or unsafe (Spielberger & Starr, 1994).

Psychologists focused only minimally on studies of exploratory behavior prior to the second half of the twentieth century (Kelley et al., 1989). Those with a behaviorist bent then began to investigate a range of behaviors they grouped under the rubric of curiosity or exploratory behavior (Loewenstein, 1994). As cited in Loewenstein (1994), during the first part of the twentieth century, Experimental Psychology's references to exploratory behavior were found in the work of Pavlov (1927) and McDougall (1908; 1918), primarily focusing on instinctive or investigative reflexes. McDougall (1908) proposed that instincts were motivators for behavior. Pavlov (1918) proposed that the behaviors associated with curiosity and fear were elicited by the same stimuli, and that the two behaviors evolved to motivate exploration and reduce the risks of exploration, respectively (as cited in Loewenstein, 1994). In his studies on conditioned responses, Pavlov (1927) found that canines turned in the direction of odd or unusual novel visual or auditory stimuli, which he attributed to an investigatory reflex (as cited in Loewenstein, 1994). Pavlov (1927) described what he coined the "what is it?" reflex and specified that this reflex in humans was an example of the highest form of inquisitiveness (as cited in Kelley, Cador, & Stinus, 1989). In 1928, Bühler, Hetzer, and Mabel observed similar phenomena in babies and saw them as examples of curiosity (as cited in Loewenstein, 1994). These early twentieth century orienting reflex observations by Pavlov (1927) and Bühler et al. (1928) appear to have more commonalities with the more modern or current terminology of attention than the early, pre-modern definition of curiosity (as cited in Loewenstein, 1994).

The mid-twentieth century was marked by two significant events, which impacted the study of exploratory behavior (Pisula, 2009). Specifically, the study of exploratory behavior was propelled forward by the work of Berlyne in 1963 and Fowler in 1965 (as cited in Pisula, 2009). As of the year of their writing, Kidd and Hayden (2015) wrote that "curiosity – and the desire for information more broadly – has attracted the interest of the biggest names in the history of psychology (e.g., James, 1913; Pavlov, 1927; Skinner, 1938)" (p. 449), yet it was only in more recent years of the 21st century that there has been more extensive research in neuroscience and psychology directed at studying curiosity and the mechanisms that underlie its expression. Loewenstein (1994) stated that in the 1950s Berlyne observed that the definition and model of curiosity had disintegrated, which prompted Berlyne and others to develop more organized categorizations of various types of curiosity.

Although researchers have demonstrated interest in the study of curiosity since the emergence of the field of psychology, Kashdan et al. (2009) emphasized that the study “has been plagued by inconsistent terminology, operational definitions, and measurement strategies” (p. 2). Kidd and Hayden (2015) commented that the field lacks a reliable and widely agreed-upon operational definition for curiosity. Grossnickle (2016) noted that the concept of curiosity has been used interchangeably with many terms by scholars and in informal conversations, which has limited research. Some of the terms used synonymously with curiosity in scholarly work as well as in everyday language include: interest (Bowler, 2010; Kashdan, 2004; Silvia, 2006), need for cognition (Mussel, 2010), intellectual engagement (Mussel, 2010), openness to experience (Mussel, Winter, Gelleri, & Schuler, 2011), sensation seeking (Byman, 2005), wonder (Schmitt & Lahroodi, 2008), novelty preference (Greene, 1964), exploration, exploratory preference, intrinsic motivation, information seeking, preference for complexity, preference for unknown, preference for uncertainty, need to resolve uncertainty (Kagan, 1972), and desire for knowledge (Loewenstein, 1994). It has also been described as a prerequisite for motivation (Byman, 2005). Through attempts to quantify and explain the phenomenon, individuals have attempted to measure curiosity with dozens of different instruments, which has further obscured the meaning of curiosity (Byman, 2005). Often in colloquial language one may hear people describe curiosity as an interest in novelty, a visual awareness of one’s environment, a desire to know, and a desire to ask questions.

Silvia (2012) noted that there are many different models of curiosity that have been proposed by researchers and most of the “major schools of thought in motivation science have had something to say about what curiosity is, how it works, and what it does" (p. 157). Some of these theories include models of curiosity as an instinct (James, 1890; McDougall, 1908; Pavlov, 1927), a drive (Berlyne, 1950), a state of optimal arousal (Berlyne, 1967; Hebb, 1955; Leuba, 1955), a need (Murray, 1938), and a reduction/induction theory (Litman & Jimerson, 2004).

Functions of curiosity. A common theory about the function of curiosity is that it serves to motivate or enhance learning. Some early researchers hypothesized that novelty was the primary stimulus feature of relevance for infants (Sokolov, 1963). A young infant's visual gaze tends to direct toward areas of high contrast, which functions to help the infant detect objects and perceive their shapes (Salapatek & Kesson, 1966) as well as to perceive the onset of motion (Aslin & Shea, 1990). These processes guide organisms toward novel information and the ultimately toward knowledge acquisition (Kidd & Hayden, 2015). Curiosity has been connected to a variety of factors such as those that promote spatial learning in rodents (O'Keefe & Nadel; 1978), education (Day, 1971; Engel, 2011, 2015; Gray 2013), as well as infant/child attention and learning (Berlyne, 1978; Dember & Earl, 1957; Kinney & Kagan, 1976; Sokolov, 1963). Haith (1980) argued that the organizing principles for visual behavior are fundamentally based on stimulus-drive. Information has value to any organism that has the capability to make use of that knowledge (Kidd & Hayden, 2015). The benefits of the information may be immediate or may be useful at some point in the future; therefore, delayed benefits appear to require a learning system (Kidd & Hayden, 2015). The most common theory on the function of curiosity is to motivate learning (Kidd & Hayden, 2015).

Drive reduction-based theories. The explanatory fiction of instinct was replaced by drive theories (Kelley et al., 1989). Psychologists such as Richter (1922), Hull (1943), and Dollard and Miller (1950) wrote about drive theory in relation to animal behavior. Hull's theory suggested that organisms experience a state of drive and behaviors that reduce that drive are reinforced (as cited in Silvia, 2012). The early to mid-twentieth century saw the development of drive-based theories to explain the origins of curiosity. These models all embraced the concept that drive is inherent in curiosity, which produced an unpleasant state of arousal (Loewenstein, 1994). Proponents of curiosity-drive theory believed that curiosity was connected to unpleasant or aversive experiences of uncertainty and exploratory behavior was instigated by the curiosity drive. Thus, exploratory or information-seeking behavior is reinforced by the reduction of uncertainty (Litman, 2005). According to this model, unusual, novel, or ambiguous stimuli, for example, can disrupt one's expected level of coherence and lead to the development of an individual's need to obtain new information about the stimuli. Supporting this model, the results of Berlyne's (1950, 1955) research showed that the presentation of novel visual stimuli elicited human and non-human animals to approach these stimuli as well as to sustain their attention (as cited in Litman, 200w5). After attending to the stimuli for a period of time, Berlyne (1950, 1955) observed that the animals ended their investigations of the stimuli, which led him to believe that the uncertainty was resolved (as cited in Litman, 2005). Litman (2005) also cited studies on memory and curiosity that appear to support the curiosity-drive theory. The results of these studies showed participants more consistently recalled the answers to questions deemed to be more puzzling and that correct responses were learned in relation to the degree of this curiosity (uncertainty) reduction (Berlyne, 1954). Drive theories attempted to explain the motivation for seeking and learning new information as a reduction of an uncomfortable state of uncertainty, but researchers (Brown, 1953; Butler, 1957; Harlow, 1953; Hebb, 1958) found that there were examples of human and non-human animals demonstrating information seeking or exploratory behavior in the absence of novel or unusual stimuli (as cited in Litman, 2007). These results and observations of animals' exploratory responses before the presentation of the ambiguous or novel stimuli differed from drive reduction theories and suggested the presence of an alternate way to account for curiosity behavior.

Arousal models. During the 1950s, an alternate framework for curiosity arose in an attempt to explain exploratory motivations. These models shared some features with drive reduction theory but instead of focusing on the reduction of uncertainty as motivation, they focused on maintaining an optimal level of stimulation. Arousal models, as they were named, focused on the relationship between sensory intake and arousal, citing the need to maintain an optimal level of arousal. Although this concept was considered and outlined by many individuals, one of the most notable presentations was from Hebb (1955), and later reprinted by Fowler (1965) among a collection of articles on exploration. Hebb (1955) analyzed motivational processes and outlined two main components of a sensory experience: arousal and cue functions. Hebb (1955) suggested that there might be a curvilinear relationship between arousal and exploratory behavior, such that when arousal levels fall below the optimal level, stimulation seeking behavior increases to raise arousal to a more optimal level and conversely, when the arousal level is too high, information seeking behavior decreases in order to lower the arousal level. Therefore, within this theoretical model, organisms are motivated to maintain their comfortable or optimal levels of stimulation. The consequence (reinforcement or punishment) for an organism's specific response can vary depending on the context of the occurrence in order to maintain the ideal level of arousal (Pisula, 2009).

Berlyne (1960) suggested a revision of drive theory as his initial model of curiosity. While he maintained that there is a preference for low levels of stimulation, he proposed that an organism's level of arousal within an environment had a non-linear relationship to variables such as novelty, uncertainty, complexity, and conflict of stimuli (Silvia, 2012). Berlyne (1960) outlined a U-shaped relationship between novelty and arousal (as cited in Silvia, 2012). Optimal arousal theories maintain that curiosity induction is rewarding, and incorporates feelings of interest as opposed to feelings of uncertainty (Litman, 2005).

Knowledge gap. More recently, Loewenstein (1994) expanded Berlyne's concept of epistemic curiosity by defining conditions under which curiosity occurs (Pluck et al., 2011). An important factor in human curiosity is the urge to close the information gap when one becomes aware that he/she has inadequate information about a given subject (Pisula, 2009). This is a key factor driving curiosity (Pisula, 2009). Loewenstein (1994) followed this line of thinking when proposing a knowledge or information gap theory of curiosity, describing curiosity as a state of deprivation that develops from a perception of a gap between one's knowledge and understanding. He suggested that this gap of information produces an aversive feeling of deprivation, or curiosity, and an individual's motivation to reduce this feeling causes him/her to try to obtain the missing information (Silvia, 2012). A small amount of knowledge serves as a priming dose that increases the organism's level of curiosity (Kidd & Hayden, 2015). The acquisition of the information is initially experienced as rewarding but when the organism acquires sufficient knowledge, then the state of curiosity is reduced through the satiation of information (Kidd & Hayden, 2015). Kang et al. (2009) supported the knowledge gap theory when they found people to show less curiosity about answers to trivia questions when they either had no idea about an answer to the questions or when they were strongly confident in their knowledge. The individuals who were shown to be most curious were those who had some sort of idea for the answers, but lacked confidence in their responses. Kang et al. (2009) also found that curiosity enhances the acquisition of new knowledge.

Intrinsic motivation. Another contemporary model views curiosity as a type of information-seeking that is distinguished from other forms by being internally motivated (Loewenstein, 1994; Oudeyer & Kaplan, 2007). Proponents of this perspective viewed curiosity solely as a reflection of an intrinsic drive, whereas information-seeking theorists allowed for a drive that could be either of intrinsic or extrinsic origins (Kidd & Hayden; 2015).

Exclusionary Learning

Dixon (1977) used the term exclusion to "refer to the responding away from or excluding the stimulus choice trained in the presence of one spoken word to select the untrained stimulus choice in the presence of an untrained spoken word" (p. 434). In the field of behavior analysis, the term emergent matching or exclusion is utilized to refer to this type of learning, whereas those in the field of psycholinguistics refer to this as relation linguistic inference, the disambiguation effect, or fast mapping (Kastak & Schusterman, 2002). Researchers have conducted studies on exclusion performances and learning with typically developing individuals (McIlvane, Kledaras, Munson, King, de Rose, & Stoddard, 1988), individuals with disabilities (Dixon, 1977; McIlvane, Bass, O'Brien, Gerovac & Stoddard, 1984; McIlvane & Stoddard, 1981), and non-human animals (Kastak & Schusterman, 1994; Tomonaga, 1993).

Dixon (1977) first taught young adults with developmental disabilities to select a target stimulus, the trained choice, when presented with two different visual stimuli and the vocal antecedent naming the target stimulus (spoken word for the stimulus). After participants had met criteria for the training, Dixon conducted exclusion probes. During these probes, the young adults were presented with a trained visual stimulus and an untrained visual stimulus along with the spoken word for the novel stimulus. Dixon (1977) found that participants, after hearing the unfamiliar word, excluded the known visual stimulus and selected the previously negative exemplar. The results showed that through the relational training participants learned the correct responses as well as the incorrect responses.

Ferrari, de Rose, and McIlvane (1993) examined the effectiveness of selection training with learning through exclusion in children who were typically developing but had histories of school failure. Ferrari et al. (1993) found that the children learned at a faster rate and demonstrated more consistent learning of novel conditional discriminations and new naming relations of the visual stimuli following the exclusion conditions. Ferrari et al. (1993) noted that the exclusionary learning minimized incorrect responses and was more effective than the selection training for generating auditory-visual matching in addition to the naming of the visual stimuli.

Kastak and Schusterman (2002) noted:

> One way of determining if a learning outcome has resulted from exposure to one or more exclusion trials is to present the new discrimination in the presence of novel items rather than familiar ones. If the conditional discrimination is maintained when responding by exclusion is prevented, then a learning outcome has been achieved (p. 451).

Kastak and Schusterman (2002) concluded, above, that to test for true learning, the responses learned through exclusion must then be assessed when presented with unfamiliar items to determine if the individual has learned the response.

More recently, Greer and Du (2015) investigated Naming by exclusion in preschool-aged children. They (Greer & Du, 2015) found that out of 39 children with Naming, just five demonstrated Naming by exclusion: learning word-object relations from hearing the vocal name for an unknown stimulus presented within an array of known stimuli. Greer and Du (2015) selected 16 children with Naming but who were missing Naming by exclusion and randomly assigned matched pairs to either the experimental group or the control group. The participants within the experimental group received an intervention of exclusion multiple exemplar training in addition to their regular school curriculum. Following intervention, the participants in the experimental group demonstrated Naming by exclusion, whereas one of the eight in the control group showed this skill. Greer and Du (2015) proposed that Naming by exclusion meets the criterion for a behavioral developmental cusp and also discussed the significance and implications for education.

Curiosity in Education

Kidd and Hayden (2015) stated that curiosity functioned to motivate learning and acquisition of knowledge. They noted that curiosity is likely an evolved characteristic, which offered the benefit of increased evolutionary fitness to organisms that demonstrated curiosity (Kidd & Hayden, 2015). Therefore, they found that curiosity reflected internal and external features of one's knowledge and appeared to be a crucial factor in learning (Kidd & Hayden, 2015). “Simple manipulations of stimulus novelty, complexity, and variety suffice to arouse curiosity” (Pisula, 2009, p. 133). The result of satisfying one's own curiosity is a powerful reward in itself (Pisula, 2009). It would therefore seem that our knowledge about sensory reinforcement, curiosity, and exploration is a sufficient basis for developing a friendly and stimulating educational environment. Results from research (Kempermann, Gast, & Gage, 2002; Kobayashi, Ohashi, & Ando, 2002; Rosenzweig & Bennett, 1996; as cited in Pisula, 2009) have suggested that novel stimuli stimulate the brain in ways that induce beneficial effects. For example, solving puzzles, intellectual problems and other cognitive challenges associated with new stimuli, helps keep our brains fit (Pisula, 2009). Along this line of thinking, Kashdan, Rose, and Fincham (2004) summarized that "curiosity prompts proactive, intentional behaviors in response to stimuli and activity with the following properties: novelty, complexity, uncertainty, and conflict" (p. 291).

Properties of Visual Stimuli

There are variables that affect one's attention to stimuli. Berlyne (1954, 1979) labeled these variables "collative qualities." Cupchik and Berlyne (1979) used the term collative variables or collative qualities "to describe the effects of comparisons among elements which are presented either simultaneously or in succession" (p. 94). They noted that these properties could be examined on "subjective dimensions such as novel-familiar, simple-complex, and ambiguous-clear" (p.94) and these dimensions could impact variables such as the levels of stimuli novelty and surprise (Cupchik & Berylne, 1979). These properties depended on comparison elements from current and past stimulus fields or vary based on aspects of an individual's present stimulus field (Berylne, 1954). These qualities included stimuli patterns, complexity, novelty, and incongruity (Berlyne, 1954). As cited in Gottlieb, Oudeyer, Lopes, and Baranes (2013), some (Boehnke, Berg, et al., 2011) have described the concept of surprise as a form of contextual novelty that may explain "attentional attraction toward salient events" (p. 7). McCay-Peet, Lalmas, and Navalpakkam (2012) examined the impact of visual saliency on use engagement. McCay-Peet et al. (2012) noted that results of research in both neuroscience and cognitive psychology have demonstrated that when individuals are presented with cluttered screens or displays their attention selects out the more salient stimuli or objects, which appear visually different from the comparison stimuli of the array.

Rationale

Recent research (Cahill & Greer, 2014; Greer & Du, 2015) has examined differences in the demonstration of Naming across different senses and dimensions of stimuli. Greer and Du

(2015) conducted research on Naming by exclusion and suggested there may be additional types of Naming cusps. As of the date of this study, there has been no published research on the performance of adults on Naming experience and Naming assessment procedures. There is also a scarcity in published literature of Naming studies with groups that contained participants who were all diagnosed or classified as children with disabilities. In the three experiments reported herein, I sought to further the research into Naming by directly comparing two different Naming experiences as well as the impact of varying levels of familiarity in visual stimuli on the demonstration of Naming. Additionally, I investigated possible correlations between the Naming capability and question asking behavior as a measure of curiosity. The present studies were designed to investigate the following research questions: if individuals demonstrate the Naming capability with match-to-sample (MTS) Naming experiences, will the capability also be present following exclusionary Naming experiences? Will the topographies be balanced across different Naming experiences? Will the Naming components demonstrate their independence similarly across the two Naming experiences? Does the Naming capability relate to an individual's curiosity behavior in the presence of novel visual stimuli? Do properties of visual stimuli, such as familiarity, affect the demonstration of Naming? In the outlined experiments I focused on the levels of acquisition of untaught listener and speaker responses following two different Naming experiences and across varying degrees of collative variables in visual stimuli.

CHAPTER II

EXPERIMENT 1

The purpose of the first experiment, a descriptive study, reported herein was to compare two groups, the first group comprised of children with disabilities and the second comprised of adults without disabilities. I sought to assess typically developing adults using the same Naming experience and assessment methods as the youth to evaluate whether the adults could successfully complete the Naming probe measures. If typically developing adults could not achieve criterion levels on the measures, then it would be unlikely that young children with disabilities would demonstrate criterion levels on the identical assessment. I conducted two types of assessment procedures to assess for the presence or absence of the Naming capability following two different Naming experience conditions. For the first procedure, I provided match-to-sample (MTS) instruction as the Naming experience prior to the assessment for the acquisition of the untaught forms. The second procedure involved an exclusionary instructional procedure as the Naming experience prior to the assessment for the untaught forms. I sought to determine if the results would vary across age and disability as well as to determine if the type of teaching condition (Naming experience) affected the results of the tests for presence/absence of Naming.

Method

Adult Participants

The adult participants for this study were 14 adults (adults were considered to be over the age of 18), who were persons without disabilities. They were familiar to the experimenter, but were naïve to the experiment, the procedure for the Naming probes, and the term Naming. The experimenter recruited the adult participants, and they resided in one of three major United States metropolitan cities (New York City, San Francisco, and the Washington, District of Columbia Metropolitan areas).

All 14 (100%) of the adult participants completed high school. Twelve of the fourteen (85.7%) completed both high school and undergraduate education, and nine (64.3%) of the adult participants additionally completed a form of graduate education. The adult participants ranged in age from 26 to 70 years with a mean age of 47.6 and a median of 43.0. There were seven female adult participants and seven male adult participants. Table 1 contains a description of each adult participant's age and sex.

Table 1

Adult Participants' Ages and Sex

	Adult Participants													
Variable	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Age	26	32	64	38	39	52	50	42	41	70	68	62	44	39
Sex	f	m	f	m	f	m	f	m	f	m	m	f	f	m

Note: m = male and f = female.

Youth Participants

There were 17 youth participants in this study. The youth participants were between 5 and 10 years of age with a mean age of 7.6 years and a median of 8.0. There were 2 (11.8% of the youth) female and 15 (88.2% of the youth) male participants. The experimenter selected these participants from self-contained special education classrooms within public elementary schools outside of a major metropolitan city. The staff within the classroom implemented the

Comprehensive Application of Behavior Analysis to Schooling® (CABAS) model. This meant that these participants were accustomed to data collection procedures, reinforcement schedules, probe sessions, and learn unit instruction. Additionally, the experimenter did not need to habituate herself to the children since they were familiar with the experimenter from the school setting. The experimenter selected the participants to determine whether or not they had Naming in repertoire based on the Type 1 Naming probes and/or the Type 2 Naming probes. All youth participants were educationally classified as students with disabilities. Refer to Table 2 for additional details on the youth participants.

Table 2

Youth Participants' Demographics and Descriptions

Participant	Sex	Age	Classification	Level of VB	Test	Test Scores
Y1	m	7	SLI	L/S with some R/W skills	SB5	FSIQ: 58 NVIQ: 55 VIQ: 64
Y2	m	9	ASD	L/S/R with some W skills	SB5	FSIQ: 66
Y3	f	9	ASD	L/S with some R/W skills	WISC4	FSIQ: 53 PRI: 75 PSI: 70 VCI: 50 WMI: 50
Y4	m	8	MD	L/S	SB5	FSIQ: 65
Y5	m	9	ASD	L/S with some R/W skills	SB5	FSIQ: 66
Y6	m	9	MD	L/S with some R/W skills	WISC4	FSIQ: 88 PRI: 86 PSI: 100 VCI: 81 WMI: 102

(*table continues*)

Table 2 continued

Participant	Sex	Age	Classification	Level of VB	Test	Test Scores
Y7	m	10	ASD	L/S with some R/W skills	SB5	FSIQ: 54 NVIQ: 61 VIQ: 51
Y8	m	8	ASD	L/S with some R/W skills	SB5	FSIQ: 57
Y9	m	8	ID	L/S	SB5	FSIQ: 57 NVIQ: 60 VIQ: 58
Y10	m	9	ASD	L/S with some R/W skills	SB5	FSIQ: 44 VIQ: 49 NVIQ: 44
Y11	m	8	ASD	L/S/R with some W skills in repertoire	SB5	FSIQ: 71 VIQ: 64 NVIQ: 81
Y12	m	6	OHI	L/S with some R/W skills in repertoire	WPPSI -3	FSIQ: 100 PIQ: 101 VIQ: 102
Y13	m	6	OHI	L/S/R with some W skills in repertoire	WPPSI -3	FSIQ: 79 PIQ: 82 VIQ: 81
Y14	f	5	ASD	L/S/R/W	—	—
Y15	m	6	ASD	L/S/R/W	—	—
Y16	m	7	ASD	L/S/R/W	—	—
Y17	m	6	ASD	L/S/R/W	—	—

Note: m = male, f = female, PSI = Processing Speed Index, WMI = Working Memory Index, PRI = Perceptual Reasoning Index, VCI= Verbal Comprehension Index, PIQ = Performance Intelligence Quotient, FSIQ = Full Scale Intelligence Quotient, NVIQ = Nonverbal Intelligence Quotient, VIQ = Verbal Intelligence Quotient, SB5 = Stanford-Binet Intelligence Scales - Fifth Edition, WISC4 = Wechsler Intelligence Scale for Children – IV, WPPSI-3 = Wechsler Preschool and Primary Scales of Intelligence – III, L = Listener, S = Speaker, R = Reader, W = Writer, ASD = Autism, OHI = Other Health Impairment, ID = Intellectual Disability, MD = Multiple Disabilities, SLI = Speech or Language Impairment.

Setting

Adult participants' instructional and probe sessions' setting. The experimenter conducted the MTS Naming experiences, exclusion Naming experiences, and Naming probe sessions with the adult participants in separate rooms within the participants' households. The experimenter completed the Naming experience sessions and probe sessions with the adult participant seated directly in front of a desktop computer monitor or a laptop computer. The experimenter stood or sat beside the participant during the sessions. When an independent observer was present for a session, the independent observer sat adjacent to and slightly behind the participant.

Youth participants' instructional and probe sessions' setting. The experimenter led the MTS Naming experiences, exclusion Naming experiences, and Naming probe sessions with the youth participants in an unoccupied hallway within the participants' school, in an unoccupied classroom, or within the participants' classroom with the use of a partition to block visual distractions. The experimenter conducted the Naming experience sessions and probe sessions with each youth participant seated directly in front of a desktop computer monitor. The experimenter stood or sat beside the participant during the sessions. When an independent observer was present for a session, the independent observer sat adjacent to and slightly behind the participant.

Materials

The materials utilized for the participants' MTS Naming experiences, exclusion Naming experiences, and probe sessions included: desktop computers and/or laptop computers, Microsoft PowerPoint software, prepared PowerPoint files, data collection forms, pens, and a video recorder for interobserver agreement. The visual stimuli for each set were compiled into a PowerPoint file for the Naming experience sessions and a second file for the probe sessions. The

PowerPoint files contained sets of stimuli. There were five stimuli in each set. The experimenter utilized two different visual versions, or multiple exemplars, of each stimulus to teach abstraction of visual stimulus control. For example, one could teach abstraction for a rose by rotating exemplars of a large red rose, a small red rose, an enlarged portion of a yellow rose, and a large pink rose. Set 1 was employed for the MTS Naming experiences followed by the Type 1 Naming probe sessions, and Set 2 was utilized for exclusion Naming experiences and then Type 2 (Naming by exclusion condition) Naming probe sessions. The PowerPoint presentations for the exclusion Naming experiences contained the target stimuli set as well as known visual stimuli (negative exemplars).

Adult participants' instructional and probe sessions' materials. Sets 1 and 2 each contained five stimuli with two visual versions of each stimulus (refer to Table 3 for a description of the probe stimuli for adult participants). The experimenter used pictures of unknown fish species for the stimuli in Set 1 and unknown and unfamiliar Adinkra visual symbols for Set 2.

Youth participants' instructional and probe sessions' materials. In addition to the materials used for all participants, a partition was utilized during sessions with youth in order to limit visual distractions. The experimenter used pictures of unknown fish and butterfly species for the stimuli in Set 1 and novel Adinkra visual symbols for Set 2 for the youth participants (refer to Table 4 for a description of the youth participants' probe stimuli). The stimuli for each set were compiled into a PowerPoint file for the instructional sessions and a second file for the probe sessions. Similar to the stimuli for the adult participants, the youth participants were exposed to the stimuli in Set 1 for the MTS Naming experiences followed by the Type 1 Naming probe sessions, and Set 2 for exclusion Naming experiences and then Type 2 Naming probe sessions.

Table 3

Description of Stimuli Sets for Adult Participants

Set	Type of Naming Experience Preceding Probe Session	Stimuli
Set 1 for all Participants except Participant F	MTS	Goby Discus Tetra Pleco Gramma
Set 1 for Participant F	MTS	Goby Discus Square Spot Pleco Gramma
Set 2 Positive Exemplars	Exclusion	Fofo Denkyem Sankofa Aya Eban
Set 2 Negative Exemplars	Exclusion	Pictures: stop sign, smiley face, moon, “plus” sign Numbers: 3, 6, 8, 5 Words: baby, water, shirt, eat Letters: S, Q, B, K

Table 4

Description of Stimuli Sets for Youth Participants

Set	Type of Naming Experience Preceding Probe Session	Stimuli
Set 1 for Participants Y1, Y3, Y5, Y7, Y8, Y9, Y10, Y11, Y12, Y13, Y14, Y15, Y16, Y17	MTS	Goby Discus Tetra Pleco Gramma
Set 1 for Participants Y2, Y4, and Y6	MTS	Brimstone Morpho Coolie Clipper Flambeau
Set 2 Positive Exemplars	Exclusion	Fofo Denkyem Sankofa Aya Eban
Set 2 Negative Exemplars for all Participants except Participant Y9	Exclusion	Pictures: stop sign, smiley face, moon, “plus” sign Numbers: 3, 6, 8, 5 Words: baby, water, shirt, eat Letters: S, Q, B, K
Set 2 Negative Exemplars for Participant Y9	Exclusion	Pictures: stop sign, smiley face, moon, “plus” sign Numbers: 3, 6, 8, 5 Words: yellow, little, my, down Letters: S, Q, B, K

Dependent Variables

The dependent variables were the participants’ numbers of correct responses for untaught listener (point to) responses, numbers of untaught speaker (tact and intraverbal) responses, numbers of names (word-object responses) learned in the speaker topography, and numbers of names (word – object responses) learned in the listener topography for stimuli during Type 1 and Type 2 Naming probes.

The target behaviors for the Naming probes included point-to, pure tact, and impure tact responses to sets of 2-dimensional stimuli presented on a computer monitor through Microsoft PowerPoint. For the "point to ___" response, the participant was given a vocal verbal antecedent, "point to ___," and the participant was to point to the target stimulus that was among negative exemplars (in a field of three stimuli). The pure tact response was defined as the participant stating the correct name of the stimulus following the presentation of the visual stimulus. The intraverbal response consisted of the experimenter presenting a picture and providing a vocal verbal antecedent such as, "what's this?" The experimenter did not deliver reinforcement nor provide corrections during the Naming probe trials for the untaught forms.

Independent Variables

The independent variables for this experiment were age group and Naming experience.

Data Collection

The experimenter collected data on the numbers of correct and incorrect responses to: 1) Naming probe trials for each of the three untaught response types (10 trials per topography) during the Naming probes, 2) sessions of 20-learn unit presentations for the MTS Naming experiences, and 3) sessions of 20-learn unit presentations for the exclusion Naming experiences. The experimenter recorded a plus (+) on the data sheet following a correct response and a minus (-) following an incorrect response. The experimenter recorded the correct and incorrect responses on paper and then recorded the number of correct responses per session on a graph.

Procedure

The experimenter conducted Naming probes to assess the two different types of Naming opportunities, but, first, conducted pre-experimental probes for all potential stimuli for the Type 1 Naming probe sessions to develop the stimuli sets and to show that the stimuli were novel to the participants at the start of the study. Novel Adinkra African symbols were utilized for the Type 2 Naming probe sessions (please refer to Tables 3 and 4 for descriptions of the test stimuli). The experimenter conducted Naming probe sessions, MTS Naming experiences, and exclusion Naming experiences through Microsoft PowerPoint slideshows on a computer.

MTS Naming experiences and probe sessions (Type 1). During the Type 1 Naming probe sessions participants first learned to observe and match the visual stimuli while hearing the tact responses. This MTS instruction functioned as each participant's Naming experience for Type 1 Naming probe sessions. The experimenter taught the visual MTS while saying the words/names of the stimuli using 20-learn unit blocks (sessions) until the participant met criterion for the match topography, which was set at two consecutive sessions at 90% or greater accuracy. Each 20-learn unit MTS session included four presentations of each of the five stimuli in the set (see Table 4 for stimuli).

The experimenter presented the target stimuli in random order and never presented the same target stimulus consecutively during MTS. The target stimulus was presented in the top, center of the computer screen. In the lower half of the screen there were three stimuli, including one positive exemplar and two negative exemplars. The experimenter randomly positioned the comparison stimuli within the lower half of the screen so that the positive exemplar was presented in different placements (left, middle, and center) across MTS. Additionally, she randomly selected the negative exemplars in each presentation so the target stimuli were matched across different set stimuli and varying visual versions of stimuli. The experimenter pointed at the target stimulus in the top of the screen and stated, "Match ____ with ____," including the tact of the stimulus (for example, "match car with car"). The participant then attempted to match the target stimulus with the positive exemplar that was in front of him/her by pointing to his/her response on the computer screen within 3 s. The experimenter delivered reinforcement in the form of vocal praise following correct responses and delivered corrections following incorrect responses during the MTS Naming experiences.

The following is an example of a participant's correct response during MTS learn unit instruction:

1) the experimenter obtains the participant's attention

2) the experimenter presents a Microsoft PowerPoint slide containing the target stimulus in the top of the screen, and two negative exemplars as well as a positive exemplar in the bottom half of the screen

3) the experimenter emits the vocal verbal antecedent, such as, "match tetra with tetra"

4) the participant responds within 3 s by pointing to the positive exemplar of the tetra fish on the bottom half of the screen and

5) the experimenter delivers vocal praise following the correct response, for example, "That's perfect!" and records the participant's response

An example of the sequence for a correction following an incorrect response to MTS learn unit instruction is:

1) the experimenter obtains the participant's attention

2) the experimenter presents the Microsoft PowerPoint slide containing the target stimulus in the top of the screen, and two negative exemplars as well as a positive exemplar in the bottom half of the screen

3) the experimenter emits the vocal verbal antecedent, such as, “match tetra with tetra”

4) the participant points to a negative exemplar, a betta fish, on the bottom half of the screen

5) the experimenter ensures the participant is attending to the visual stimuli on the screen and repeats the vocal verbal antecedent, “match tetra with tetra”

6) the experimenter points to the positive exemplar of the tetra fish on the bottom half of the screen

7) the experimenter again obtains the participant’s attention and repeats the antecedent, “match tetra with tetra”

8) the participant then points to the positive exemplar of the tetra fish

Following the attainment of criterion for the MTS experience (90% or greater accuracy across two consecutive sessions), there was a 2 hr interval of time between the Naming experience and the Type 1 Naming probe session. The experimenter conducted the participants’ probe sessions for the untaught repertoires using the test stimuli to test for the presence of the Naming capability.

The probe sessions consisted of 10 probe trials for each of the three untaught responses (point-to, tact, and intraverbal tact responses) and had no reinforcement or correction components (unconsequated probe sessions). The three topographies were blocked. There were 10 trials for each response topography, with two opportunities for each of the five stimuli. There was one opportunity for each visual version of a stimulus. The experimenter randomly presented the stimuli during the 10 trials for each response topography and never presented the same stimulus consecutively (for example: tetra visual version 1, goby visual version 1, pleco visual version 1, discus visual version 1, gramma visual version 1, goby visual version 2, discus visual version 2, tetra visual version 2, gramma visual version 2, and pleco visual version 2). The experimenter first conducted 10 probe trials for the point response topography in a field of three stimuli. Then she conducted 10 probe trials for the pure tact topography, and, lastly, delivered 10 opportunities for the impure tact (intraverbal) topography. The participant needed to emit 80% - 100% (8-10 out of 10 responses for each response form) correct responses across all three untaught responses for the set of stimuli in order to demonstrate Naming for the set of stimuli.

Exclusion Naming experiences and probe sessions (Type 2). Once a participant completed the Type 1 Naming probe, the experimenter conducted a Type 2 Naming probe. The experimenter conducted Type 2 Naming probes either on the same day following the completion of the Type 1 Naming probes or 1-7 days later; the timeframe was dependent upon the adult participants' availabilities. For the Type 2 Naming probe sessions, the experimenter first taught the participant to point to each stimulus through an exclusionary instructional procedure while she stated the words/names of the stimuli (see Tables 3 and 4 for stimuli).

The participants viewed arrays of stimuli displayed on a computer monitor, in which all stimuli on each PowerPoint slide were known except one stimulus. The experimenter requested the unknown stimulus by name nested among the known stimuli, and this served as the Naming opportunity for the participant. Each 20-learn unit session included four presentations (two for each visual version) of each of the five target stimuli in the set. The experimenter taught each participant the correct responses using learn unit instruction until the participant met criterion, which was set at two consecutive sessions at 90% or greater accuracy.

Each visual antecedent on a PowerPoint slide contained a target stimulus (a novel African Adinkra symbol) and four common stimuli (negative exemplars) presented on a computer monitor. The experimenter presented the target stimuli in random order and never presented the same target stimulus consecutively during the exclusion Naming experiences. The experimenter randomly positioned the target stimuli and negative exemplars on the PowerPoint slides. Following the presentation of a slide, the experimenter provided a vocal verbal antecedent for a selection response, such as “point to ____” or “touch ____.” The participant then attempted to select the target stimulus within 3 s through exclusion of the common, previously known stimuli by pointing or touching his/her response on the computer screen. The experimenter delivered reinforcement, in the form of vocal praise, following correct responses and corrections following incorrect responses during the exclusion Naming experiences.

The following is an example of a participant’s correct response to a learn unit during the exclusionary condition:

1) the experimenter obtains the participant’s attention

2) the experimenter presents a Microsoft PowerPoint slide containing the target unknown stimulus and four known stimuli

3) the experimenter emits the vocal verbal antecedent, such as, “touch Fofo”

4) the participant responds within 3 s by pointing to the visual stimulus for Fofo

5) the experimenter delivers vocal praise following the correct response, for example, “You’re absolutely right!” and records the participant’s response

An example of the sequence for a correction following an incorrect response to an exclusionary learn unit is:

1) the experimenter obtains the participant’s attention

2) the experimenter presents a Microsoft PowerPoint slide containing the target stimulus and four known stimuli

3) the experimenter emits the vocal verbal antecedent, such as, “Point to Fofo”

4) the participant points to a negative exemplar, the letter S

5) the experimenter ensures the participant is attending to the visual stimuli on the screen and repeats the vocal verbal antecedent, “Point to Fofo”

6) the experimenter points to the visual stimulus of the Fofo symbol on the computer monitor

7) the experimenter again confirms the participant’s attention and states, “Point to Fofo.”

8) the participant points to the visual stimulus of the Fofo

Following the attainment of criterion (90% across two consecutive sessions) for the exclusion Naming experience, similar to the Type 1 Naming probe procedure, there was a 2 hr interval of time between the last session of exclusion experience and the Type 2 Naming probe session. The experimenter then conducted probe sessions for the untaught repertoires to test for the presence of the Naming capability for test stimuli following the exclusion Naming experience. The experimenter completed Type 2 Naming probe sessions utilizing the same procedure as the Type 1 Naming probe method. The probe sessions consisted of 10 probe trials for each of the three untaught responses (point to, tact, and intraverbal tact responses) and had no reinforcement or correction components (unconsequated probe sessions). The three topographies were blocked. There were 10 trials for each response topography and two opportunities for each stimulus (one for each visual version) in the topography. The experimenter first conducted 10 probe trials for the point response topography in field of three stimuli. Then she conducted 10 probe trials for the pure tact topography, and, lastly, delivered 10 opportunities for the impure tact (intraverbal) topography. The participant needed to emit 80% - 100% (8-10 out of 10 responses for each response form) correct responses across all three untaught responses for the set of stimuli in order to demonstrate Naming for the set of stimuli.

Design

The design of this study was a 2 x 2 (Age Group [Youth, Adult] x Naming Experience [MTS, Exclusion]) factorial design with repeated measures on Naming experience conditions across two age groups. The dependent variables (numbers of listener responses, numbers of speaker responses, numbers of word-object responses in the listener topography, and numbers of word-object responses in the speaker topography) were repeatedly measured across the Naming experiences for all participants. I utilized repeated-measures analyses of variance to examine the within-subject effects across the two types of Naming experiences and the between-subject effects for age groups on the participants' numbers of responses during probe sessions for the Naming capability. This study descriptively compared two groups (adults without disabilities and youth with disabilities) and two types of Naming experiences (MTS and exclusion) on the numbers of listener and speaker responses emitted during Naming probe sessions as well as the numbers of learned word-object responses in the two topographies.

Interobserver Agreement

The experimenter and an independent observer collected data to obtain interobserver agreement (IOA) for the MTS Naming experiences, exclusion Naming experiences, and Naming probe sessions. An independent observer was either present during the sessions or an observer later collected data, based on video recordings. IOA was calculated by dividing the number of agreements by the total number of trial-by-trial (point-to-point) agreements and disagreements per probe session and multiplying by 100%.

Interobserver agreement for adult participants. The percentage of sessions with IOA, the mean IOA for the sessions, and the range of IOA are reported in Tables 5 and 6. IOA was obtained for 100% of the adult participants' Naming probe sessions with a mean agreement of 98.4% (range of 86.7 - 100%). IOA was obtained for 100% of the adult participants' Naming experience sessions with mean of 99.8% agreement (range of 97.5 - 100%).

Interobserver agreement for youth participants. The percentage of sessions with IOA, the mean IOA, and the range of IOA are reported in Tables 7 and 8. IOA was obtained for 88.9% of the youth participants' Naming probe sessions with a mean agreement of 98.9% (range of 93.3-100%). IOA was obtained for 93.1% of the youth participants' MTS and exclusion Naming experiences with a mean agreement of 99.7% (range of 97.5-100%).

Table 5

IOA for the Adult Participants' Naming Probes

Participant	% of Probe Sessions with IOA	Mean IOA	Range of IOA
A	100%	100%	—
B	100%	100%	—
C	100%	93.3%	86.7 – 100%
D	100%	96.7%	93.3 – 100%
E	100%	93.4%	90.0 – 96.7%
F	100%	96.7%	93.3 – 100%
G	100%	100%	—
H	100%	98.4%	96.7 – 100%
I	100%	100%	—
J	100%	100%	—
K	100%	100%	—
L	100%	100%	—
M	100%	100%	—
N	100%	100%	—
Across all Adult Participants	100%	98.4%	86.7 – 100%

Table 6

IOA for the Adult Participants' Naming Experiences

Participant	% Naming Experiences Sessions with IOA	Mean IOA	Range of IOA
A	100%	100%	—
B	100%	100%	—
C	100%	100%	—
D	100%	100%	—
E	100%	100%	—
F	100%	100%	—
G	100%	100%	—
H	100%	100%	—
I	100%	98.8%	97.5 – 100%
J	100%	100%	—
K	100%	100%	—
L	100%	100%	—
M	100%	98.8%	97.5 – 100%
N	100%	100%	—
Across all Adult Participants	100%	99.8%	97.5 – 100%

Table 7

IOA for the Youth Participants' Naming Probes

Participant	% of Probe Sessions with IOA	Mean IOA	Range of IOA
Y1	66.6%	98.4%	96.7 – 100%
Y2	66.6%	100%	—
Y3	100%	96.7%	—
Y4	50.0%	100%	—
Y5	100%	98.4%	96.7 – 100%
Y6	100%	98.4%	96.7 – 100%
Y7	100%	100%	—
Y8	100%	98.4%	96.7 – 100%
Y9	50%	100%	—
Y10	100%	98.4%	96.7 – 100%
Y11	100%	100%	—
Y12	100%	100%	—
Y13	100%	96.7%	93.3 – 100%
Y14	100%	98.4%	96.7 – 100%
Y15	100%	100%	—
Y16	100%	100%	—
Y17	100%	96.7%	93.3 – 100%
Across all Youth Participants	88.9%	98.9%	93.3 – 100%

Table 8

IOA for the Youth Participants' Naming Experiences

Participant	% of Naming Experience Sessions with IOA	Mean IOA	Range of IOA
Y1	66.6%	98.8%	97.5 – 100%
Y2	66.6%	100%	—
Y3	100%	98.8%	97.5 – 100%
Y4	50.0%	100%	—
Y5	100%	98.8%	97.5 – 100%
Y6	100%	100%	—
Y7	100%	100%	—
Y8	100%	100%	—
Y9	100%	99.0%	98.3 – 100%
Y10	100%	100%	—
Y11	100%	100%	—
Y12	100%	100%	—
Y13	100%	100%	—
Y14	100%	100%	—
Y15	100%	100%	—
Y16	100%	100%	—
Y17	100%	100%	—
Across all Youth Participants	93.1%	99.7%	97.5 – 100%

Results

Numbers of Correct Listener and Speaker Responses

I used 2 x 2 (Age Group [Youth, Adult] x Naming Experience [MTS, Exclusion]) repeated measures analyses of variance (ANOVA) to examine the within-subject effects across the two types of Naming experiences and between-subject effects for age groups on the participants' numbers of listener and speaker responses during probe sessions for the Naming capability (Tables 9 and 10).

There were 10 opportunities for listener responses and 10 opportunities for each of the two speaker components, tact responses and intraverbal responses. The mean of each participant's numbers of tact and intraverbal responses was the participant's number of speaker responses for a probe session. The mean numbers of listener and speaker responses for each age group and for each type of Naming experience are outlined in Table 11 and Table 12 and visually shown in Figures 1, 2, and 3.

Table 9

ANOVA Results for Numbers of Correct Listener Responses

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Repeated Measures						
Naming Experience	4.035	1	4.035	5.382	.028	.157
Naming Experience * Age	2.099	1	2.099	2.800	.105	.088
Error (Naming Experience)	21.739	29	.750			
Between Groups						
Age	39.557	1	39.557	7.922	.009	.215
Error (Age)	144.798	29	4.993			

Note: computed using alpha = .05

Table 10

ANOVA Results for Numbers of Correct Speaker Responses

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Repeated Measures						
Naming Experience	27.326	1	27.326	15.444	.000	.347
Naming Experience * Age	3.133	1	3.133	1.771	.194	.058
Error (Naming Experience)	51.311	29	1.769			
Between Groups						
Age	237.489	1	237.489	29.341	.000	.503
Error (Age)	234.729	29	8.094			

Note: computed using alpha = .05

As shown in Table 9, the main effect of the type of Naming experience on the numbers of listener responses was significant, F (1, 29) = 5.382, p = .028, η_p^2 = .157. Participants responded with greater numbers of accurate listener responses in Naming probes following MTS experiences. The mean number of listener responses following MTS (M = 9.32, SD = 1.76) was greater than that for exclusion (M = 8.77, SD = 1.96). Please refer to Tables 11 and 12 for additional descriptive statistics on the numbers of listener responses by Naming experience and age group.

There were a significant effect of the age group on the numbers of listener responses, F (1, 29) = 7.922, p = .009, η_p^2 = .215. The adult participants (M = 9.93, SD = 0.18) emitted higher numbers of correct listener responses than youth (M = 8.32, SD = 2.12). There was no significant interaction effect of Naming Experience x Age Group on the numbers of listener responses, F (1, 29) = 2.800, p = .105, η_p^2 = .088.

The adult participants responded with significantly greater numbers of speaker responses than the youth participants (Age: F (1, 29) = 29.341, p < .001, η_p^2 = .503) (Table 10). The mean number of speaker responses for the adult group (M = 8.79, SD = 1.35) was greater than the mean for the youth (M = 4.85, SD = 2.42). The main effect of the type of Naming experience on the numbers of speaker responses was significant, F (1, 29) = 15.4444, p < .001, η_p^2 = .347, with participants emitting higher numbers of correct speaker responses following the MTS Naming experiences (M = 7.27, SD = 3.01) than for exclusion experiences (M = 5.99, SD = 2.92) (Tables 10 and 12).

Similar to the absence of an interaction between the independent variables for the numbers of correct listener responses, the analysis revealed no significant interaction effect between Age Group x Naming experience for the numbers of correct speaker responses, F (1,

29) = 1.771, p = .194, η_p^2 = .058 (Table 10). Please refer to Tables 11 and 12 for descriptive statistics on the numbers of speaker responses for each age group and Naming experience condition.

Table 11

Descriptive Statistics for the Numbers of Correct Listener and Speaker Responses

Age Category	Type of Response	*M*	*SD*	*N*
Total	Listener	9.05	1.75	31
Adult	Listener	9.93	0.18	17
Youth	Listener	8.32	2.12	14
Total	Speaker	6.63	2.81	31
Adult	Speaker	8.79	1.35	17
Youth	Speaker	4.85	2.42	14

Table 12

Descriptive Statistics for the Numbers of Correct Listener and Speaker Responses between Naming Experience and Age Group

Type of Response	Naming Experience	Age Category	*M*	*SD*	*N*
Listener	MTS	Total	9.32	1.76	31
		Adult	10.00	0.00	14
		Youth	8.77	2.25	17
	Exclusion	Total	8.77	1.96	31
		Adult	9.86	0.36	14
		Youth	7.88	2.29	17
Speaker	MTS	Total	7.27	3.01	31
		Adult	9.68	0.72	14
		Youth	5.29	2.71	17
	Exclusion	Total	5.99	2.92	31
		Adult	7.89	2.16	14
		Youth	4.41	2.52	17

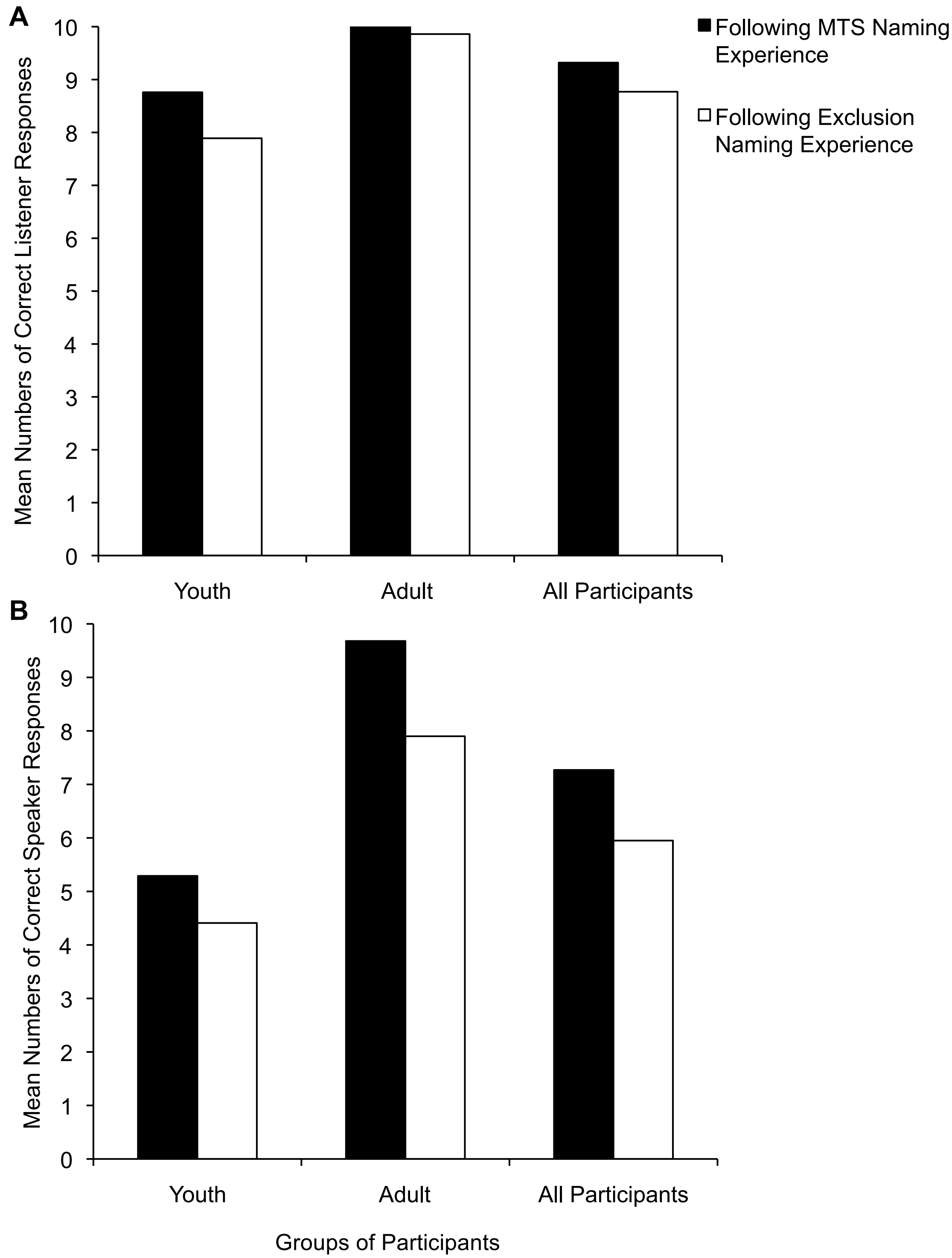


Figure 1. This figure shows the means of the numbers of correct listener (A) and speaker (B) responses during Naming probe sessions for each age group and across all participants between the two types of Naming experiences.

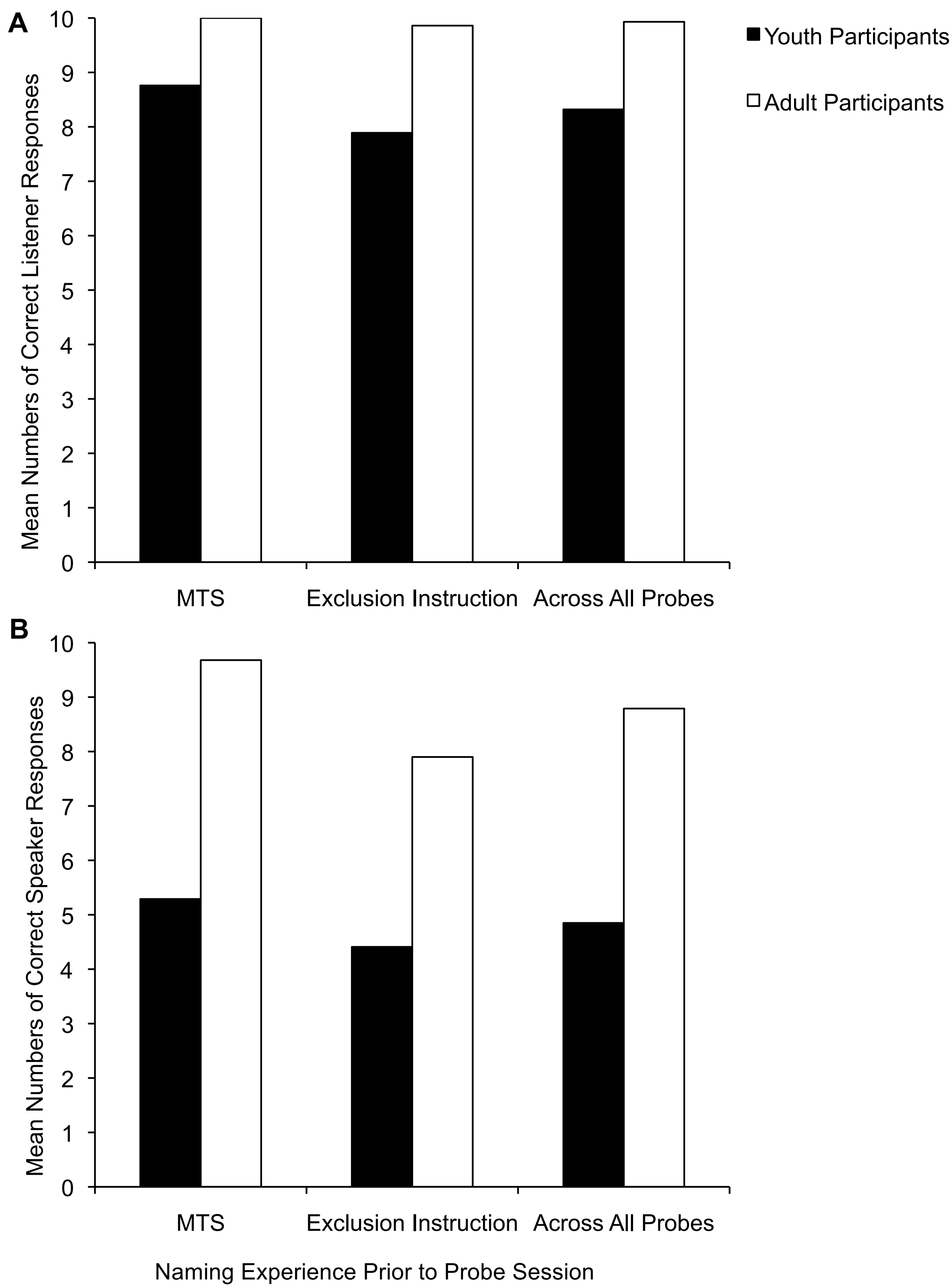


Figure 2. This figure shows the means of the numbers of correct listener (A) and speaker (B) responses for the two types of Naming experiences and across all Naming experiences between the two age groups.

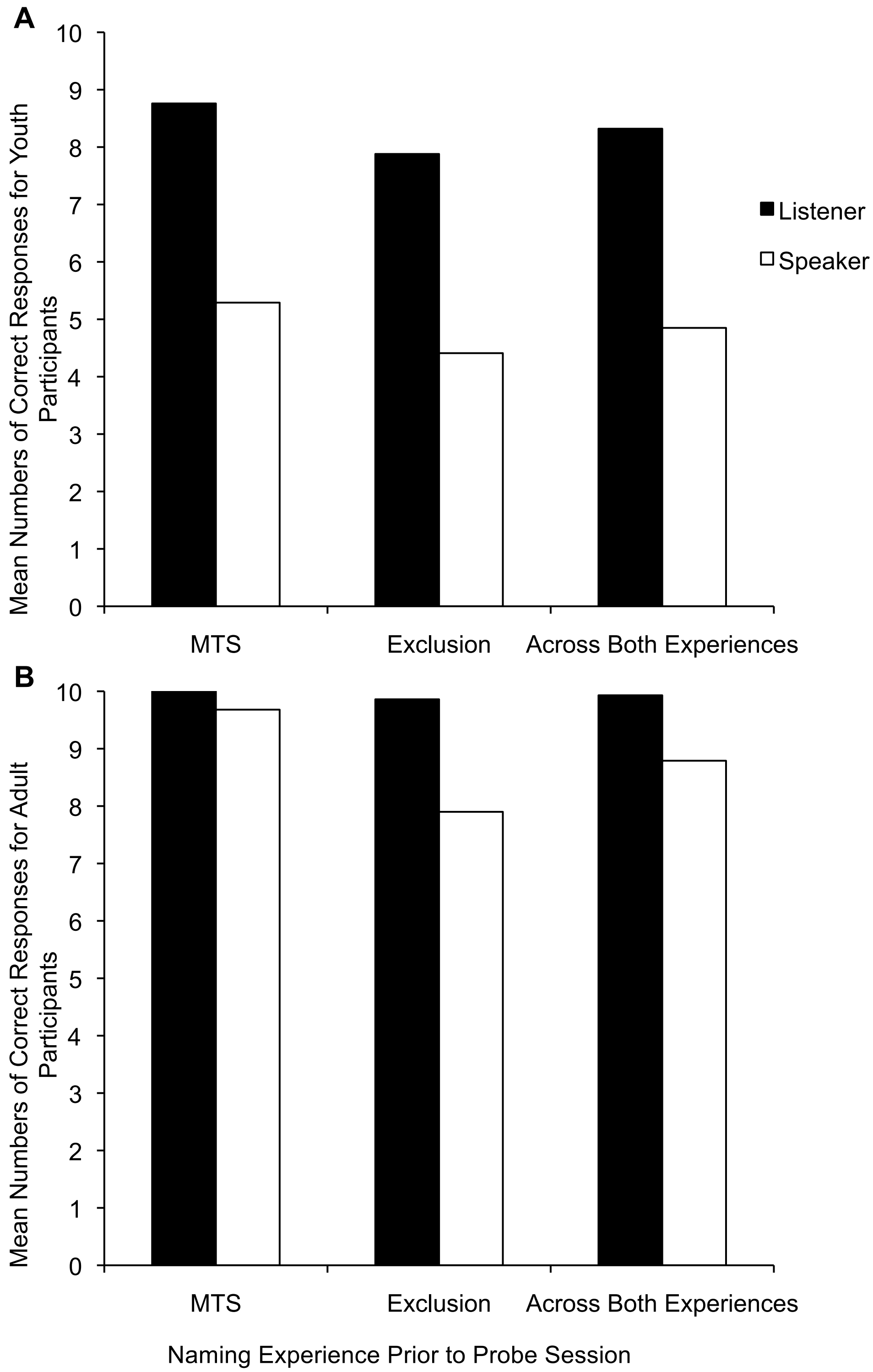


Figure 3. This figures shows the means of the numbers of correct listener responses and speaker responses for youth participants (A) and adult participants (B) following the two types of Naming experiences and overall.

Numbers of Word-Object Responses Mastered for Stimuli within a Set

Similar to the prior analyses for this study, I used 2 x 2 (Age Group [Youth, Adult] x Naming Experience [MTS, Exclusion]) repeated measures ANOVA to examine the effects of the independent variables on the participants' numbers of criteria (maximum of five) achieved for the word-object responses (names of stimuli) within a set for each topography during probe sessions for the Naming capability (ANOVA results are displayed in Tables 13 and 14). There were five stimuli in each set, allowing for a maximum of five stimuli criteria for the each topography. The mean of each participant's numbers of criteria for stimuli for the tact and intraverbal responses was calculated as the mean number criteria for stimuli speaker responses overall for a probe session. The descriptive statistics including the mean numbers of mastered word-object responses for each age group and for each type of Naming experience are outlined in Table 15 and Table 16 and visually shown in Figures 4, 5, and 6.

Table 13

ANOVA Results for the Numbers of Mastered Word-Object Responses for Stimuli in the Listener Topography

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial Eta Squared
Repeated Measures						
Naming Experience	2.395	1	2.395	7.089	.013	.196
Naming Experience * Age	.976	1	.976	2.888	.100	.091
Error (Naming Experience)	9.798	29	.338			
Between Groups						
Age	17.765	1	17.765	7.972	.008	.216
Error (Age)	64.622	29	2.228			

Note: computed using alpha = .05

Table 14

ANOVA Results for the Numbers of Mastered Word-Object Responses for Stimuli in the Speaker Topography

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial Eta Squared
Repeated Measures						
Naming Experience	11.006	1	11.006	19.957	.000	.408
Naming Experience * Age	.103	1	.103	.187	.669	.006
Error (Naming Experience)	15.994	29	.552			
Between Groups						
Age	80.664	1	80.664	36.507	.000	.557
Error (Age)	64.078	29	2.210			

Note: computed using alpha = .05

As shown in Table 13, the main effect of the type of Naming experience preceding the Naming probes on the numbers of learned word-object responses (names) for stimuli in the listener topography was significant, F (1, 29) = 7.089, p = .013, η_p^2 = .196. The mean number of mastered word-object responses in the listener form following MTS Naming experiences *(M* = 4.55, *SD* = 1.12) was greater than that for exclusion (*M* = 4.13, *SD* = 1.36).

The effect of age group on the numbers of mastered listener word-object responses for stimuli within a set was significant, such that adult participants met higher numbers of criteria in listener forms than youth participants, F (1, 29) = 7.972, p = .008, η_p^2 = .216 (Table 15). The mean number of learned word-object listener responses for the adult group *(M* = 4.93, *SD* = 0.18) was more than that for the youth *(M* = 3.85, *SD* = 1.41). There was no significant interaction effect of age group and Naming experience for numbers of the participants' mastered word-object responses in the listener form, F (1, 29) = 2.888, p = .100, η_p^2 = .091 (Table 13).

The adult participants also responded with significantly greater numbers of mastered word-object responses for stimuli in the speaker topography than the youth participants, F (1, 29) = 36.507, p < .001, η_p^2 = .557 (Table 14). The mean number of learned word-object responses in the speaker form for the adult group *(M* = 4.32, *SD* = 0.70) was greater than the corresponding mean for the youth *(M* = 2.03, *SD* = 1.27).

The effect of the type of Naming experience on the numbers of learned word-object responses in speaker form was significant, F (1, 29) = 19.957, p < .001, η_p^2 = .408, with participants achieving higher numbers of criteria for stimuli in the speaker topography following the MTS Naming experiences *(M* = 3.48, *SD* = 1.63) than exclusion conditions *(M* = 2.65, *SD* = 1.64) (Table 14). There was no significant interaction effect of age and Naming experience for numbers of the participants' criteria in speaker form, F (1, 29) = .187, p = .669, η_p^2 = .006.

Please refer to Tables 15 and 16 for descriptive statistics on the numbers of mastered word-object responses for each age group and Naming experience condition.

Table 15

Descriptive Statistics for the Numbers of Mastered Listener and Speaker Word-Object Responses for Stimuli in a Set by Age Group

Age Category	Response Type for Word-Object Responses (Stimuli Criteria)	*M*	*SD*	*N*
Total	Listener	4.34	1.17	31
Adult	Listener	4.93	0.18	14
Youth	Listener	3.85	1.41	17
Total	Speaker	3.07	1.55	31
Adult	Speaker	4.32	0.70	14
Youth	Speaker	2.03	1.27	17

Table 16

Descriptive Statistics for the Numbers of Mastered Listener and Speaker Word-Object Responses for Stimuli in a Set between Naming Experience and Age Group

Type of Response	Naming Experience	Age	*M*	*SD*	*N*
Listener	MTS	Total	4.55	1.12	31
		Adult	5.00	0.00	14
		Youth	4.18	1.42	17
	Exclusion	Total	4.13	1.36	31
		Adult	4.86	0.36	14
		Youth	3.53	1.59	17
Speaker	MTS	Total	3.48	1.63	31
		Adult	4.79	0.43	14
		Youth	2.41	1.46	17
	Exclusion	Total	2.65	1.64	31
		Adult	3.86	1.17	14
		Youth	1.65	1.27	17

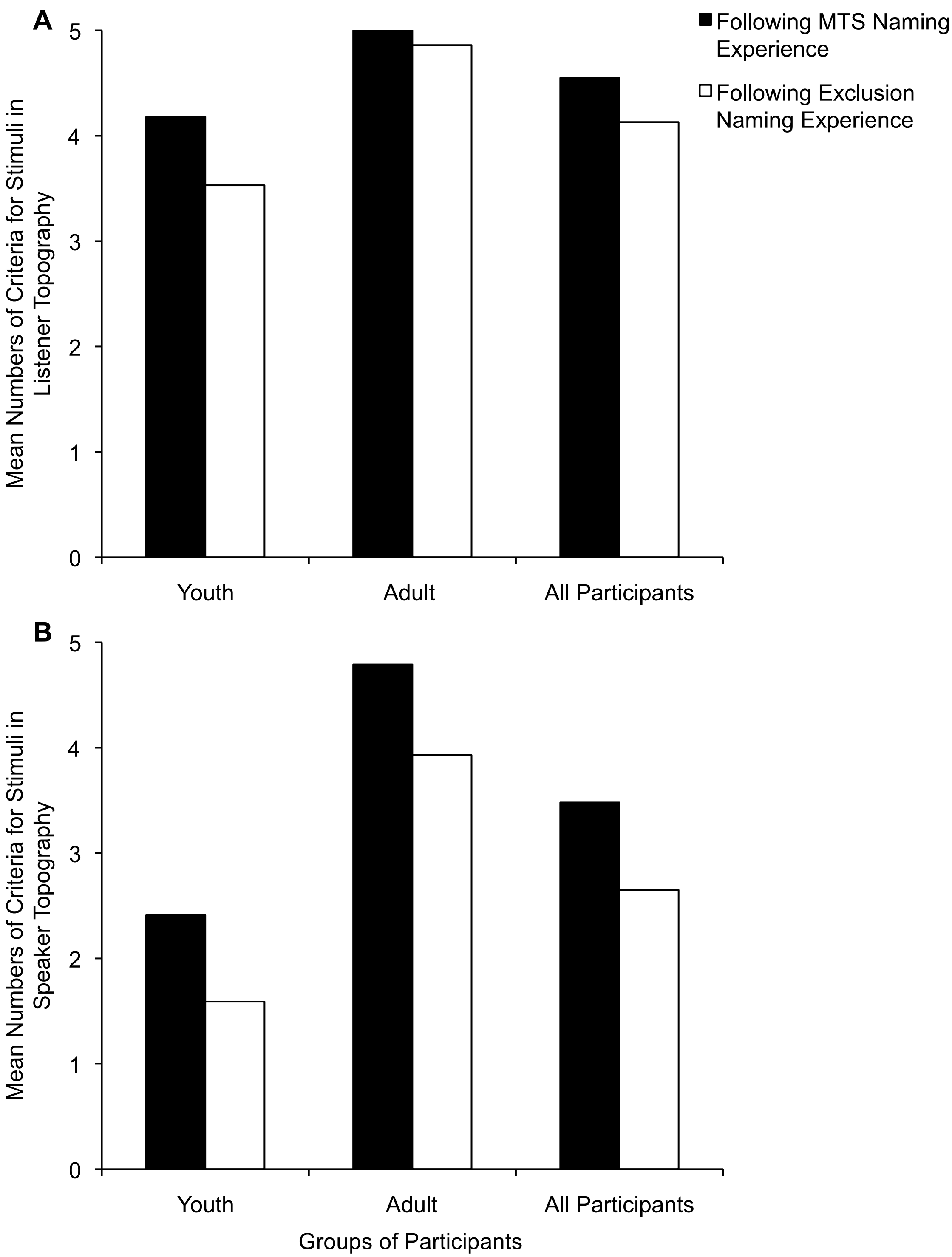


Figure 4. This figure shows the means of the numbers of mastered word-object responses (0 – 5) for stimuli in a set for the two topographies, listener (A) and speaker (B), during Naming probe sessions for each age groups and across all participants between the two types Naming experiences.

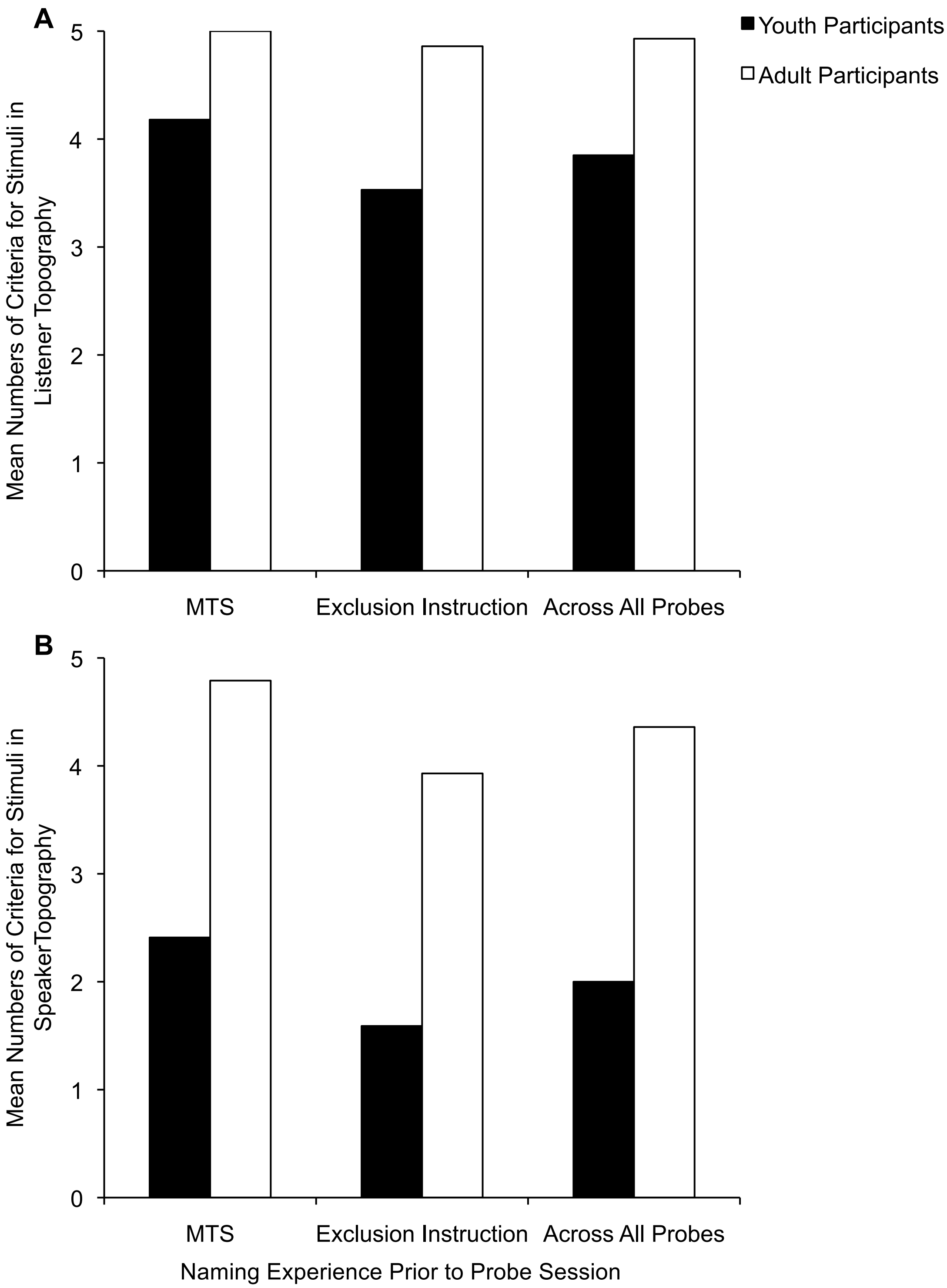


Figure 5. This figure shows the means of the numbers of mastered word-object responses (0-5) per set in listener (A) and speaker (B) form for the two types of Naming experiences and across all Naming experiences between the age groups.

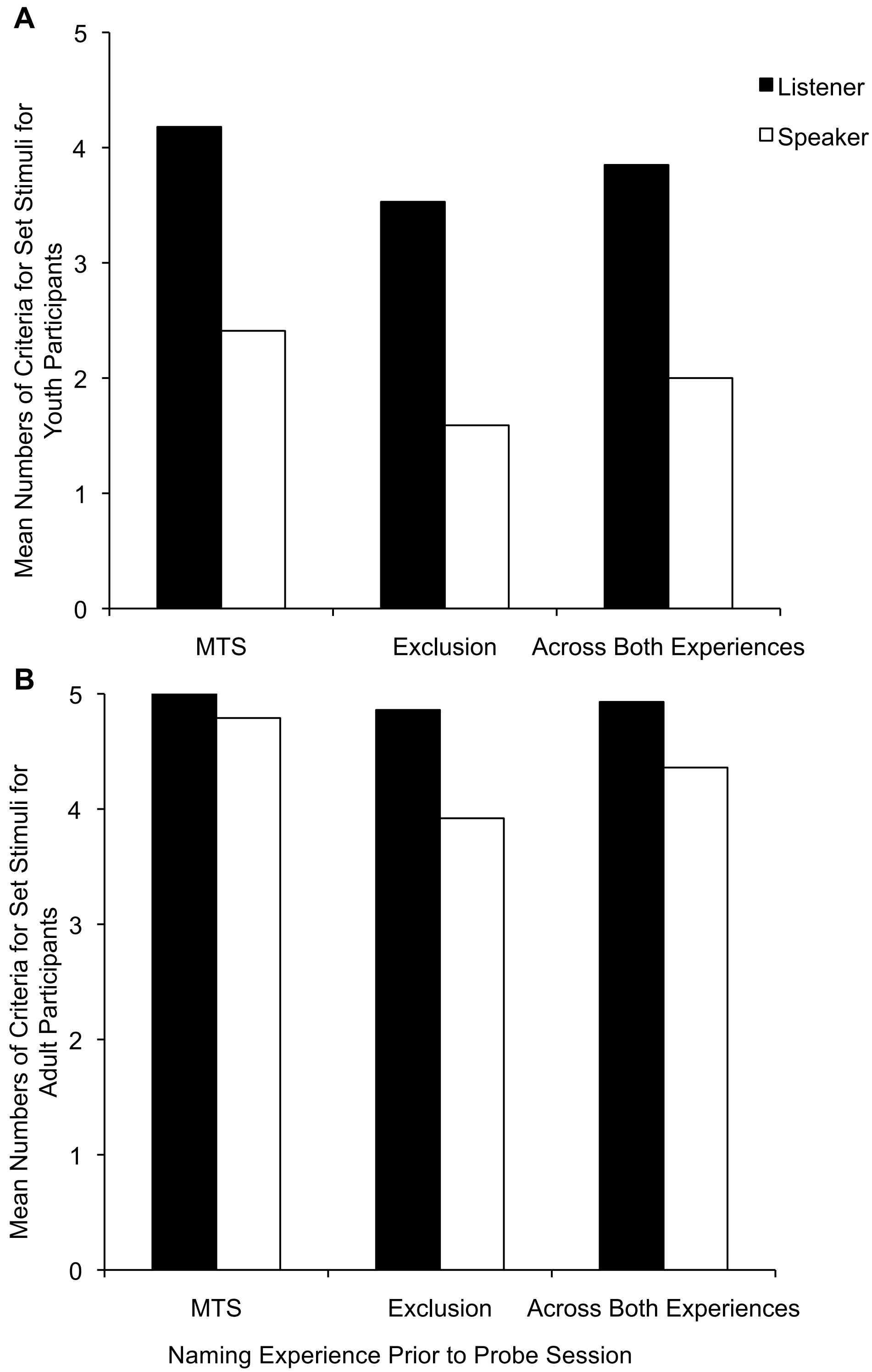


Figure 6. This figure shows the means of the numbers of mastered listener and speaker word-object responses (0 – 5) for stimuli in a set for youth participants (A) and adult participants (B) following the two types of Naming experiences and overall.

Discussion

I investigated the effects of two different Naming experiences on the numbers of correct untaught listener and speaker responses and the numbers of mastered word-object responses (criteria for stimuli) for adults without disabilities and youth with disabilities. The results of this study affirm the independence of the listener and speaker components of Naming. The data showed that there were significant differences between the two age groups on the dependent variables and that the type of Naming experience, MTS and exclusion, was statistically significant on the dependent variables for the group of participants.

The main effect of age group was significant on the listener responses, speaker responses, mastered word-object responses in the listener topography, and mastered word-object responses for the speaker topography with the adults responding with greater numbers than the youths' for each dependent variable, respectively. The main effect of type of Naming experience was particularly significant for the two dependent variables in the speaker form, but was also shown to be statistically significant for the listener responses and listener word-object responses. Overall the participants' means for the dependent variables were greater in the Naming probes following MTS Naming experiences in comparison to those following exclusion Naming experiences. Additionally the participants, as a whole and each group individually, responded with greater numbers of correct listener responses than speaker responses.

The results show that the adult participants' Naming repertoires were fairly balanced for the listener responses across the two types of Naming experiences (MTS $M_{\text{listener}} = 10.00$ and Exclusion $M_{\text{listener}} = 9.86$) and had minimal to no variability in the group's distribution for this topography (MTS SD_{listener} = all values in the data set were equal so there was no variation and Exclusion SD_{listener} 0.36). The adult group's speaker components were not quite as balanced as its listener components across the two types of Naming experiences (MTS $M_{speaker}$ = 9.68 and Exclusion $M_{speaker}$ = 7.89). There was a larger spread in the distribution of the group's numbers of speaker responses following exclusion experiences in comparison to following MTS Naming experiences (Exclusion $SD_{speaker}$ = 2.16 and MTS $SD_{speaker}$ = 0.72), whereas, the youth participants had more similar levels of variability across the listener and speaker components following both types of Naming experiences (listener MTS SD_{youth} = 2.25, listener Exclusion SD_{youth} = 2.29, speaker MTS SD_{youth} = 2.71, and speaker Exclusion SD_{youth} = 2.52). Following the completion of both types of Naming probes, several of the adult participants noted that they utilized tactics to try to learn the names of the stimuli, such as associations with animals that had similar visual shapes or names of animals or letters that they felt sounded similar to the vocal names of the target stimuli. One adult participant explicitly noted that he had other personal events during the time period of the Naming experiences and probe sessions, and, therefore, he was less motivated to learn the names of the probe stimuli.

In considering these results, I wondered whether there might be additional, more specific types or subtypes of Naming cusps as discussed by Greer and Du (2015) and Lo (2016), such as a Naming by exclusion cusp and a Naming with contrived visual stimuli cusp. Greer and Du (2015) found that participants who had previously demonstrated Naming following experiences of hearing the names whilst observing the stimuli did not necessarily demonstrate Naming by exclusion. In addition to the participants' school curricula, Greer and Du (2015) implemented a form of multiple exemplar instruction with exclusionary components using table-top stimuli with the experimental group while the control group continued with solely the school curriculum. The treatment of the exclusion multiple exemplar training was effective in establishing learning names by exclusion, and the researchers suggested the results contribute to the support for

Naming by exclusion as a developmental cusp (Greer & Du, 2015). Are there different subtypes of Naming by exclusion? Could there be Naming cusps that are differentiated by the type of stimuli?

For the children who do not have Naming in repertoire, I wondered if it might be possible to induce these cusps through a procedure to establish unfamiliar and novel stimuli as reinforcers. Does the Naming capability relate to an individual's curiosity behavior in the presence of novel visual stimuli? In the first experiment, I used more familiar unknown types of visual stimuli for the MTS Naming sets and unfamiliar unknown stimuli for the exclusion Naming sets to ensure that the target stimuli in the exclusionary experiences were not only unknown but also that they were unlikely to have ever been exposed to the participants within their prior experiences. The difference between the familiarity levels, though, may have affected the numbers of correct responses during the Naming probe sessions. Therefore, for the second experiment to control for this possible effect, I utilized novel Naming probe stimuli that were unfamiliar types of visual stimuli for all participants across both Naming experiences.

Chapter III

Experiment 2

Method

I hypothesized that participants who demonstrate the Naming capability will demonstrate more “question asking” behavior in the presence of novel stimuli. Similar to the prior experiment, for this experiment I conducted Naming probes following the two types of Naming experiences. Additionally, I conducted probe sessions to record measures of question asking in the presence of unknown stimuli. Once I completed probe measures for all participants, the participants entered intervention conditions to establish novel and unfamiliar (“contrived”) visual stimuli as reinforcers to see if that affected the Naming capability and the measure of curiosity.

Participants

There were six participants in this experiment. The participants did not have the Naming capability in repertoire at the start of the study, but were required to have the prerequisite skills and cusps for acquiring Naming, such as teacher presence results in instructional control, orienting to voices, orienting to faces, conditioned reinforcement for stimuli on a desk or table-top, auditory matching, point responses, visual matching, fluent echoics, and tact repertoires. These participants were between 9 and 11 years of age with a mean age of 9.6 at the start of the study. Similar to the youth participants in the first experiment, I selected these participants from self-contained special education classrooms. These participants were in a classroom for students in grades three – five within a public elementary school outside of a major metropolitan city. The staff within the classrooms implemented the CABAS® model. This meant that these participants were accustomed to data collection procedures, positive reinforcement schedules, probe sessions, and learn unit instruction. As with the prior experiment, I did not need to habituate myself to the youth participants since they were familiar with me from the school setting. I chose the participants to determine whether or not they had Naming in repertoire based on standard Naming probes with MTS as the experience and/or the Naming by exclusion probes with exclusionary instruction as the experience. All youth participants were educationally classified as students with disabilities. Please refer to Table 17 for details on the participants.

Table 17

Participants' Descriptions

Participant	Sex	Age	Educational Classification	Level of Verbal Behavior	Test and Test Scores
B1	m	11	ASD	L/S/R with some writing skills in repertoire	SB5 FSIQ: 63 NVIQ: 70 VIQ: 59
B2	m	9	OHI	L/S/R with some writing skills in repertoire	SB5 FSIQ: 74 NVIQ: 70 VIQ: 81
B3	m	9	OHI	L/S with some reading and writing skills in repertoire	WISC-V FSIQ: 75 VCI: 84 NVI: 73
B4	m	9	ASD	L/S with some reading and writing skills in repertoire	SB5 FSIQ: 73 NVIQ: 75 VIQ: 73
B5	m	9	ED	L/S with some reading and writing skills in repertoire	SB5 FSIQ: 73 NVIQ: 84 VIQ: 64
B6	m	11	ASD	L/S/R with some writing skills in repertoire	SB5 FSIQ: 70 NVIQ: 82 VIQ: 62

Note: m = male and f = female; SB5 = Stanford-Binet Intelligence Scale, Fifth Edition; WISC-V = Wechsler Intelligence Scale for Children – Fifth Edition; FSIQ = full-scale intelligence quotient, NVIQ = nonverbal intelligence quotient, VIQ = verbal intelligence quotient, VCI = verbal comprehension index, NVI = nonverbal index; L = Listener, S = Speaker, R = Reader; ASD = Autism, OHI = Other Health Impairment, ED = Emotional Disturbance.

Setting

An experimenter implemented all instructional and probe sessions with the participants at a desktop computer or laptop computer within the participants' classroom with the use of a partition to block visual distractions and to create a separate space within the classroom. An experimenter conducted the instructional sessions and probe sessions with each participant seated directly in front of a desktop or laptop computer monitor. The experimenter stood or sat beside the participant during the sessions. When an independent observer was present for a session, the independent observer sat adjacent to and slightly behind the participant. The experimenter presented the visual stimuli on the computer monitor in front and within reach of the participant.

Materials

The experimenter utilized a variety of materials for the participants' Naming experiences, Naming probe sessions, curiosity probe sessions, and intervention conditions. These materials included: desktop computers, a laptop computer, Microsoft PowerPoint software, prepared PowerPoint files, data collection forms, a partition, and pens. The PowerPoint files contained sets of visual stimuli.

Each stimuli set used for the Naming probe sessions contained five novel two-dimensional stimuli with two visual versions of each stimulus (refer to Table 18 for descriptions of the participants' Naming probe stimuli). These stimuli sets included novel Hebrew script that was unknown and unfamiliar stimuli to the participants. The vocal names of the Hebrew script stimuli were one to two syllables in length. Experimenters utilized two different visual versions, or multiple exemplars, of each stimulus to teach abstraction. The stimuli for each set were compiled into a PowerPoint file for the Naming experience sessions and a second file for the probe sessions. The PowerPoint files for the instructional sessions (prior to the Naming probes) used for the Naming experiences varied between the two types of Naming experiences. The instructional PowerPoint files for MTS Naming experiences contained only the five novel stimuli from that set. Each slide for the MTS instruction included one target stimulus centered in the top half of the computer screen with a line dividing the top and bottom halves of the monitor. Within the bottom portion of the slide were three of the stimuli, including the other visual version of the target stimulus. The location of the target stimuli was varied to avoid positional prompts. The instructional PowerPoint files for the exclusion Naming experiences contained slides of known stimuli and the novel stimuli. Each instructional slide for the exclusion Naming experience contained a known letter, a known number, a known written word, and a picture of a known common animal in addition to one novel stimulus from the participant's set.

The experimenter combined known and unknown stimuli in the PowerPoint files for the curiosity probe sessions (see Tables 19 and 20 for the specific stimuli). There were two types of stimuli used for the curiosity probe sessions. The experimenter conducted one probe for measuring curiosity with novel cartoon characters (unknown, but familiar stimuli) presented along with known stimuli (known letters, single digit numbers, animals, words) and one probe with visually unfamiliar, unknown stimuli that appeared contrived to the participants (for example: letters from the Greek alphabet and ancient Chinese characters from the oracle bone script) presented along with the known stimuli (known letters, numbers, animals, words). Each PowerPoint slide for both types of curiosity probes (for novel cartoon characters and for unfamiliar stimuli) contained one novel stimulus and four known stimuli.

For the intervention conditions, the experimenter used sets of unknown stimuli (Nordic Runes) that were unfamiliar types of stimuli and appeared contrived to the participants. These stimuli sets are outlined in Table 21. Each intervention set for the instructional portion contained five novel stimuli with two visual versions of each stimulus. During the pairing portion of an instructional session, each PowerPoint slide contained one visual stimulus from the intervention set. The experimenter immediately conducted a tact probe session following a completed session of pairing trials. The PowerPoint slideshows for the tact probes also contained five slides that were dispersed into the slideshow and each of these slides showed a known and common domestic animal picture (a cat, a dog, a frog, a bird, or a fish). The known animal stimuli were incorporated into the tact probes to provide an opportunity for the participant to receive praise during the intervention's tact probe sessions. Please see Table 22 for assigned probe and intervention sets for each participant.

Table 18

Sets of Novel Stimuli for the Naming Probe Sessions

Naming Probe Stimuli Sets							
N1		N2		N3		N4	
Tact	Visual	Tact	Visual	Tact	Visual	Tact	Visual
Gimel	ג	Dalet	ד	Aleph	א	Ayin	ע
Yod	י	Het	ח	Zayin	ז	Bet	בּ
Lamed	ל	Tsadi	צ	Resh	ר	Nun	נ
Shin	ש	Mem	מ	Tet	ט	Kaph	ךּ
Tav	ת	Qof	ק	Pe	פּ	Samekh	ס

Table 19

Names of the Familiar, Unknown Stimuli (Cartoon Characters) for the Curiosity Probe Sets

Familiar, Unknown Curiosity Stimuli Sets					
F1	F2	F3	F4	F5	F6
1. Penfold 2. Mr. Magoo 3. Roobarb 4. Chumley 5. Tennessee Tuxedo	1. Nero 2. Riff Raff 3. Willo the Wisp 4. Running Board 5. The Tick	1. Foghorn Leghorn 2. Muttley 3. QuickDraw McGraw 4. Gossamer 5. Mr. Twiddle	1. Grape Ape 2. Felix 3. Heckle and Jeckle 4. Witch Hazel 5. Bertie	1. Baba Looey 2. Pepe Le Pew 3. Bender 4. The Brain 5. Snooper	1. Huckleberry Hound 2. Atom Ant 3. Droopy 4. Magilla Gorilla 5. Hugo

Table 20

Names of the Unfamiliar, Unknown Stimuli (Greek letters and Ancient Chinese Oracle Bone Scripts) for the Curiosity Probe Sets

Unfamiliar, Unknown Curiosity Stimuli Sets						
U1	U2	U3	U4	U5	U6	U7
psi	phi	wáng	yuè	shàng	mù	kŏu
theta	zeta	tŭ	shuĭ	hăo	guî	lì
delta	lamda	huŏ	guang	yú	fèng	dōng
gamma	omega	bèi	niăo	liù	bâi	niú
mu	sigma	xiàng	qiān	jiŭ	wàn	xià

Table 21

Sets of Stimuli (Nordic Runes) for the Intervention Sessions

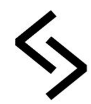
Intervention Stimuli Sets					
R1		R2		R3	
Tact	Visual	Tact	Visual	Tact	Visual
Fehu		Dagaz		Berkanan	
Mannaz		Sowilo		Algiz	
Opila		Naudiz		Perp	
Raido		Hagalaz		Jera	
Laguz		Purisaz		Wunjo	

Table 22

Participants and their Assigned Sets for the Probes and Interventions

	Participants					
	First Triad			Second Triad		
Type of Stimuli Set	B1	B2	B3	B4	B5	B6
Naming Probe Sets with MTS Naming Experiences	N1 N3	N1	N2	N2	N2	N1 N3
Naming Probe Sets with Exclusion Naming Experiences	N2 N4	N2	N1	N1	N1	N2
Unknown, Familiar Stimuli for Curiosity Probe Sets	F2 F1 F3 F4	F1 F2 F4 F3	F1 F2 F3 F4 F5	F1 F2 F4 F3 F5	F2 F1 F4 F3 F5	F2 F1 F3 F4 F5 F6
Unknown, Unfamiliar Stimuli for Curiosity Probe Sets	U1 U2 U4 U3	U1 U2 U4 U3	U2 U1 U3 U4	U2 U1 U3 U4 U5	U2 U1 U4 U3 U5	U1 U2 U3 U4 U5
Unknown, Unfamiliar Stimuli Sets for Intervention Conditions	R1 R2	R2 R3	R3 R1	R1 R3	R2 R1	R3 R2

Dependent Variables

The dependent variables in this study were the numbers of correct responses of untaught listener and speaker responses during Naming probes, the mean numbers of mastered listener and speaker word/object responses (stimuli names) during Naming probes, the numbers of mands for names of novel stimuli during curiosity probes, the numbers of correct tact responses upon second presentation for the novel stimuli in the curiosity probes, and the numbers of inaccurate tact responses for novel stimuli in the curiosity probes. The target behaviors for the Naming probes included point-to, tact, and intraverbal responses to sets of 2-dimensional stimuli presented on a computer monitor through Microsoft PowerPoint. For the "point to ___" response, the participant was given a vocal verbal antecedent, "point to ___," and the participant was to point to the target stimulus that was among negative exemplars (in a field of three stimuli). The pure tact response was defined as the participant stating the correct name of the stimulus following the presentation of the visual stimulus, and the impure tact, an intraverbal response, consisted of the experimenter presenting a picture and providing a vocal antecedent such as, "what's this?" The experimenter recorded a correct response for the impure tact when the participant vocally responded with the correct name of the picture. Reinforcement was not delivered nor were corrections provided during the Naming probe trials for the untaught forms.

During the curiosity probe sessions the experimenter recorded the participant's vocal verbal behavior following the presentation of a slide containing the known stimuli and unknown stimulus. The experimenter documented each instance a participant asked for the name (an example of a mand for information) of the novel stimulus on the slide, incorrectly guessed the name, and correctly responded with the name of the novel stimulus when it was presented the second time.

Independent Variable

The independent variable for this experiment was a stimulus pairing observation procedure. Each intervention session was comprised of a pairing component and a tact probe component.

Design

The design of this experiment was a multiple probe design across participants. The intervention was time-lagged across the two triads of participants. The participants were randomly assigned to one of the two triads. The first triad included Participant B1, Participant B2, and Participant B3. The second group of three was made up of Participants B4, B5, and B6. The experimenter conducted Naming and curiosity pre-intervention probe sessions with all six participants. The stimuli sets and sequence of the sets were counterbalanced within each triad and across the triads. Once all three participants from the first triad showed stable levels of responding in the pre-intervention probes, then they entered their first intervention conditions. The experimenter also completed additional pre-intervention probe sessions with the participants in the second triad until their measures showed stable states of responding. After all participants in the first triad met criteria for their initial intervention conditions, then the experimenter completed post-probe measures with those participants (B1, B2, and B3) before they entered their second intervention phases and completed additional pre-intervention probe sessions with Participants B4, B5 and B6 prior to the start of their first treatment condition to control for maturation. This pattern continued until all participants completed two intervention phases and post-intervention probes following the second treatment conditions.

Procedure

The procedures for the Naming experiences and Naming probe sessions were the same as those outlined and implemented for Experiment 1. For the curiosity probe sessions, I showed the participant one PowerPoint slide at a time on a computer monitor. Each slide contained five stimuli (one unknown stimulus nested amongst four familiar and known stimuli). I pointed to one stimulus at a time and asked the participant for the name (example: “what’s the name of this animal?” “what is this letter?” “what number is this?” “what is the name of this symbol?”). I did not deliver praise following correct responses nor implement corrections following incorrect responses on the curiosity measures. I recorded the participant’s vocal verbal responses to the unknown stimulus on each slide. If the participant responded to the stimulus with a mand for the name or information regarding the unknown stimulus then I vocally provided that information.

The intervention condition was a tact pair/probe procedure. During the pairing component, the experimenter did not collect data on the participant’s responses, but attempted to ensure that the participant was looking at the computer monitor and, as much as could be controlled for, attending to the stimuli on the screen. The experimenter presented each visual stimulus (one per slide) and emitted the vocal tact response for the stimulus. Participants were not required to respond to the experimenter, beyond attending to the visual stimulus, in any manner, during the pairing trials. Immediately following the pairing component (20 experimenter-led trials), the experimenter ran 20 trials to probe for the tact responses. Parallel to the structure of the pairing component trials, the 20 tact probe trials included four opportunities for each of the five stimuli in the particular intervention set. The experimenter defined a participant’s correct response during tact probe component to be the accurate vocal tact response within 3 s of the presentation of the visual stimulus. The experimenter continued the tact pair/probe cycle of sessions until the participant met criterion for the intervention condition (90% or greater across two consecutive sessions). The experimenter did not conduct tact pair/probe (intervention) sessions back to back, so there was at minimum 30 min between the pair/probe sessions.

Interobserver Agreement

The experimenter and an independent observer collected data to obtain IOA for the MTS Naming experiences, exclusion Naming experiences, Naming probe sessions, curiosity probe sessions, and intervention sessions. An independent observer was either present during the probe sessions or a video recording was later scored by an independent observer. For instructional sessions and Naming probe sessions IOA was calculated by dividing the number of agreements by the total number of trial-by-trial (point-to-point) agreements and disagreements per probe session and multiplying by 100%. The percentage of sessions with IOA, the mean IOA, and the range of IOA are reported in Tables 23 – 26. As shown in Table 23, IOA was obtained for 37.8% of the participants' Naming probe sessions with mean agreement of 98.5% (range of 93.3 – 100%). IOA was obtained for 40% of the participants' MTS and exclusion Naming experience instructional sessions conducted prior to probe sessions with mean agreement 100% (see Table 24). The experimenter collected IOA for 45.8% of the curiosity probe sessions with a mean of 96.7% across all participants and a range of 90 – 100% (see Table 25). For the intervention sessions, 23.1% of the sessions had IOA with a range of 90 – 100% and a mean of 98.2% (see Table 26).

Table 23

IOA for Participants' Naming Probe Sessions

Participant	% of Naming Probe Sessions with IOA	Mean IOA	Range of IOA
B1	41.7%	99.3%	96.7 – 100%
B2	40.0%	100%	—
B3	30.0%	96.7%	93.3 – 100%
B4	41.7%	98.0%	93.3 – 100%
B5	41.7%	99.3%	96.7 – 100%
B6	43.8%	97.2%	93.3 – 100%
Across All Participants	37.8%	98.5%	93.3 – 100%

Table 24

IOA for the Participants' Naming Experiences

Participant	% of Naming Experience Sessions with IOA	Mean IOA	Range of IOA
B1	25.0%	100%	—
B2	50.0%	100%	—
B3	25.0%	100%	—
B4	50.0%	100%	—
B5	16.7%	100%	—
B6	66.7%	100%	—
Across All Participants	40.0%	100%	—

Table 25

IOA for the Participants' Curiosity Probe Sessions

Participant	% of Curiosity Probe Sessions with IOA	Mean IOA	Range of IOA
B1	62.5%	94.0%	90.0 – 100%
B2	55.6%	98.0%	93.3 – 100%
B3	50.0%	98.4%	96.7 – 100%
B4	41.7%	98.7%	96.7 – 100%
B5	40.0%	95.8%	93.3 – 100%
B6	33.3%	95.0%	90.0 – 100%
Across All Participants	45.8%	96.7%	90.0 – 100%

Table 26

IOA for the Participants' Intervention Sessions

Participant	% of Intervention Sessions with IOA	Mean IOA	Range of IOA
B1	33.3%	97.5%	90.0 – 100%
B2	16.7%	100%	—
B3	17.6%	98.3%	90.0 – 100%
B4	21.4%	96.7%	95.0 – 100%
B5	24.0%	97.5%	90.0 – 100%
B6	33.3%	100%	—
Across All Participants	23.1%	98.2%	90.0 – 100%

Results

I conducted a multiple probe design that was time lagged across two triads of participants. In the subsequent paragraphs are the results for the participants' tests for Naming following the MTS as well as the exclusion Naming experiences, the results for the curiosity probe sessions, and the results for the participants' intervention conditions. Please see Figures 7 - 10 for Naming probe results and Figures 11 and 12 for curiosity probe results.

Naming Probe Results

Participant B1 demonstrated the listener component (80% or greater) throughout his pre-intervention Naming probes with both types of Naming experiences. He did not meet the criterion for the speaker component during his pre-intervention probe sessions following either type of Naming experience. His speaker (tact and intraverbal) responses ranged from four to seven correct responses prior to intervention. Following his first intervention condition, he continued to demonstrate the listener component of Naming and met criteria for the speaker component with the initial sets of stimuli for the MTS Naming experience condition and the Naming by exclusion experience. I conducted additional post-intervention 1 Naming probe sessions for both type of Naming experiences with sets of novel, unfamiliar stimuli to assess whether the participant had acquired the capability of Naming for novel stimuli or if it was potentially a practice effect from repeated exposures to the initial sets of stimuli. The participant's numbers of correct untaught listener responses showed he continued to demonstrate the listener component, but his numbers of correct untaught speaker responses for the novel sets decreased to 4 correct for each speaker response during the probe with the novel set following MTS Naming experiences and 0 correct for the novel set following exclusion Naming experiences. Participant B1's Naming probe sessions following his second intervention condition resulted in a slight decrease in numbers of accurate listener responses (7 point-to) and increases in untaught speaker responses (5 tact, 4 intraverbal) for the set following exclusion Naming experiences. He continued to demonstrate the listener component for the set following MTS Naming experiences and his numbers of tact (4 correct) and intraverbal (4 correct) responses remained the same as the prior probe session.

Participant B2 met criterion (80%) for the listener component with his initial set of stimuli following MTS Naming experiences during his first and third pre-intervention probe sessions. In his second pre-intervention probe session with the MTS Naming experiences his numbers of accurate listener responses decreased to 5 correct point-to responses. His numbers of correct point-to responses in the Naming pre-intervention probe sessions following exclusion experience were 6, 3, and 6 across his three pre-probes and he emitted 0 correct speaker responses during the pre-intervention Naming probes following exclusion Naming experiences. After his first treatment condition, he responded with 9 correct point-to, 6 correct tact, and 6 correct intraverbal responses for the stimuli in the MTS Naming experience condition. He emitted 7 accurate point-to responses, 1 correct tact response, and 1 correct intraverbal response for the stimuli following the exclusion Naming experience. After his second intervention, Participant B2 emitted 8 correct point, 6 correct tact, and 6 correct intraverbal responses for the set following the MTS Naming experiences. He emitted 7 accurate point-to, 2 correct tacts, and 2 correct intraverbal responses for the stimuli set following the exclusion experiences.

Participant B3 emitted variable numbers of correct listener responses during his three pre-intervention Naming probes for the two Naming experiences. He emitted 6, 4, and 9 correct point-to responses in his first, second and third pre-treatment Naming probes following the MTS Naming experiences respectively. The participant emitted 9, 5, and 8 accurate point-to responses during the pre-treatment Naming probes with exclusion experiences. Additionally, he did not demonstrate that he had the speaker component in repertoire prior to intervention with a range of 0 – 2 correct speaker responses in the Naming pre-probe sessions following MTS experiences and a range of 0 – 3 accurate speaker responses in the pre-probes following exclusion Naming experiences. Following his first intervention condition, he emitted 8 correct point-to, 2 correct tact, and 2 correct intraverbal responses for the set with MTS Naming experiences. Additionally, he emitted 7 point-to responses and slightly increased numbers of speaker responses (4 tact, 3 intraverbal) in the set with exclusion Naming experiences after his first treatment condition. Once Participant B3 finished his second intervention phase, he again emitted 8 correct listener responses and increased speaker responses (4 tact, 3 intraverbal) with Set N2 stimuli (MTS Naming experience). His number of accurate listener responses was nine and he emitted 4 correct speaker responses for each topography (tact and intraverbal).

The second triad of participants consisted of B4, B5, and B6. Once the first triad completed their first intervention phase, I completed post-intervention 1 probe sessions with participants B1, B2, and B3 as well as additional pre-intervention probe sessions with the second triad to control for maturation. The second triad then entered their first intervention phase at the same time as the first group of three entered an additional treatment condition.

Participant B4 did not respond to criterion levels for the listener component during his four pre-intervention Naming probes following the MTS Naming experiences with 3, 5, 4, and 6 correct point-to responses in the pre-probe sessions. He did not emit any correct speaker responses during the pre-intervention probe sessions with the MTS Naming experiences. He did demonstrate the listener component (90% accuracy in each of the four pre-probes) of Naming during all of his pre-intervention Naming probes to Set N1 stimuli, which were assessed following his exclusion Naming experiences. He consistently emitted 2 (20%) correct tact responses and 2 (20%) correct intraverbal responses during all of his pre-treatment Naming probes with exclusion as the Naming experience. After the completion of his first treatment, Participant B4 emitted 7 point-to, 2 tact, and 2 intraverbal responses to Set N2 stimuli (Naming probes following MTS experiences). He also responded with 10 (100%) correct point-to, 6 correct tact, and 6 correct intraverbal responses to Set N1 stimuli (post-intervention 1 probes following his exclusion Naming experiences). His listener responses increased to 8 correct in his post-intervention 2 Naming probe with MTS as the Naming experience, and he emitted 4 correct speaker responses in each of the two speaker forms. His results for the post-intervention 2 Naming probe session with the set assessed following exclusion as the Naming experience were 10 correct point-to, 7 correct tact, and 10 correct intraverbal responses.

Participant B5 demonstrated the listener component (80% or greater) in three of his four pre-intervention Naming probe sessions following MTS Naming experiences. He emitted 10, 6, 10, and 9 accurate point-to responses during the four probe sessions. He responded with 0 – 3 correct responses in each speaker topography across the pre-intervention probe sessions following MTS Naming experiences. Participant B5 emitted zero speaker responses during all of his pre-treatment Naming probe sessions following exclusion Naming experiences and emitted 5 – 7 correct listener responses in each of these pre-intervention probe sessions. After his first intervention, he emitted 10 point-to, 4 tact, and 6 intraverbal responses correctly to Set N2 stimuli, which followed MTS Naming experiences. He responded with 10 correct point-to, 2 tact, and 2 intraverbal responses to Set N1 stimuli in his post-treatment 1 probe session following exclusion experiences. After Participant B5 met criterion for his second intervention, he emitted 10 correct point-to, 6 tact, and 8 intraverbal responses to Set N2 stimuli. He emitted 9 point-to, 2 tact, and 2 intraverbal responses to Set N1 stimuli in his post-intervention 2 Naming probe session following exclusion Naming experiences.

The final participant, B6, completed eight pre-intervention Naming probe sessions following MTS Naming experiences prior to his first intervention condition. He emitted 7 to 10 correct point-to responses during these pre-intervention probe sessions and demonstrated the listener component with 90 – 100% accuracy in seven of the eight pre-intervention probe sessions with the MTS Naming experiences. He emitted increased numbers of correct speaker responses across the probe sessions with stimuli from Set N1 (MTS Naming experience). In the fourth pre-intervention probe session with Set N1, Participant B6 emitted 9 correct tact and 10 correct intraverbal responses, therefore, he met criterion for this set of stimuli. I conducted additional pre-intervention probe sessions with MTS Naming experiences with a novel set (N3) to determine if his increased numbers of responses were a result of a practice effect or if he acquired the capability. His latter four pre-intervention probe sessions with Set N3 stimuli following MTS Naming experiences resulted in zero speaker responses, then stable levels of speaker responses (4 tact, 4 intraverbal) in the last three pre-intervention probe sessions. This participant emitted 6 – 7 correct point-to responses to Set N2 stimuli across his four pre-intervention Naming probe sessions following exclusion Naming experiences. He consistently responded with 4 tact and 4 intraverbal responses in each of the pre-treatment Naming probe sessions with exclusion as the Naming experience. Following his first treatment, Participant B6 responded with 10 point-to, 6 tact, and 6 intraverbal responses during the post-intervention 1 Naming probe with MTS as the Naming experience. He emitted 9 point-to, 6 tact, and 6 intraverbal responses accurately during his probe session with exclusion as the Naming experience following his first intervention. Once he completed his second treatment phase, Participant B6 correctly responded with 9 point-to, 6 tact, and 6 intraverbal responses for Set N3 stimuli, which followed MTS as the Naming experience. In his post-intervention 2 Naming probe session following exclusion as the experience Participant B6 responded with the same numbers of accurate responses as his post-intervention 1 probe session: 9 point-to, 6 tact, and 6 intraverbal responses. Please see Figure 7 for the numbers of correct responses during Naming probe sessions following MTS as the Naming experience and Figure 8 for the numbers of correct responses during Naming probe sessions following exclusion instruction as the Naming experience. Please refer to Figure 9 and Figure 10 for the mean numbers of responses for each participant during the Naming probe conditions.

Curiosity Probe Results

I completed curiosity measures with participants using familiar types of stimuli as well as unfamiliar visual stimuli (Figure 11 and Figure 12). Participant B1 emitted mands for the name of the unknown stimuli 0 – 11% of his opportunities during his two pre-intervention probe sessions with familiar types of visual stimuli and emitted zero mands for the information during the two pre-treatment probe sessions with unfamiliar types of visual stimuli. He responded with one correct tact (vocal name) responses during his second pre-intervention probe for curiosity using familiar visual stimuli. Participant B1 emitted inaccurate tacts for 44 – 80% of the Naming opportunities in his pre-treatment curiosity probes with familiar types of visual stimuli and 0 – 10% of the opportunities with unfamiliar visual stimuli. Following his first intervention condition, Participant B1 emitted mands for the vocal names of the unknown stimuli for 100% of the opportunities across curiosity probe measures with familiar and unfamiliar novel visual stimuli. He learned the name for one stimulus in the probe with familiar types of visual stimuli and learned the names for two stimuli in the curiosity probe with unfamiliar visual stimuli.

Participant B1 responded with incorrect tact responses for 22% of the opportunities during the post-intervention 1 curiosity probe with familiar novel visual stimuli and for 38% of the opportunities with unfamiliar types of novel visual stimuli. After his second treatment condition, Participant B1 emitted mands for unknown stimuli for 100% of the opportunities across both types of stimuli. He learned and emitted the correct tact responses for two (40%) of the five stimuli in each of the two sets (familiar and unfamiliar visual stimuli sets) following his second intervention phase. Participant B1 emitted incorrect tact responses for 25% of his opportunities in his post-intervention 2 probe session with familiar types of visual stimuli and did not emit any incorrect tact responses during the post-intervention 2 probe session with unfamiliar visual stimuli.

Participant B2 asked for the name of the unknown stimuli for 78%, 100%, and 90% of the opportunities during his three pre-intervention curiosity probe sessions with familiar types of novel visual stimuli. He learned the name of one stimulus in the first pre-intervention probe with familiar types of stimuli and emitted zero correct tact responses during the latter two pre-intervention probe sessions with familiar types of visual stimuli. This participant emitted incorrect tact responses (guessed the vocal names) for 11 – 40% of the opportunities to name the unknown stimuli in his pre-intervention probe sessions with familiar types of visual stimuli. Participant B2 emitted mand operants for the vocal names of the unknown stimuli for 80% of the opportunities during his first pre-intervention curiosity probe session with visually unfamiliar types of stimuli and 70% of the opportunities during his second pre-intervention probe session. Participant B2 emitted zero correct tact responses during his pre-intervention curiosity probe sessions with visually unfamiliar types of stimuli. He answered with incorrect tact responses for 40% of the opportunities during his first pre-intervention curiosity probe session with unfamiliar types of stimuli and zero inaccurate tacts during his latter pre-intervention curiosity probe sessions with the visually unfamiliar type of stimuli.

Participant B3 consistently emitted mands for the vocal names (tacts) of the unknown stimuli for 100% of his opportunities across all of his pre- and post-intervention curiosity probe sessions for both unfamiliar and familiar types of visual stimuli. During the pre-intervention curiosity probe sessions with familiar types of visual stimuli Participant B3 emitted inaccurate tact responses for 100% of the unknown stimuli and learned the correct tact or vocal name for one stimulus in each probe session. In his pre-intervention curiosity probe sessions with unfamiliar types of visual stimuli, he emitted zero correct tact responses for the unknown stimuli. He emitted inaccurate tacts for 30% in the first pre-intervention probe and zero incorrect tacts for unknown stimuli in the second pre-intervention curiosity measure with unfamiliar stimuli. Following his first treatment condition, Participant B3 learned the names of three (60%) of the five stimuli and emitted inaccurate tact responses for 14% of the unknown with familiar types of stimuli. With the visually unfamiliar types of stimuli Participant B3 emitted no correct tact responses for the target stimuli and emitted incorrect tact responses for 10% of his opportunities during his post-intervention 1 probe. Once Participant B3 completed his second treatment, he emitted the correct tact responses for two (40%) of the five stimuli and emitted inaccurate tact responses for 13% of the opportunities with familiar types of visual stimuli. The same participant emitted zero inaccurate tact responses as well as zero correct tact responses for the stimuli during his post-intervention 2 curiosity probe session with unfamiliar types of visual stimuli.

Participant B4 emitted mands for the names of the unknown stimuli for 78%, 0%, and 89% of the opportunities during the three pre-treatment curiosity probe sessions with familiar types of visual stimuli. He emitted the correct tact for one stimulus in his first pre-intervention probe session and one in his third pre-intervention probe session; he emitted zero correct tact responses for the target stimuli during his second pre-intervention probe session with visually familiar types of stimuli. Participant B3 emitted incorrect tact responses for 11% of the opportunities in his first pre-intervention probe session and 10% of the opportunities in his second pre-intervention probe session. He did not emit incorrect tact responses for the target stimuli during his last pre-intervention probe session with the visually familiar stimuli.

Participant B4 emitted mand operants for the names of the unknown stimuli for 0% of his opportunities in his first pre-intervention probe session, 50% in the second pre-intervention probe, 100% of the opportunities in the third pre-intervention probe, 90% of the opportunities in the fourth, and 89% of the opportunities in his fifth pre-treatment curiosity probe session with unfamiliar types of visual stimuli. During four of his five pre-intervention probe sessions with visually unfamiliar stimuli Participant B4 emitted zero inaccurate tacts for the unknown stimuli; in the third pre-intervention probe he emitted inaccurate tact responses for 11% of the opportunities. This participant emitted the correct name or vocal tact for one stimulus in the third pre-intervention curiosity probe and one stimulus in the first pre-intervention probe session with visually unfamiliar types of stimuli. After Participant B4 finished his first intervention condition he emitted mands for the names of 100% of the unknown stimuli across both visually unfamiliar and familiar types of stimuli during the post-intervention 1 curiosity probes. He emitted zero inaccurate tact responses for both types of stimuli in the post-intervention 1 curiosity probe sessions and emitted the correct tact response for one of the five target stimuli in the curiosity probe session with familiar types of stimuli. In Participant B4's post-intervention 2 probe sessions with visually familiar and unfamiliar types of stimuli he emitted the correct tact for one of the five stimuli, emitted zero inaccurate tact responses, and emitted mands for the names for 100% of the unknown stimuli.

The fifth participant, B5, emitted zero mands for the names of the unknown stimuli and zero correct tact responses across all six (three with visually familiar types of stimuli and three with visually unfamiliar types of stimuli) of his pre-intervention curiosity probe sessions. During his pre-intervention probe sessions he emitted inaccurate tacts for the unknown stimuli for 0 – 20% of the presentations of the stimuli. Following his first treatment condition Participant B5 emitted mands for the names of the unknown stimuli for 90% of the opportunities with visually familiar stimuli and 100% of the opportunities with visually unfamiliar stimuli. Participant B5 emitted inaccurate tact responses for 20% of the unknown stimuli and zero correct tact responses during his post-intervention 1 probe with visually familiar stimuli. He emitted incorrect tact responses for 25% of the unknown stimuli and emitted the correct tact responses for two (40%) of the five stimuli in his post-intervention 1 curiosity probe session with unfamiliar types of visual stimuli. After completed his second treatment phase, Participant B5 responded similarly in across both types of stimuli in his post-intervention 2 curiosity probe sessions. He emitted correct tact responses for one (20%) of the five stimuli in each set, zero inaccurate tact responses, and mand operants for the names of unknown for 100% of the opportunities.

Participant B6 emitted variables levels of responses for correct tact responses, inaccurate tact response and mands for the names of the unknown stimuli for his pre-intervention curiosity probes sessions with both types of stimuli. He emitted mand operants for the names of the unknown stimuli for 22% – 100% of the opportunities to ask for the names of the novel stimuli. He emitted incorrect tact responses to 89%, 40%, 60%, and 11% of the unknown stimuli in the pre-intervention curiosity probe sessions with more familiar visual stimuli. Participant B6 learned the tact response for one stimulus in his first and one stimulus in his fourth pre-treatment curiosity probe sessions with the more familiar unknown stimuli sets. In the pre-intervention curiosity probe sessions with unfamiliar types of visual stimuli the participant emitted inaccurate tact responses to 38%, 33%, 67%, and 0% of the opportunities across the four pre-probe sessions. He emitted correct tact responses for one stimulus (20%) in the set during his second and third pre-treatment probe sessions and accurate tact responses for two (40%) of the stimuli in the set in his first and fourth pre-intervention curiosity probe sessions with unfamiliar novel visual stimuli. Following his first intervention phase Participant B6 correctly named four (80%) of the five stimuli in the curiosity probe set, emitted inaccurate tact responses for 17% of the presentations of unknown stimuli, and emitted mands for the names of the unknown stimuli for 100% of the opportunities with familiar visual stimuli. In the post-intervention 1 curiosity probe with unfamiliar visual stimuli he correctly named three (60%) of the five stimuli in the set, emitted zero inaccurate tact responses, and emitted mands for the names of the unknown stimuli for 100% of his opportunities. After he completed the second treatment phase, Participant B6 emitted accurate tact responses for two (40%) of the five novel stimuli in the set with visually familiar stimuli, zero incorrect tacts for the unknown stimuli, and mands for 100% of the presentations for unknown stimuli. He correctly named three (60%) of the five stimuli in the post-intervention 2 curiosity probe session with unfamiliar visual stimuli, emitted zero inaccurate tact responses for unknown stimuli, and emitted appropriate mands for the names of the unknown stimuli across 100% of the opportunities.

Intervention Results

Each participant completed two intervention conditions (see Figures 13 – 18). Participant B1 met criterion (90% across two consecutive sessions) for his first intervention condition in 12 sessions. He completed his second intervention phase in six sessions (Figure 13). Participant B1 completed his second intervention condition in fewer sessions and learned word-object responses more rapidly in the latter intervention condition than in his first treatment. The slope of his trendline based on cumulative number of mastered word-object names in the first treatment was 0.425 whereas the slope of the trendline for second condition was 0.743. Participant B2 met criterion for both of his intervention conditions in nine sessions (Figure 14). The slope of Participant B2's trendline based on cumulative number of mastered word-object names in the first intervention was 0.733 and the slope of the trendline for his second intervention was 0.617. Participant B3 participated in 21 intervention sessions for his first treatment condition and 13 sessions in his latter treatment phase. The slope of Participant B3's trendline based on his cumulative number of mastered word-object responses during the first intervention was 0.242, whereas the slope for the trendline in the second phase was 0.407. Participant B4 met criterion for each intervention condition in seven sessions. The slope of the trendlines based on the cumulative number of mastered word-object relations for both intervention conditions was 0.714. Participant B5 mastered his first treatment phase in 11 sessions and his second treatment phase in 14 sessions. Participant B5's trendlines for the cumulative numbers of mastered word-object responses had a slope of 0.582 for the first intervention and 0.385 for the second. Participant B6 met criterion for intervention 1 and 2 within six sessions. The slope of the trendline for the cumulative word-object responses was 0.457 for the first intervention and 0.771 for the second.

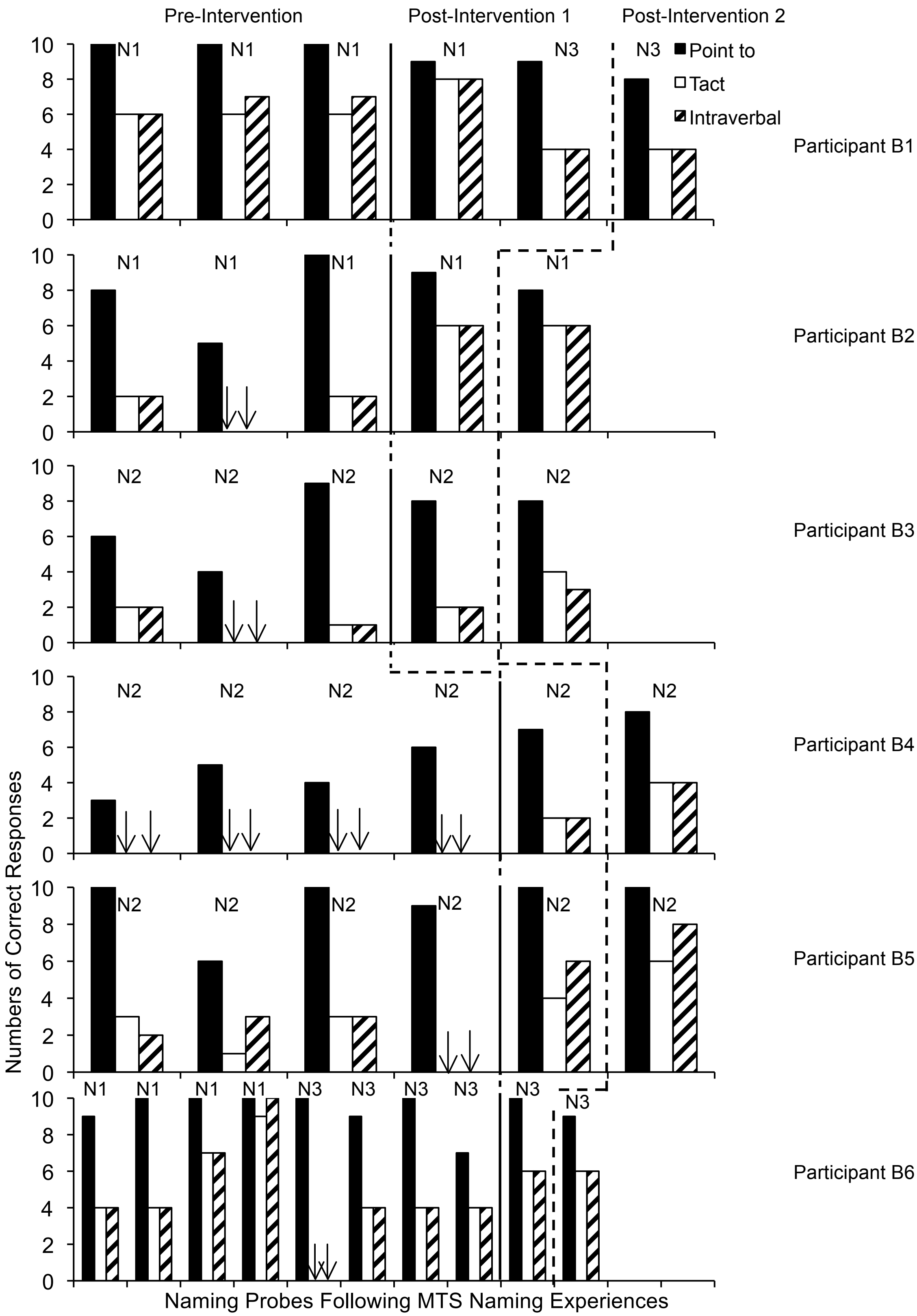


Figure 7. Participants' numbers of correct untaught listener and speaker responses during Naming probe sessions following MTS Naming experiences.

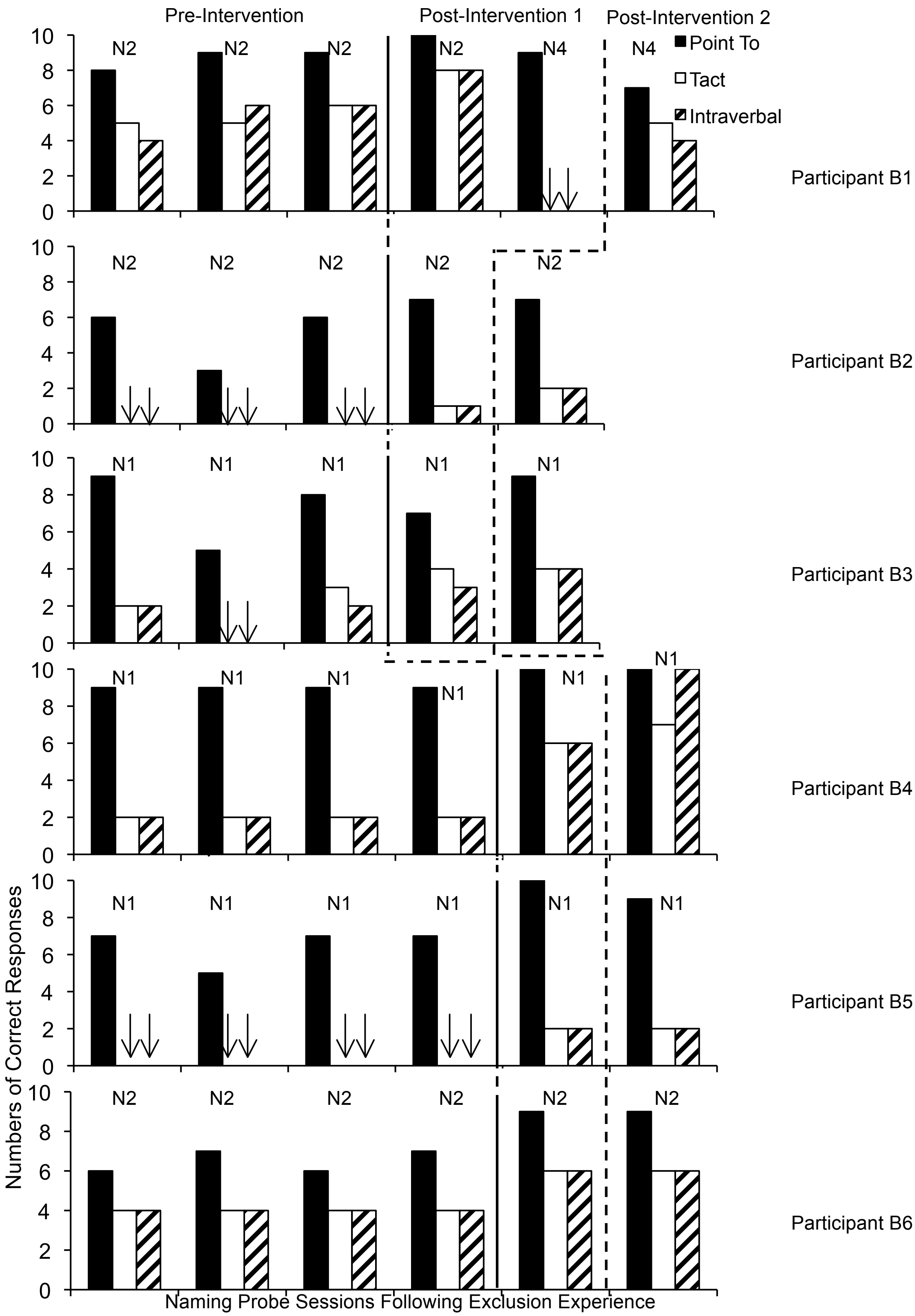


Figure 8. Participants' numbers of correct untaught listener and speaker responses during Naming probe sessions following exclusion Naming experiences.

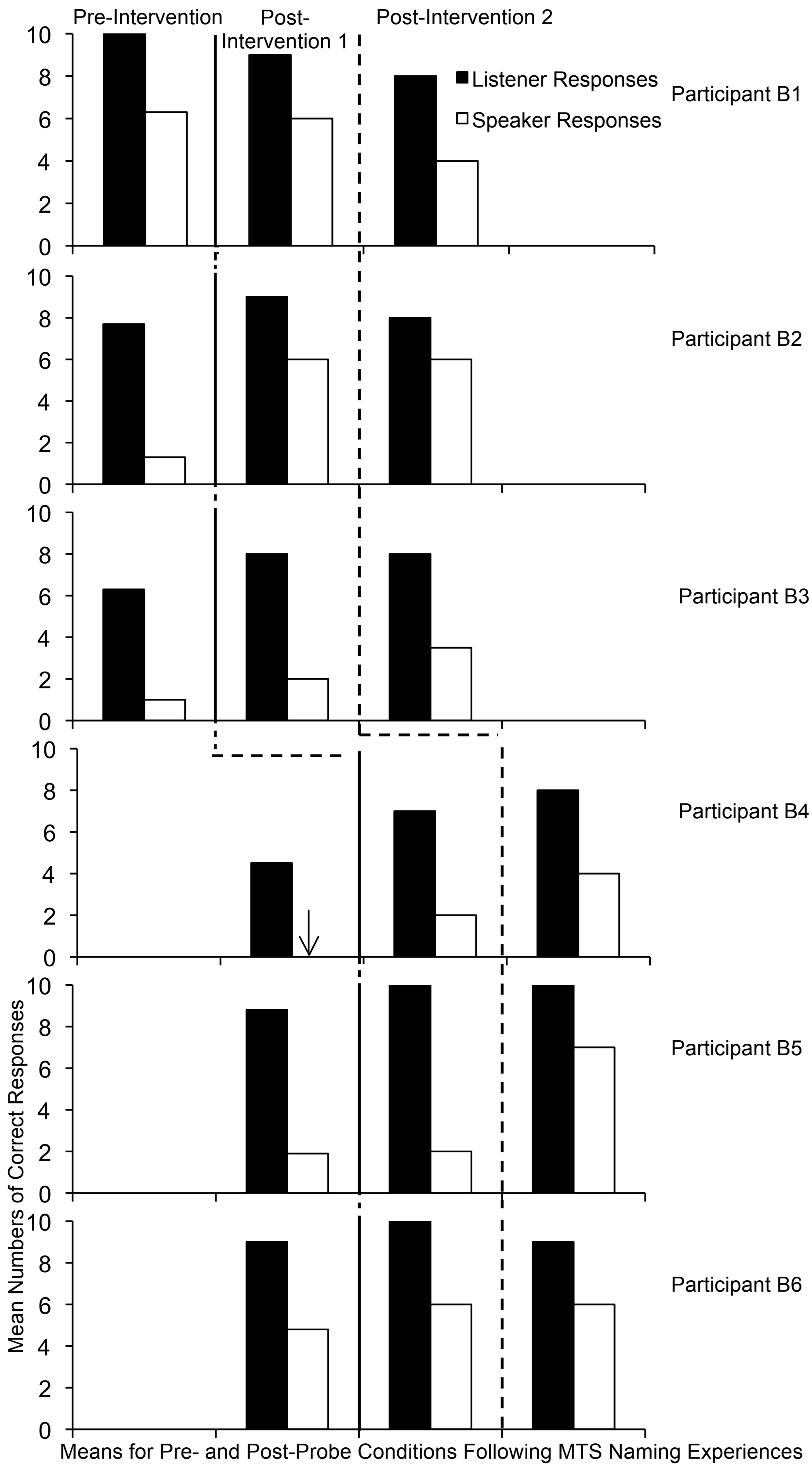


Figure 9. Participants' mean numbers of correct untaught listener and speaker responses during Naming probe sessions for each pre-post-probe condition following MTS Naming experiences.

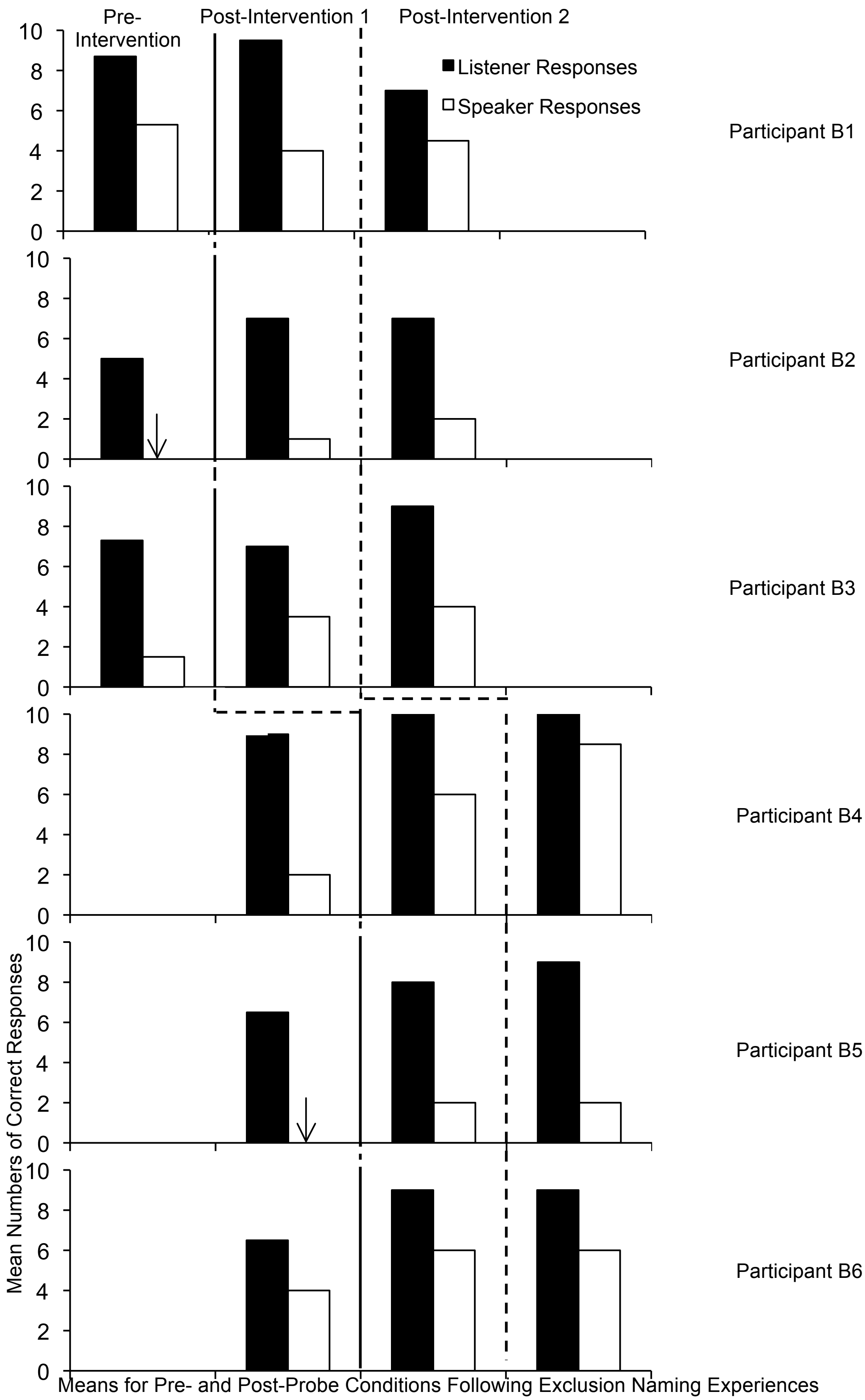


Figure 10. Participants' mean numbers of correct untaught listener and speaker responses during Naming probe sessions for each pre-and post-probe conditions following exclusion Naming.

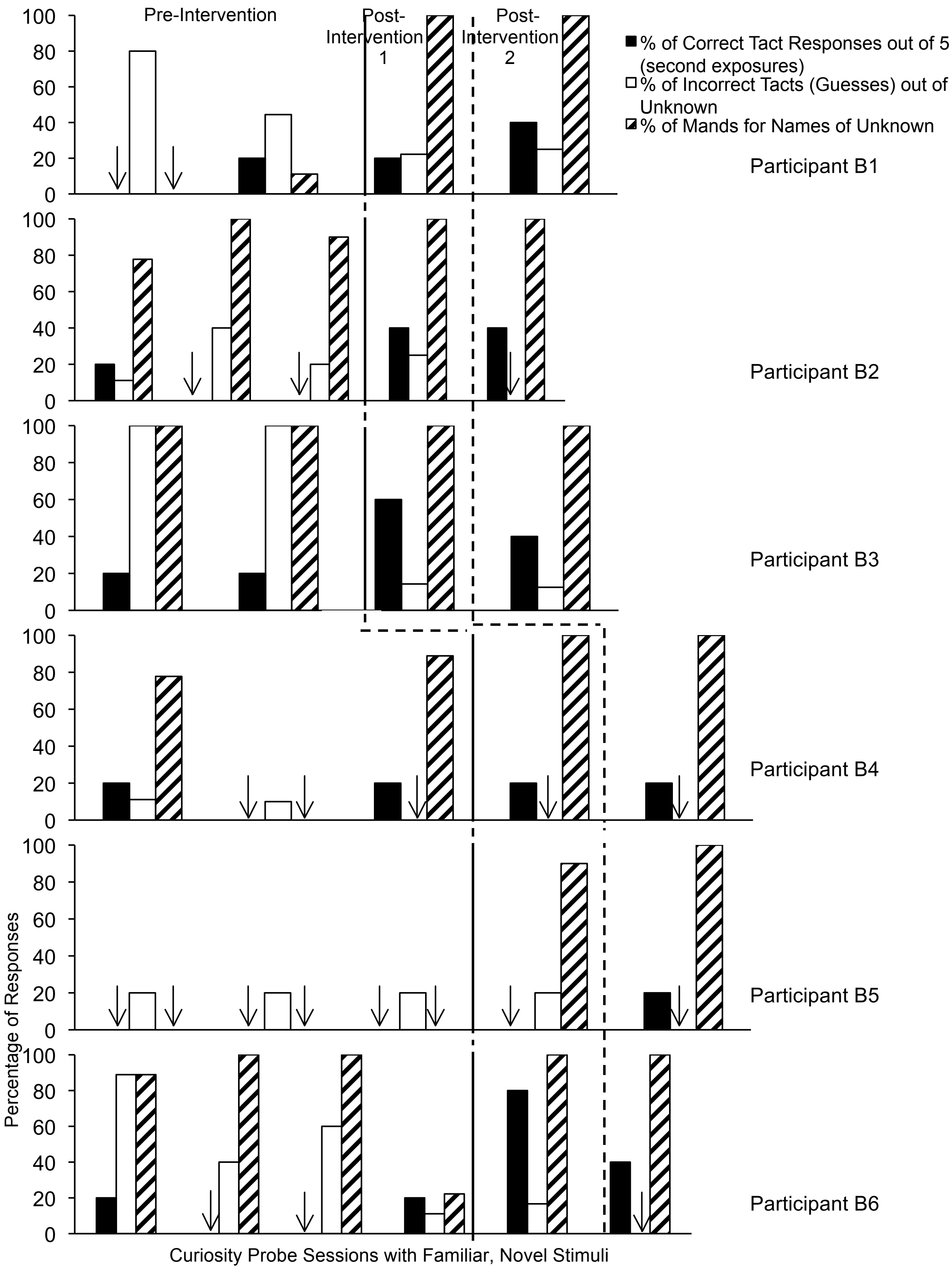


Figure 11. Participants' numbers of mands for names, incorrect tacts, and correct tacts to novel, familiar stimuli during curiosity probe sessions.

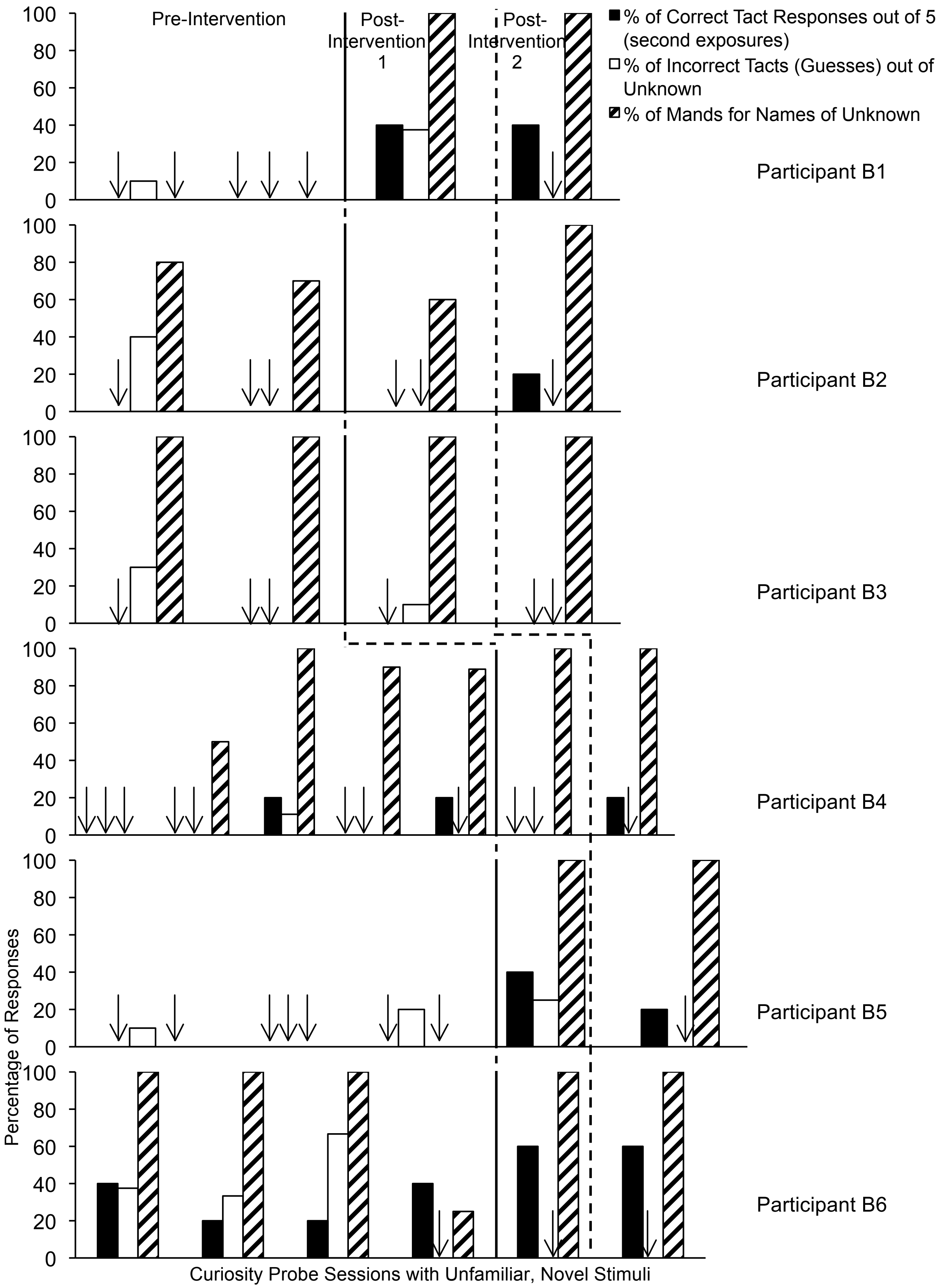


Figure 12. Participants' percentages of mands for names, incorrect tacts, and correct tacts to novel, unfamiliar stimuli during curiosity probe sessions.

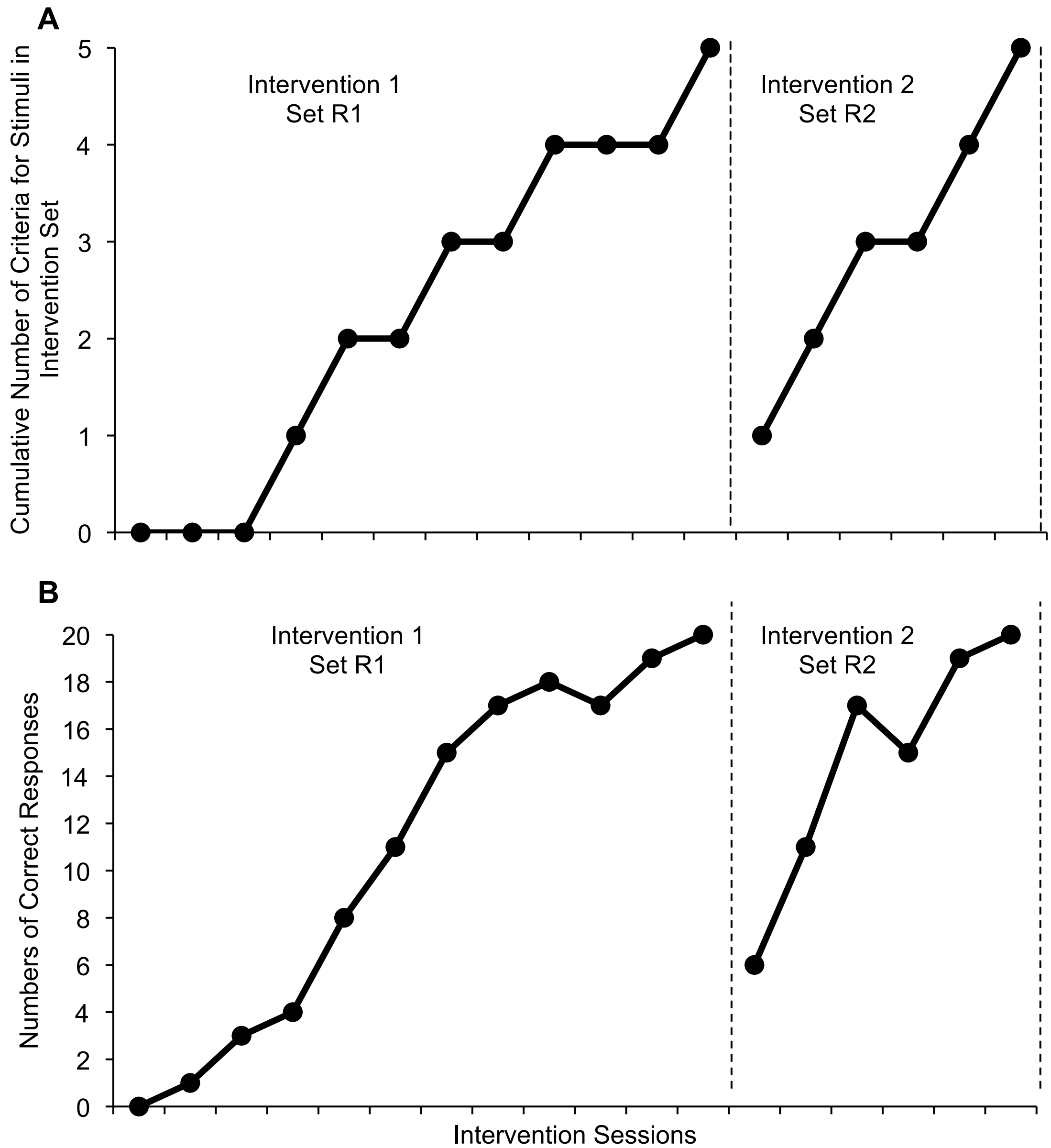


Figure 13. This figure shows Participant B1's cumulative numbers of mastered word-object responses for stimuli (A) and numbers of correct responses (B) during tact pair/probe intervention sessions.

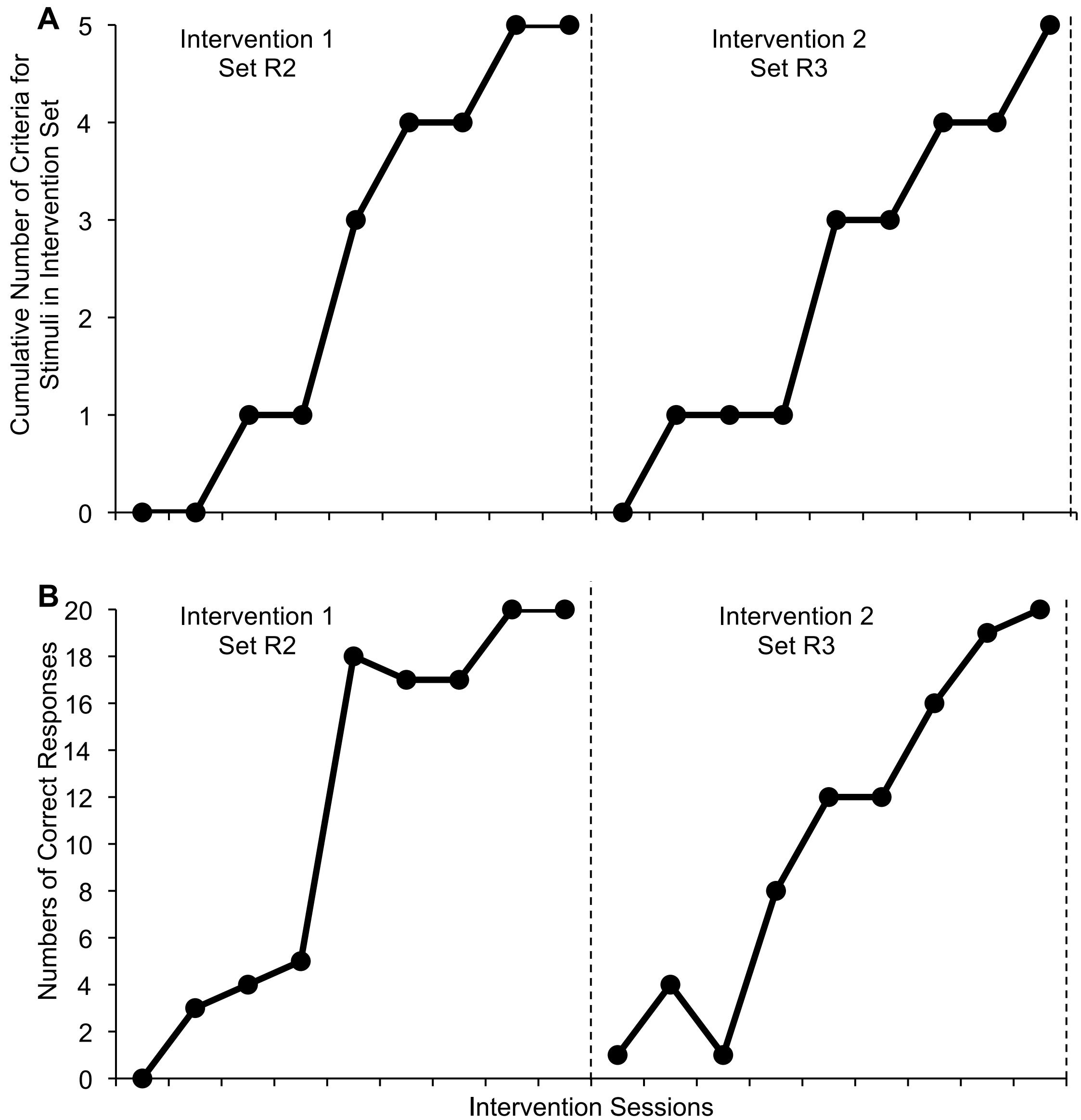


Figure 14. This figure shows Participant B2's cumulative numbers of mastered word-object responses for stimuli (A) and numbers of correct responses (B) during tact pair/probe intervention sessions.

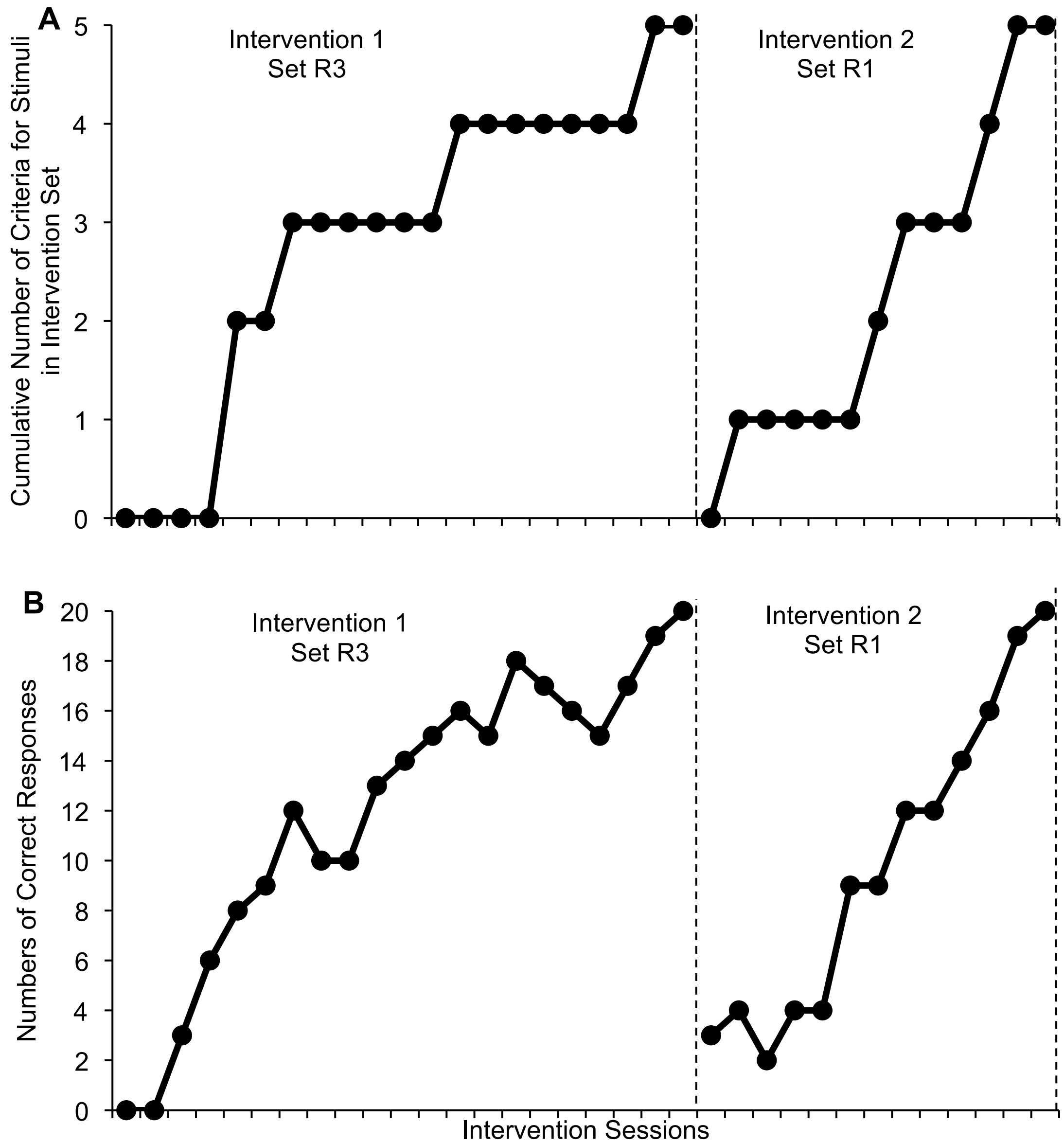


Figure 15. This figure shows Participant B3's cumulative numbers of mastered word-object responses for stimuli (A) and numbers of correct responses (B) during tact pair/probe intervention sessions.

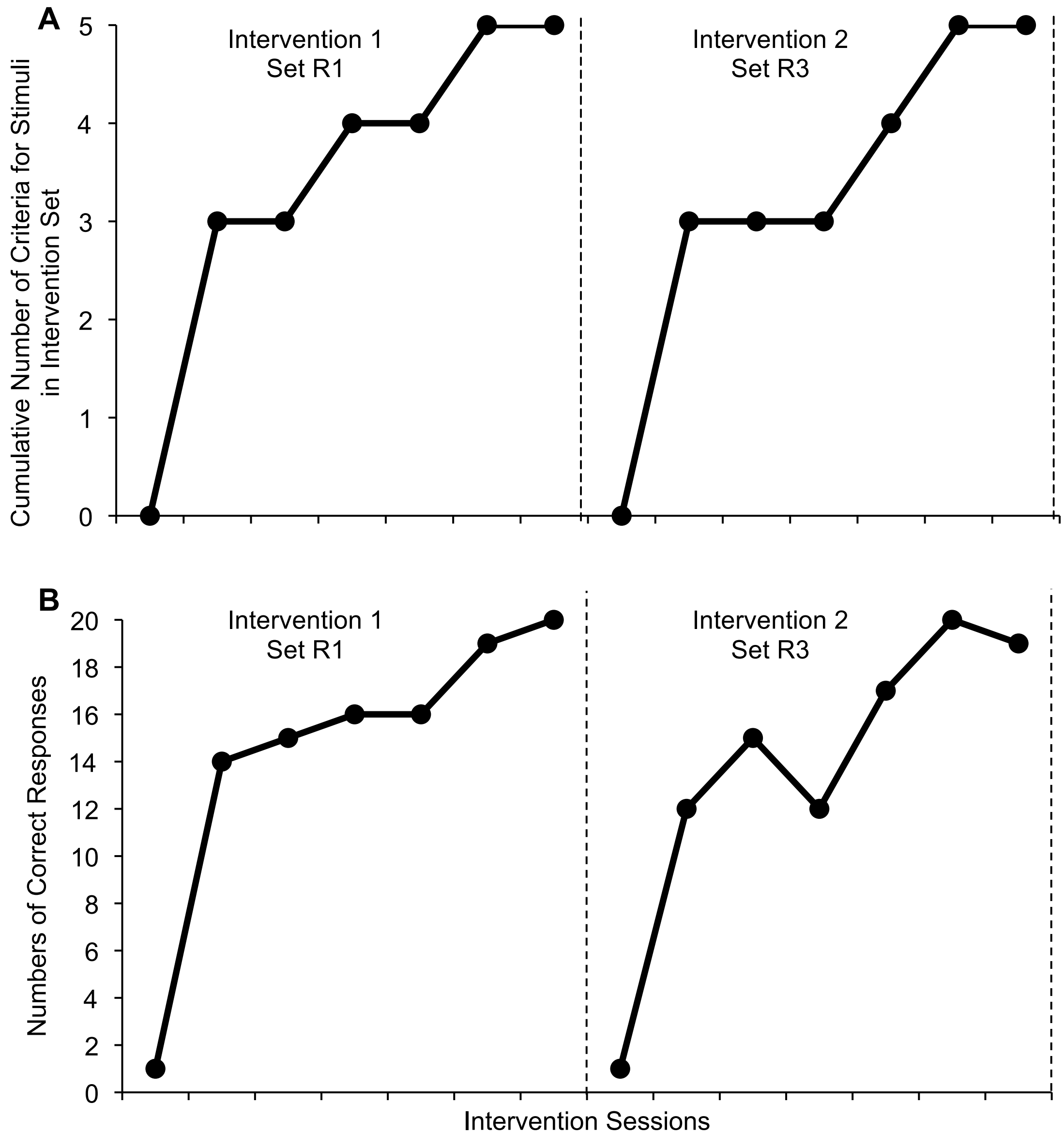


Figure 16. This figure shows Participant B4's cumulative numbers of mastered word-object responses for stimuli (A) and numbers of correct responses (B) during tact pair/probe intervention sessions.

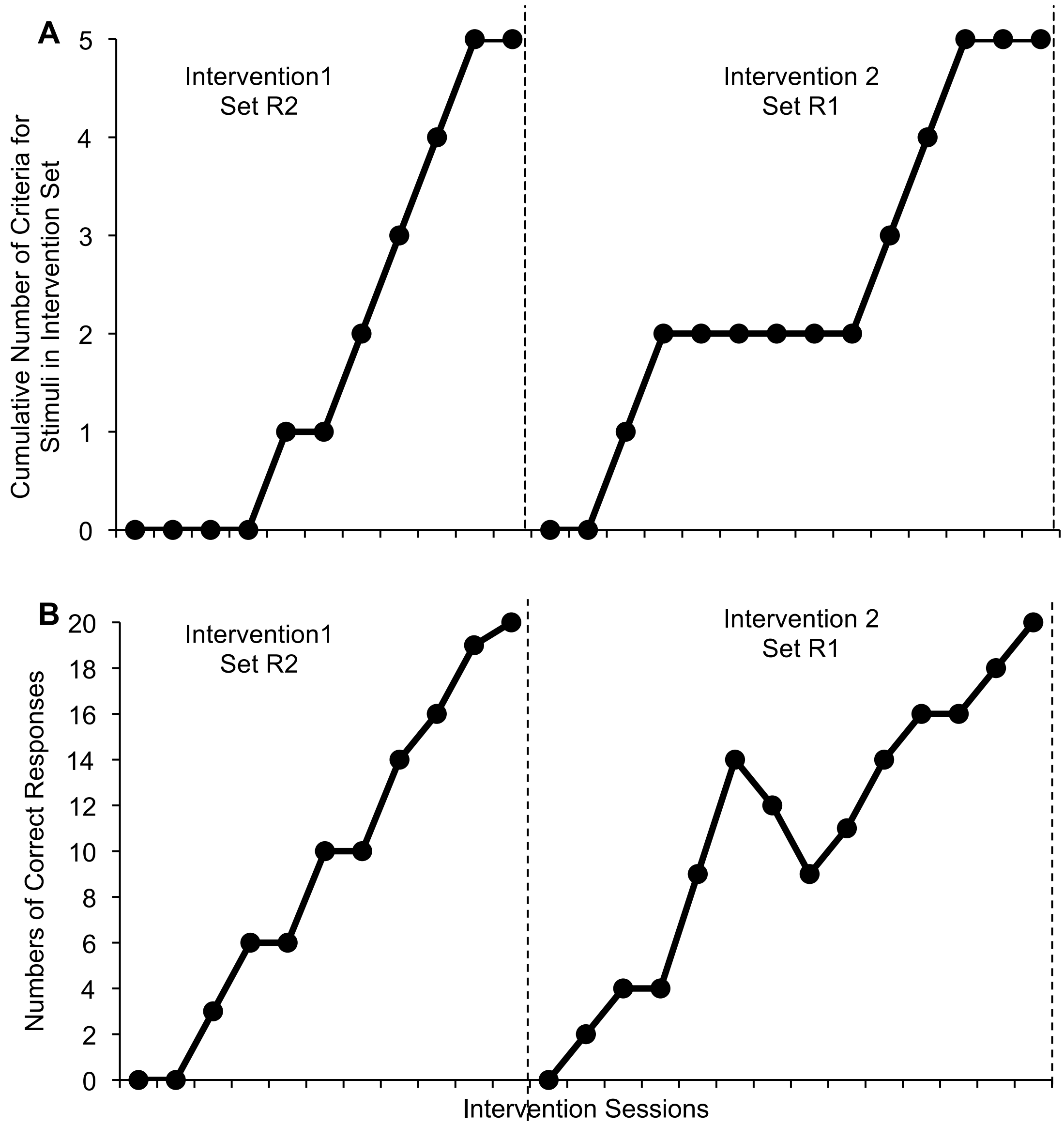


Figure 17. This figure shows Participant B5's cumulative numbers of mastered word-object responses for stimuli (A) and numbers of correct responses (B) during tact pair/probe intervention sessions.

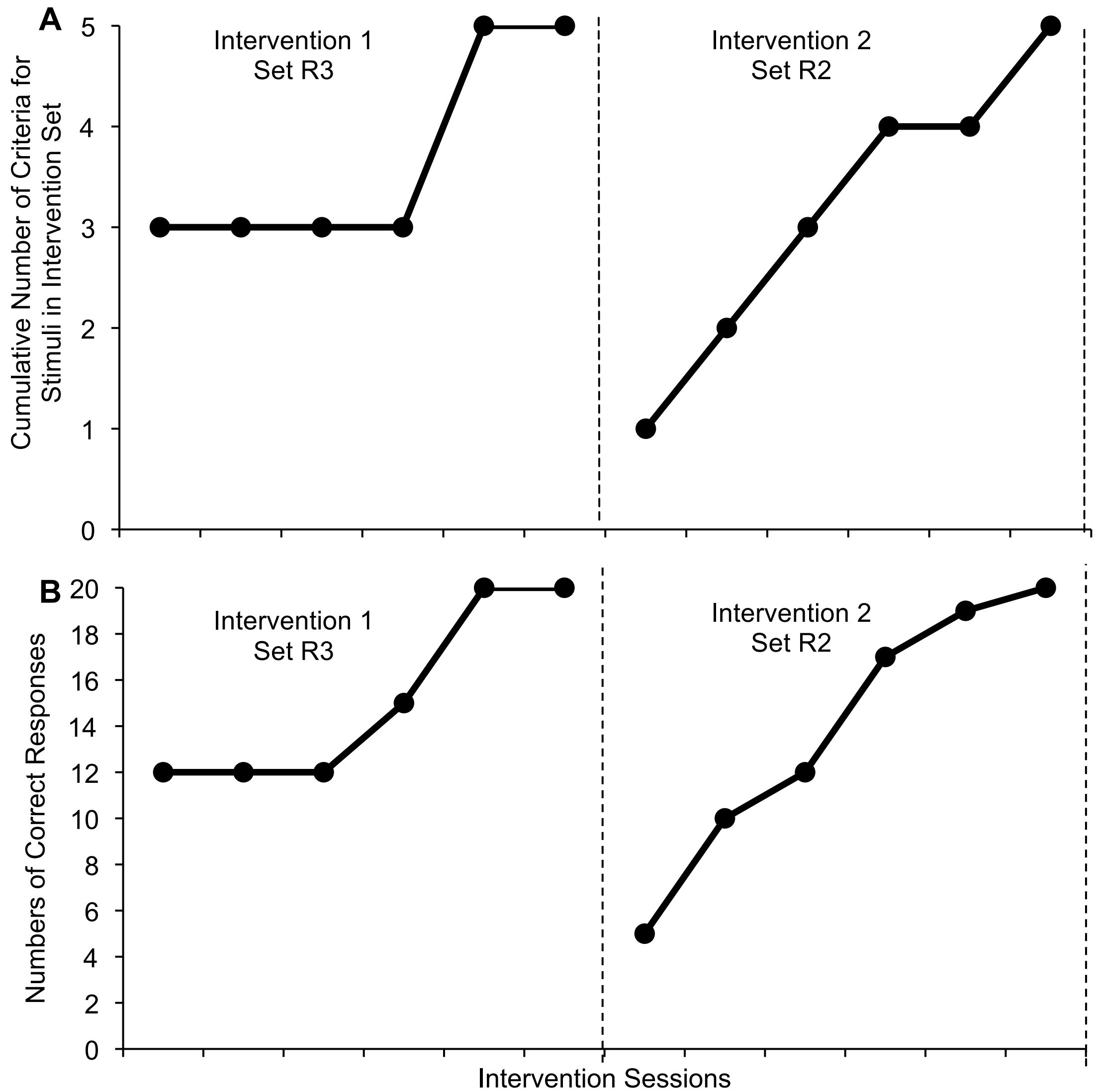


Figure 18. This figure shows Participant B6's cumulative numbers of mastered word-object responses for stimuli (A) and numbers of correct responses (B) during tact pair/probe intervention sessions.

Discussion

While the intervention procedure did not appear to fully induce Naming in the participants, there were notable effects in the participants. Following the two intervention conditions, participants B2, B3, B4, B5, and B6 demonstrated increases in their numbers of correct untaught speaker responses during Naming probe sessions with MTS Naming experiences compared to their pre-intervention probe sessions, which contained at minimum three pre-intervention probes to establish stability prior to treatment. Participant B4 also showed increased numbers of untaught listener responses in his post-treatment Naming probe sessions with MTS Naming experiences, compared to the baseline probe sessions.

After completing first and second treatment phases, participants B2, B3, B4, B5, and B6 again responded with increased numbers of accurate untaught speaker responses during the Naming probes that followed exclusionary Naming experiences. Participants B2, B4, B5, and B6 also showed slight increases in their numbers of correct point to responses following intervention compared to their levels of responding during baseline Naming probe measures with exclusion instruction as the Naming experience.

Participant B1 and B5 did not demonstrate any curiosity for the unknown stimuli during the pre-intervention probe sessions; they did not emit any mands for the names of the unknown stimuli in any of their pre-intervention curiosity probe measures across both types of stimuli sets (1 – novel, familiar types of visual stimuli, 2 – novel, unfamiliar types of visual stimuli). Following the two interventions these two participants emitted mand operants to request the names of the unknown stimuli for 100% of those opportunities. Participants B1, B2, B3, B5, and B6 learned more names (tact operants) for the previously novel stimuli in the curiosity probe sessions with unknown but familiar types of visual stimuli than they had acquired prior to intervention. Participants B1, B2, B5, and B6 learned more names of the unknown, unfamiliar types of visual stimuli following the intervention conditions compared to their levels of responding in baseline conditions. The participants' numbers of incorrect tact responses ("guesses") for the target stimuli decreased across the curiosity probe sessions for all, although most notably for participants B2, B3, B4, and B6.

I and other staff members observed Participant B1, B2, and B5 giggling and smiling in the presence of the unfamiliar symbols as well as trying to visually emulate the shapes of the intervention symbols by moving or contorting their bodies to try to make the same shapes during treatment sessions. Participant B2 was observed emitting autoclitics to specify the shapes of some of the stimuli as well as attempting to attribute functions to the unknown stimuli. Participant B3 often rehearsed the vocal tacts for the stimuli by echoing the presented stimulus and then echoing the previously presented symbol. During these rehearsals, Participant B3 would occasionally emit mands for more information about the symbols or mand for the name of a prior symbol.

There did not appear to be significant differences in levels of responding between the two types of Naming experiences in this experiment. This could be a result of the current experiment (Experiment 2) controlling for possible differences by utilizing unknown, unfamiliar types of visual stimuli for both Naming experiences, whereas, in Experiment 1 the stimuli were all unknown, but were familiar types of visual stimuli for the MTS Naming experiences and unfamiliar types of visual stimuli for the exclusion Naming experiences. The results also suggest the importance of assessing the reinforcement value of stimuli. Could the complexity and familiarity levels of stimuli affect the results of Naming assessments? Were these elementary age students with disabilities missing needed cusps to attain Naming with unfamiliar stimuli?

Chapter IV

Experiment 3

Method

For the third experiment, I conducted curiosity probe measures and Naming probes following the two types of Naming experiences. Furthermore, I counterbalanced the order of the types of Naming experience, the sequence of the types of curiosity probes, as well as the stimuli sets themselves. I also conducted Naming probe sessions with additional stimuli sets to examine if the familiarity and complexity of unknown stimuli affected the results of the participants' Naming probes. The participants in Experiment 2 were slightly older than the participants for this experiment, and the majority of the participants in the present experiment were young children without disabilities. Additionally, I selected the participants for this study because they had been noted to have many of the listener/speaker cusps in repertoire and some had portions of reader and writer skills in repertoire.

Participants

There were nine participants in this experiment. These participants were between 3 and 5 years of age with a mean of 4.1 years and a median of 4.0 years at the start of the study. The group of participants included seven male (77.8%) and two female (22.2%) participants. The participants were all placed within an integrated classroom for students with and without disabilities at a preschool located outside of a major metropolitan city. The preschool was a publicly funded and privately run preschool for students approved by their districts for early intervention services. The school also accepted a limited number of students without disabilities on a tuition basis. The staff at the school implemented the CABAS® methodology and behavior analytic curricula. At the time of the study, four (44.4%) of the nine participants had educational classifications as preschool students with disabilities and the remaining five (55.6%) were students without disabilities. Please see Table 27 for more detailed demographic information on the participants.

Table 27

Participants' Descriptions

Participant	Sex	Age	Educational Classification	Level of Verbal Behavior	Test Scores
P1	f	3	—	L/S	—
P2	m	5	—	L/S	—
P3	f	4	Preschool student with a disability	L/S	WPPSI-IV FSIQ: 97
P4	m	4	Speech & Language	L/S	—
P5	m	5	—	L/S/R	—
P6	m	4	Preschool student with a disability/autism	L/S	—
P7	m	3	—	L/S	—
P8	m	5	Preschool student with a disability/autism	L/S	—
P9	m	4	—	L/S	—

Note: WPPSI-IV = Wechsler Preschool and Primary Scales of Intelligence – IV. FSIQ = Full Scale Intelligence Quotient. m = male; f = female. L = Listener; S = Speaker; R = Reader.

Setting

An experimenter conducted the probe sessions for this experiment with the participants within a primarily unoccupied hallway within the participants' school, in an unoccupied classroom within the school, and in an unoccupied staff office in order to limit visual and auditory distractions. The experimenter determined the location of probe sessions within the preschool based on the availability of space with limited distractions. The experimenter presented the visual stimuli on the computer monitor in front and within reach of the participant. The participant was seated directly in front of a laptop computer monitor, and the experimenter stood or sat beside the participant during the sessions. When an independent observer was present for a session, the independent observer sat or stood adjacent to and slightly behind the participant.

Materials

The experimenter used the following materials: laptop computers, Microsoft PowerPoint software, prepared PowerPoint files, data collection forms, and pens. The PowerPoint files contained sets of stimuli. The stimuli sets used for the Naming probe sessions each contained five unknown, two-dimensional stimuli with two visual versions of each stimulus (refer to Tables 28, 29, and 30 for a description of the participants' Naming probe stimuli).

These stimuli sets included novel stimuli that varied in their levels of familiarity and complexity across the stimuli types: 1) Hebrew script symbols that were unknown and unfamiliar stimuli to the participants, 2) astronomical symbols that were unknown and unfamiliar types of stimuli, and 3) contrived cartoon monsters (with contrived names) that were unknown, but more familiar stimuli for participants. The vocal names of the stimuli were one to two syllables in length. The experimenter utilized two different visual versions, or multiple exemplars, of each stimulus to teach abstraction.

The stimuli for each set were compiled into a PowerPoint file for the Naming experience sessions and a second file for the probe sessions. The PowerPoint files for the Naming experience sessions (prior to the Naming probes) varied between the two types of Naming experiences. The instructional PowerPoint files for MTS Naming experiences contained only the five unknown stimuli from that set. Each slide for the MTS experience included one target stimulus centered in the top half of the computer screen and a thin, gray line dividing the top and bottom halves of the monitor. Within the bottom portion of the slide were three of the stimuli from the same set, including the other visual version of the target stimulus. The experimenter varied the location of the matching stimulus (positive exemplar) to avoid unintentional positional prompts or patterns. The instructional PowerPoint files for the exclusion Naming experiences contained slides of known, common stimuli and the unknown stimuli. Each instructional slide for the exclusion Naming experience contained a known letter of the English alphabet, a known number, a known visual representation of a common color, and a picture of a known common animal in addition to one unknown target stimulus from the participant's set.

The experimenter combined known and unknown stimuli in the PowerPoint files for the curiosity probe sessions (see Tables 31 and 32 for the specific stimuli). Each stimuli set for the curiosity probes contained five stimuli with two visual versions of each stimulus, similar to the Naming sets. There were two types of stimuli used for the curiosity probe sessions. The experimenter conducted one probe for measuring curiosity with unknown cartoon characters (familiar type of stimuli) presented along with known stimuli (known English letters, numbers, colors, animals) and one probe with visually unfamiliar, unknown stimuli that appeared contrived to the participants presented along with the known stimuli (known English letters, numbers, animals, colors). Each slide for both types of curiosity probes contained one unknown stimulus and four known stimuli. Please refer to Table 33 for the participants' assigned stimuli sets and the sequences of their Naming and curiosity probes.

Table 28

Sets of Hebrew Script Stimuli for Naming Probe Sessions

Sets of Hebrew Script Stimuli					
H1		H2		H3	
Tact	Visual	Tact	Visual	Tact	Visual
Gimel	ג	Dalet	ד	Aleph	א
Yod	י	Het	ח	Zayin	ז
Lamed	ל	Tsadi	צ	Resh	ר
Shin	ש	Mem	מ	Tet	ט
Tav	ת	Qof	ק	Pe	פ

Table 29

Sets of Astronomical Stimuli for Naming Probe Sessions

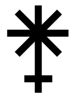
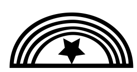
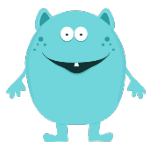
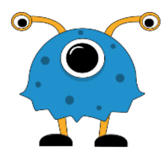
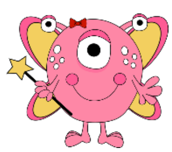
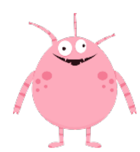
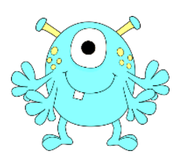
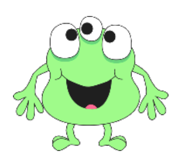
Sets of Astronomical Stimuli					
A1		A2		A3	
Tact	Visual	Tact	Visual	Tact	Visual
Juno		Charon		Ceres	
Cybele		Vesta		Flora	
Orcus		Pallas		Metis	
Mimas		Hektor		Thetis	
Dione		Iris		Psyche	

Table 30

Sets of Familiar, Contrived Cartoon Monsters for Naming Probe Sessions

Sets of Cartoon Monster Stimuli					
M1		M2		M3	
Tact	Visual	Tact	Visual	Tact	Visual
Patek		Needore		Doomar	
Minoob		Baimax		Frabee	
Stiffle		Trinoo		Hepex	
Kleema		Wugev		Clivom	
Arun		Opat		Utig	

Note: Several images retrieved from http://www.mycutegraphics.com/graphics/monster-images.html. Copyright 2014 by L. Strickland.

Table 31

Names of the Familiar, Unknown Stimuli for Curiosity Probe Sets

Sets		
F1	F2	F3
Penfold	Nero	Grape Ape
Mr. Magoo	Riff Raff	Felix
Roobarb	Willo[a]	Heckle and Jeckle
Chumley	Gossamer[a]	Witch Hazel
Tuxedo[a]	The Tick	Bertie

[a] The full name of the character was shortened due to age of participants.

Table 32

Sets of Unfamiliar, Unknown Stimuli for Curiosity Probe Sessions

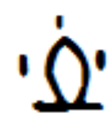
Sets					
C1		C2		C3	
Tact	Visual	Tact	Visual	Tact	Visual
psi	Ψ	phi	φ	wáng	
theta	Θ	zeta	ζ	tǔ	
delta	δ	lamda	λ	huǒ	
gamma	γ	omega	Ω	bèi	
mu	μ	sigma	Σ	xiàng	

Table 33

Participants, their Sequences of Naming Experiences and Curiosity Probes, and their Assigned Sets for Probes

	Participants								
Type of Stimuli Set	P1	P2	P3	P4	P5	P6	P7	P8	P9
Sequence of Naming Experiences within each Type of Stimuli	MTS EXC	EXC MTS	MTS EXC	EXC MTS	EXC MTS	MTS EXC	EXC MTS	MTS EXC	EXC MTS
Naming Probe Sets with MTS Naming Experiences									
Hebrew Script	H1	H2	H2 H3	H1	H1 H3	H2	H2	H1	H1
Astronomical Stimuli	A1	A2	A2	A1	A1	A2	A2	A1 A3	A1
Contrived Cartoon	M1	M2	M2	M1	M1	M2 M3	M2	M1	M1
Naming Probe Sets with Exclusion Naming Experiences									
Hebrew Script	H2	H1	H1	H2	H2	H1	H1	H2	H2
Astronomical Stimuli	A2	A1	A1	A2	A2	A1	A1	A2	A2
Contrived Cartoon	M2	M1	M1	M2	M2 M3	M1	M1	M2	M2
Sequence of Curiosity Probes	UFC FC	UFC FC	FC UFC	UFC FC	FC UFC	UFC FC	FC UFC	FC UFC	FC UFC
Familiar, Unknown Stimuli for Curiosity Probe Sets	F1	F2	F1	F2	F2	F1	F1	F2	F2
Unfamiliar, Unfamiliar Stimuli for Curiosity Probe Sets	C2	C1	C1	C2	C2	C1	C2	C2	C1

Note: Match-to-Sample = MTS; Exclusion = EXC; Familiar Curiosity Stimuli Set = FC; Unfamiliar Curiosity Stimuli Set = UFC.

Dependent Variables

Similar to Experiment 2, the dependent variables in this study were the participants' numbers of correct untaught listener and speaker responses during Naming probe sessions, mean numbers of listener and speaker criteria for stimuli during Naming probes, numbers of mands for names of unknown stimuli during curiosity probes, and numbers of correct and incorrect tact responses during curiosity probes.

The target behaviors for the Naming probes included point-to, pure tact, and impure tact responses to sets of 2-dimensional stimuli presented on a computer monitor through Microsoft PowerPoint. For the "point to ___" response, the participant was given a vocal verbal antecedent, "point to ___," and the participant was to point to the target stimulus that was among negative exemplars (in a field of three stimuli). The pure tact response was defined as the participant stating the correct name of the stimulus following the presentation of the visual stimulus, and the impure tact, an intraverbal response, consisted of the experimenter presenting a picture and providing a vocal antecedent such as, "what's this?" The experimenter recorded a correct response for the impure tact when the participant vocally responded with the correct name of the picture. Reinforcement was not delivered nor were corrections provided during the Naming probe trials for the untaught forms.

During the curiosity probe sessions the experimenter recorded the participant's vocal verbal behavior following the presentation of a slide containing the known stimuli and unknown stimulus. The experimenter documented each instance a participant asked for the name (an example of a mand for information) of the unknown stimulus on the slide, incorrectly guessed the name, and correctly responded with the name of the unknown stimulus when it was presented the second time.

Independent Variables

The type of Naming experience and type of stimuli were the independent variables.

Design

This study compared two types of Naming experiences on the acquisition of untaught listener and speaker responses and compared different types of visual stimuli for the Naming probes on untaught listener and speaker responses. The experimenter also examined the relationship between participants' responses on Naming probes to their measures of "question asking" or "information seeking" behavior during curiosity probe sessions.

Data Collection

The experimenter collected data on: 1) the numbers of correct and incorrect responses to Naming probe trials for each of the three untaught response types (10 trials per topography) during the Naming probes, 2) the numbers of correct and incorrect responses during the 20-learn unit presentations for each session of the Naming experiences, and 3) the numbers of mands for names, correct tact responses, and incorrect tact responses during the curiosity probe sessions. For the Naming experiences and Naming probe sessions, the experimenter recorded a plus (+) on the data sheet following a correct response and a minus (-) following an incorrect response. The experimenter recorded the correct and incorrect responses on paper and then recorded the number of correct responses per session on a graph.

During the curiosity probe sessions, the experimenter designed a data sheet, which contained one row for each of the 10 opportunities (five unknown stimuli presented amongst known stimuli twice) to respond to a PowerPoint slide. The experimenter subdivided the rows on the curiosity data sheet into columns for recording each instance for each target stimulus of a mand for the name of the unknown stimulus, an incorrect tact, and a correct tact. The experimenter marked a check in the corresponding box if a participant emitted a mand for the name, a correct tact response, or an incorrect tact response to the unknown stimulus for each opportunity (one row on the data sheet represented one opportunity). Following each curiosity probe session, the experimenter totaled each response type for the session.

Then, the experimenter calculated the percentage of each target response based on the numbers of opportunities for each of the targeted behaviors. The maximum number of correct tact responses for the unknown stimuli in the curiosity probes was fixed at five, since the stimuli were novel at the start of the probe session. Therefore, the first opportunity to view each of the five stimuli could not lead to a correct tact response. For example, if the participant emitted a mand for the name of each stimulus the first time it was presented and learned the tact response, then the maximum number he could achieve for correct tact responses in one session was five (this would be an example of the participant learning all five stimuli after the first presentations and emitting the correct tact responses for each stimulus following the second presentations within the probe). The total numbers of incorrect tact response opportunities and opportunities to mand for the names of the unknown stimuli varied based on the numbers of correct tact responses during the second presentations of the stimuli within a probe. For example, if a participant did not learn any of the five tact responses then he could potentially incorrectly tact or mand for the name 10 times (five stimuli each with two presentations). Whereas, if a participant emitted a mand for the name for an unknown stimulus and then emitted the correct tact for that same stimulus following its second presentation then the numbers of opportunities for incorrect tacts and mands for names were reduced based on the number(s) of correct tact responses (the numbers of times a participant asked for the name and then learned the name). The experimenter graphed the following: 1) percentage of correct tact responses out of five opportunities, 2) percentage of incorrect tact responses out of his/her number of unknown, and 3) percentage of mands for name out of his/her number of unknown for each curiosity probe session.

Procedure

The experimenter utilized the same general procedure outlined within the first experiment's procedure section for the Naming experiences and Naming probe sessions. Additionally, for this experiment the experimenter conducted further Naming probe sessions using two-dimensional astronomical symbols and contrived cartoon monsters assigned contrived two syllable vocal names in addition to the Naming probe sessions with Hebrew script. The experimenter's procedure for the curiosity measures was identical to the one summarized in Experiment 2.

Interobserver agreement

The experimenter and an independent observer collected data to obtain IOA for the MTS Naming experiences, exclusion Naming experiences, Naming probe sessions, and curiosity probe sessions. For Naming experience sessions and Naming probe sessions the experimenter calculated IOA by dividing the number of agreements by the total number of trial-by-trial (point-to-point) agreements and disagreements per probe session and multiplying by 100%. The percentage of each participant's sessions with IOA, the mean IOA, and the range of IOA are reported in Tables 34 - 36. IOA was obtained for 35.6% of the participants' Naming probe sessions with mean agreement of 99.7% (range of 96.7 – 100%). IOA was obtained for 28.0% of the participants' MTS and exclusion instructional sessions conducted prior to probe sessions with mean agreement of 100%. For the curiosity measures, 30.0% of the probe sessions had IOA, with a range of 93.3 – 100% and a mean of 98.1%.

Table 34

IOA for the Participants' Naming Probe Sessions

Participant	% of Naming Probe Sessions with IOA	Mean IOA	Range of IOA
P1	30.8%	100%	—
P2	16.7%	100%	—
P3	35.3%	100%	—
P4	41.7%	99.3%	96.7 – 100%
P5	47.4%	100%	—
P6	38.1%	98.8%	96.7 – 100%
P7	28.6%	100%	—
P8	30.0%	99.5%	96.7 – 100%
P9	50.0%	100%	—
Across All Participants	35.6%	99.7%	96.7 – 100%

Table 35

IOA for the Participants' Naming Experiences

Participant	% of Naming Experience Sessions with IOA	Mean IOA	Range of IOA
P1	16.7%	100%	—
P2	16.7%	100%	—
P3	28.7%	100%	—
P4	50.0%	100%	—
P5	37.5%	100%	—
P6	28.7%	100%	—
P7	33.3%	100%	—
P8	21.4%	100%	—
P9	16.7%	100%	—
Across All Participants	28.0%	100%	—

Table 36

IOA for the Participants' Curiosity Probe Sessions

Participant	% of Curiosity Probes with IOA	Mean IOA	Range of IOA
P1	25.0%	100%	—
P2	25.0%	93.3%	—[a]
P3	50.0%	98.4%	96.7 – 100%
P4	25.0%	100%	—
P5	33.3%	96.7%	93.3 – 100%
P6	25.0%	96.7%	—[a]
P7	25.0%	100%	—
P8	33.3%	98.4%	96.7 – 100%
P9	25.0%	100%	—
Across All Participants	30.0%	98.1%	93.3 – 100%

[a] There was IOA for one of the participant's curiosity probe sessions; therefore there was no range of IOA.

Results

I compared the results of Naming probe measures across Naming experiences (MTS, Exclusion) and types of Stimuli (Hebrew Script, Astronomical Symbols, Contrived Cartoons) to examine the within-subjects effects of the independent variables on the participants' numbers of listener and speaker responses during probe sessions for the Naming capability and on the target behaviors for the curiosity probes. I also analyzed the data using Pearson's correlations to examine the strength and direction of associations between dependent variables from the Naming probes and curiosity measures.

Numbers of Listener and Speaker Responses

The mean numbers of listener and speaker responses during Naming probe sessions for each type (category) of stimuli and across each type of Naming experience are outlined in Table 37 and visually shown in Figures 19 – 21. The participants' numbers of correct responses during all Naming probes to achieve stability of responding are shown in Figures 22 – 27. During each Naming probe session, there were 10 opportunities for listener responses and 10 opportunities for each of the two speaker components, tact responses and intraverbal responses. The experimenter calculated the mean of the two speaker response categories (tact and intraverbal) and considered that to be the mean of the participant's speaker responses for that particular probe. Since participants participated in at least two, or more, probes for each type of Naming experience to achieve steady state responding and across each type of stimulus category, the experimenter calculated the mean for each participant's listener responses and speaker responses to Hebrew script stimuli, astronomical stimuli, and contrived cartoon monster stimuli.

As shown in Table 37 and Figure 22, it is consistent and clear that mean numbers of correct untaught listener responses (range of means: 6.10 – 8.06) were greater than mean numbers of correct untaught speaker responses (range of means: 2.44 – 3.82) for both types of Naming experiences and across all types of stimuli examined within this experiment. The mean number of listener responses across all Naming experiences and across all types of stimuli was 7.45. Whereas, the mean number of speaker responses across all Naming experiences and across all tested stimuli was 2.97.

In comparing the two Naming experiences, the MTS means across all stimuli for each of the two responses topographies (listener M_{MTS} = 7.11; speaker M_{MTS} = 2.72), were slightly lower than the means following exclusionary Naming experiences (listener $M_{\text{exclusion}}$ = 7.73; speaker

$M_{exclusion}$ = 3.21). This can be seen, more specifically, when comparing the two listener means (MTS $M_{listener}$ = 7.11; exclusion $M_{listener}$ = 7.73) and the two speaker means (MTS $M_{speaker}$ = 2.72; exclusion $M_{speaker}$ = 3.21) across all stimuli.

For both listener response means and speaker response means, the MTS Naming experiences resulted in mean responses with Hebrew script stimuli being the lowest (listener *M* = 6.10; speaker *M* = 2.44), followed by mean responses with astronomical stimuli (listener *M* = 7.18; speaker *M* = 2.49), and the greatest means for both response typographies with the more familiar type of stimuli, contrived cartoon monsters (listener *M* = 8.06; speaker *M* = 3.24).

This pattern was reversed with the exclusion Naming experiences, with the greatest means for both response forms with the Hebrew script (listener *M* = 8.01; speaker *M* = 3.82) followed by the means for astronomical stimuli (listener *M* = 8.00; speaker *M* = 2.92) and the lowest means with the contrived cartoon monsters (listener *M* = 7.22; speaker *M* = 2.89).

As outlined in Table 37, there was greater variation in the distribution for the numbers of speaker responses compared to the variation shown for the listener responses across all Naming probes ($SD_{listener}$ = 1.62; $SD_{speaker}$ = 2.89) and for all Naming experiences for each stimuli type (Hebrew script: $SD_{listener}$ = 1.77, $SD_{speaker}$= 2.95; astronomical symbols: $SD_{listener}$ = 1.72, $SD_{speaker}$ = 3.09; cartoon monsters: $SD_{listener}$ = 1.99, $SD_{speaker}$= 3.15).

There was also a greater spread of the distribution of the speaker responses than the listener responses for each type of Naming experience across all stimuli (MTS: $SD_{listener}$ = 2.01, $SD_{speaker}$ = 2.99; Exclusion: $SD_{listener}$ = 1.71, $SD_{speaker}$ = 2.85). This was also true within each Naming experience for each stimuli category for variation in numbers of speaker responses compared to the variation shown for listener responses in each respective category (please see Table 37 for standard deviations for each type of stimuli within each Naming experience).

Table 37

Descriptive Statistics for Listener and Speaker Responses during Naming Probe Sessions

Type of Response	Type of Naming Experiences	Type of Stimuli	*M*	*SD*	N
Listener	Across Both Naming Experiences	Across All Stimuli	7.45	1.62	9
		Hebrew	7.06	1.77	9
		Astronomical	7.53	1.72	9
		Familiar/Monsters	7.64	1.99	9
	MTS	Across All Stimuli	7.11	2.01	9
		Hebrew	6.10	2.43	9
		Astronomical	7.18	2.15	9
		Familiar/Monsters	8.06	1.79	9
	Exclusion	Across All Stimuli	7.73	1.71	9
		Hebrew	8.01	1.69	9
		Astronomical	8.00	1.54	9
		Familiar/Monsters	7.22	2.49	9
Speaker	Across Both Naming Experiences	Across All Stimuli	2.97	2.89	9
		Hebrew	3.14	2.95	9
		Astronomical	2.72	3.09	9
		Familiar/Monsters	3.07	3.15	9
	MTS	Across All Stimuli	2.72	2.99	9
		Hebrew	2.44	3.22	9
		Astronomical	2.49	3.27	9
		Familiar/Monsters	3.24	3.52	9
	Exclusion	Across All Stimuli	3.21	2.85	9
		Hebrew	3.82	3.03	9
		Astronomical	2.92	3.11	9
		Familiar/Monsters	2.89	2.95	9

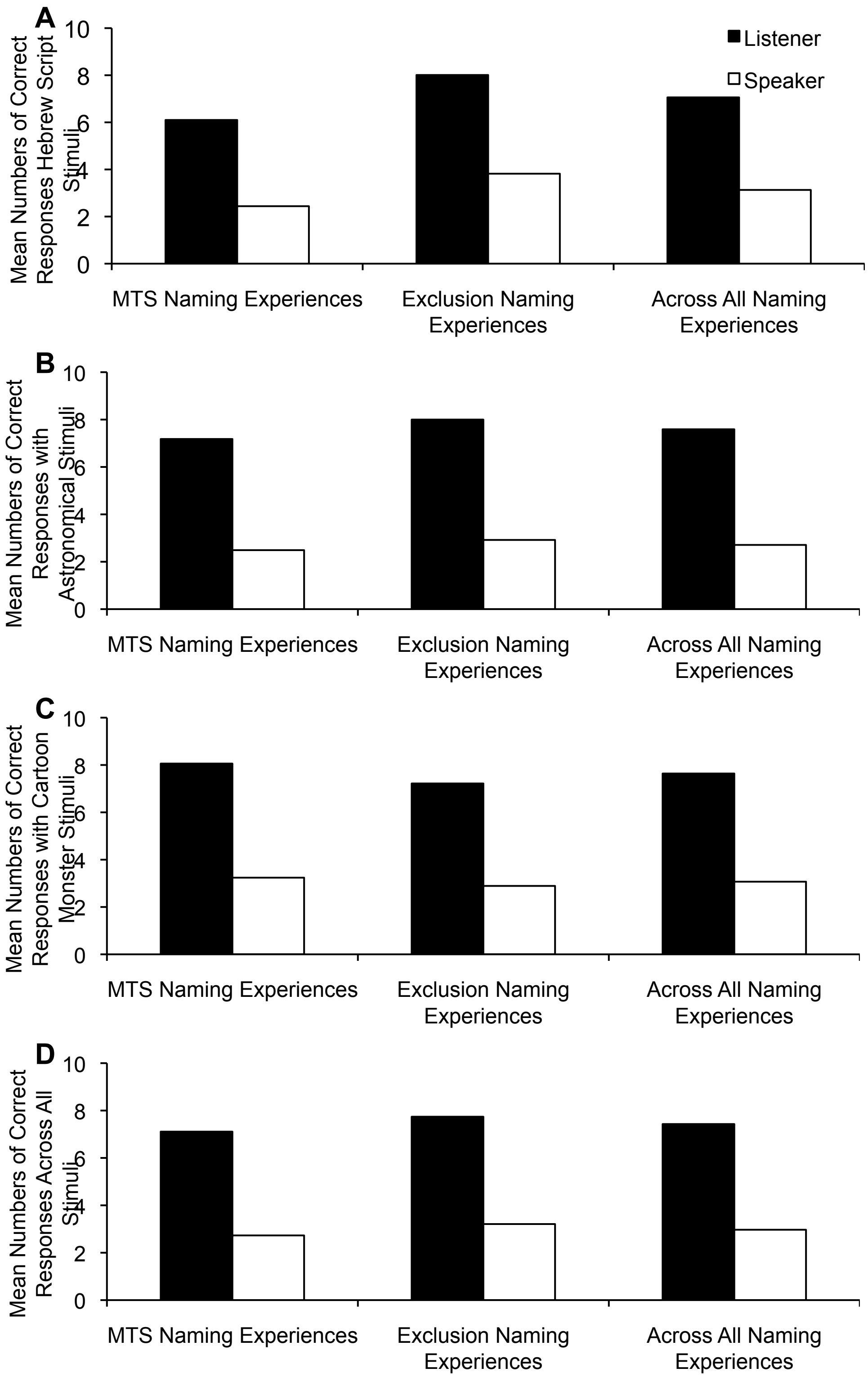


Figure 19. This figure contains the participants' mean numbers of listener and speaker responses between the two Naming experiences and across all Naming experiences for: Hebrew script (A), astronomical symbols (B), contrived cartoon monsters (C), and across all stimuli (D).

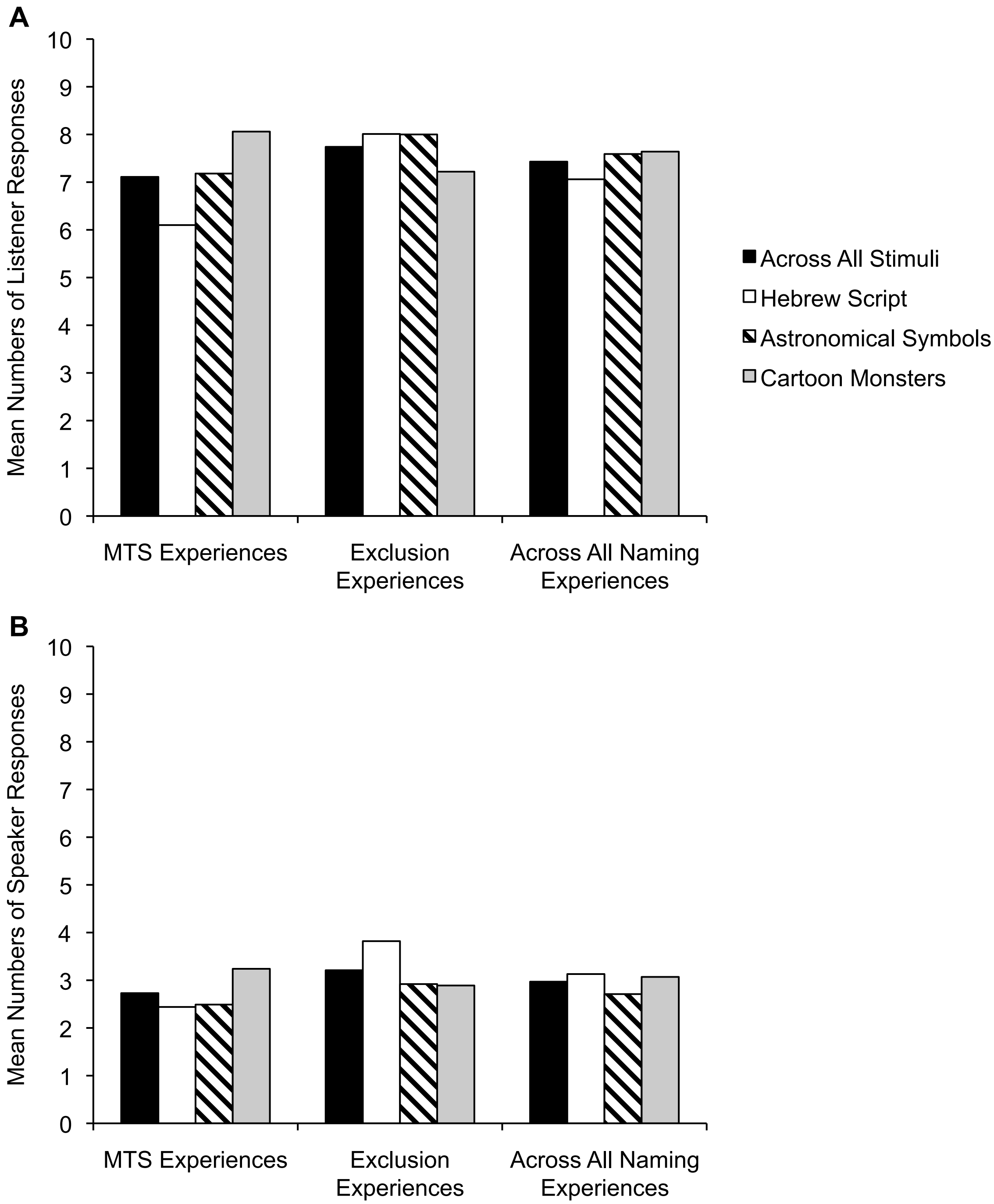


Figure 20. The participants' mean numbers of listener responses (A) and speaker responses (B) for stimuli categories and across Naming experiences.

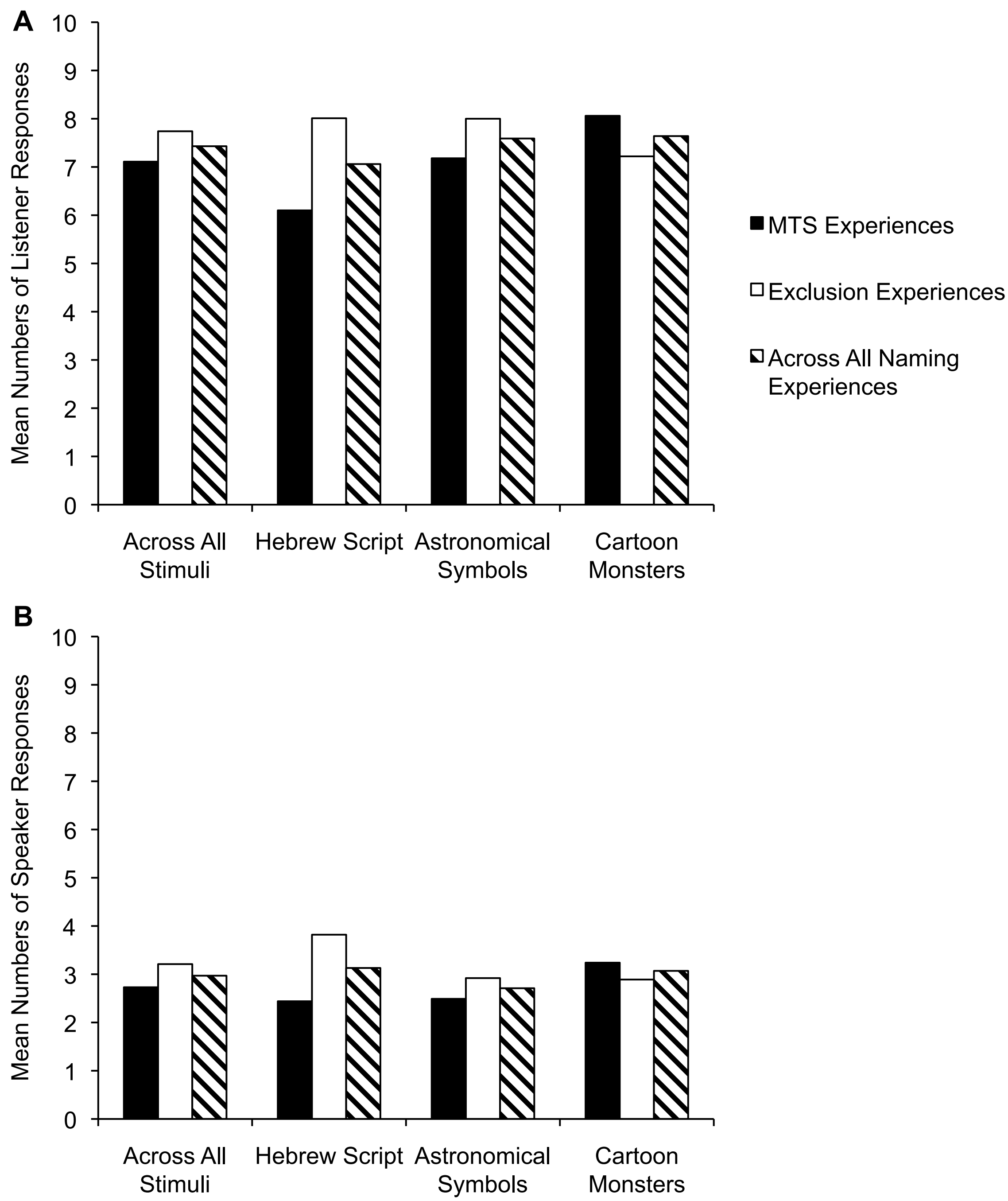


Figure 21. The participants' mean numbers of listener responses (A) and speaker responses (B) for Naming experiences and between stimuli categories.

Numbers of Mastered Word-Object Responses

The mean numbers of mastered word-object responses (names) in the listener and speaker topographies for each type (category) of stimuli and across each type of Naming experience are outlined in Table 38. During each Naming probe session, there were 10 opportunities for listener responses and 10 opportunities for each of the two speaker components. Each stimulus was presented twice for each topography (point to, tact, intraverbal), therefore, a participant needed to respond correctly to both opportunities in order to demonstrate she had learned a word-object response. A participant was required to emit correct responses for all presentations for a stimulus across both tact and intraverbal to meet the criterion for mastering a speaker word-object response.

As shown in Table 38, the mean numbers of mastered word-object responses in the listener topography (range of means: 2.26 – 3.50) were greater than mean numbers of word-object responses in the speaker form (range of means: 0.97 – 1.48) for both types of Naming experiences and across all types of stimuli examined within this experiment. The mean number of listener responses across all Naming experiences and across all types of stimuli was 3.12. Whereas, the mean number of speaker responses across all Naming experiences and across all tested stimuli was 1.25. In comparing the two Naming experiences, the MTS means across all stimuli for each of the two responses topographies (listener M_{MTS} = 2.90; speaker M_{MTS} = 1.13), were slightly lower than the corresponding means following exclusionary Naming experiences (listener $M_{\text{exclusion}}$ = 3.34; speaker $M_{\text{exclusion}}$ = 1.37).

Table 38

Descriptive Statistics for the Numbers of Mastered Listener and Speaker Word-Object Responses for Stimuli within Sets between Naming Experience Conditions and Types of Stimuli

Type of Criteria	Naming Experience	Type of Stimuli	M	SD	N
Listener	Across Both Naming Experiences	Across All Stimuli	3.12	1.13	9
		Hebrew	2.85	1.19	9
		Astronomical	3.22	1.05	9
		Familiar/Monsters	3.30	1.33	9
	MTS	Across All Stimuli	2.90	1.31	9
		Hebrew	2.26	1.55	9
		Astronomical	2.96	1.23	9
		Familiar/Monsters	3.50	1.35	9
	Exclusion	Across All Stimuli	3.34	1.13	9
		Hebrew	3.44	1.18	9
		Astronomical	3.48	1.24	9
		Familiar/Monsters	3.10	1.53	9
Speaker	Across Both Naming Experiences	Across All Stimuli	1.25	1.34	9
		Hebrew	1.25	1.44	9
		Astronomical	1.12	1.50	9
		Familiar/Monsters	1.37	1.36	9
	MTS	Across All Stimuli	1.13	1.37	9
		Hebrew	1.03	1.62	9
		Astronomical	0.97	1.50	9
		Familiar/Monsters	1.39	1.64	9
	Exclusion	Across All Stimuli	1.37	1.35	9
		Hebrew	1.48	1.47	9
		Astronomical	1.28	1.62	9
		Familiar/Monsters	1.34	1.22	9

Correlations across Naming and Curiosity Measures

The correlation coefficient measures for the participants' dependent variables in the curiosity probes and Naming probes are shown in Table 39 – 41. The participants' responses to all probes to achieve stable rates of responding are visually displayed in Figures 22 – 26 for Naming probes and Figures 27 – 28 for the curiosity measures.

As shown in Table 39, the Pearson correlation coefficient measures demonstrated significant positive relations between the participants' numbers of listener responses emitted in Naming probes and their speaker responses, $r(7) = .830$, $p<.01$, in Naming probes and their percentages of inaccurate tact responses during curiosity probe sessions with unfamiliar stimuli, $r(7) = .675$, $p<.05$.

The participants' numbers of speaker responses emitted during Naming probe sessions correlated significantly with their numbers of listener responses in Naming probe sessions, $r(7) = .830$, $p<.01$, percentage of correct tact responses during curiosity probe sessions with unfamiliar stimuli, $r(7) = .690$, $p<.05$, percentage of correct tact responses for familiar types of stimuli in curiosity probe sessions, $r(7) = .795$, $p<.05$, and percentage of inaccurate tact responses for unknown familiar types of visual stimuli in curiosity probe sessions, $r(7) = .833$, $p<.01$. The numbers of correct tacts in curiosity probes with unfamiliar visual stimuli showed strong positive relations with the numbers of correct tacts in curiosity probes with familiar visual stimuli, $r(7)= .864$, $p<.01$. Similarly, the numbers of mands in curiosity probes with unfamiliar stimuli was strongly correlated with the numbers of mands in curiosity probes with familiar stimuli, $r(7) = .990$, $p<.01$.

The correlation coefficient measures across the dependent variables in the curiosity probe sessions and learned word-object responses (names) in Naming probe sessions are outlined in

Table 40. The Pearson correlation coefficient measures demonstrated significant positive relations between the participants' numbers of learned listener word-object responses in Naming probe sessions and their learned speaker word-object responses in Naming probes, $r(7) = .831$, $p<.01$, and their percent of inaccurate tact responses in curiosity probes with familiar stimuli, $r(7) = .699$, $p<.05$. The participants' numbers of learned word-object speaker responses in Naming probe sessions correlated significantly with their numbers of learned listener word-object responses in Naming probe sessions, $r(7) = .831$, $p<.01$, their percentage of correct tacts in curiosity probes with unfamiliar visual stimuli, $r(7) = .688$, $p<.05$, their percentage of correct tacts in curiosity probes with familiar visual stimuli, $r(7) = .815$, $p<.01$, and their percentage of inaccurate tact responses in curiosity probes with familiar stimuli, $r(7) = .812$, $p<.01$.

As displayed in Table 41, the participants' numbers of mastered word-object responses in the listener topography significantly correlated with their numbers of learned word-object responses in the speaker topography, $r(7) = .831$, $p<.01$, their numbers of correct listener responses, $r(7) = .992$, $p<.01$, their numbers of correct speaker responses, $r(7) = .851$, $p<.01$, during Naming probe sessions (see Table 45). The participants' numbers of mastered word-object responses in the speaker topography significantly correlated with their numbers of correct listener responses, $r(7) = .813$, $p<.01$, their numbers of correct speaker responses, $r(7) = .995$, $p<.01$, and, as noted previously, their numbers of learned word-object responses in the listener topography. Please refer to Tables 39 – 41 for a full description of the correlation findings.

Table 39

Correlations of Variables for Numbers of Correct Responses in Naming Probes and Responses in Curiosity Probe Measures

Variables	1	2	3	4	5	6	7	8
1. Numbers of Listener Responses in Naming Probes	__							
2. Numbers of Speaker Responses in Naming Probes	.830**	__						
3. Percent Correct Tacts in Unfamiliar Curiosity Probes	.532	.690*	__					
4. Percent Inaccurate Tacts in Unfamiliar Curiosity Probes	.180	.359	.275	__				
5. Percent Mands in Unfamiliar Curiosity Probes	.077	.390	.321	.219	__			
6. Percent Correct Tacts in Familiar Curiosity Probes	.548	.795*	.864**	.066	.595	__		
7. Percent Inaccurate Tacts in Familiar Curiosity Probes	.675*	.833**	.360	.553	.068	.369	__	
8. Percent Mands in Familiar Curiosity Probes	.153	.449	.321	.292	.990**	.585	.164	__

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 40

Correlations of Variables for Numbers of Mastered Listener and Speaker Word-Object Responses and Responses in Curiosity Probe Measures

Variables	1	2	3	4	5	6	7	8
1. Numbers of Listener Word-Object Naming Probes	__							
2. Numbers of Speaker Word-Object Naming Probes	.831**	__						
3. Percent Correct Tacts in Unfamiliar Curiosity Probes	.521	.688*	__					
4. Percent Inaccurate Tacts in Unfamiliar Curiosity Probes	.238	.289	.275	__				
5. Percent Mands in Unfamiliar Curiosity Probes	.154	.371	.321	.219	__			
6. Percent Correct Tacts in Familiar Curiosity Probes	.561	.815**	.864**	.066	.595	__		
7. Percent Inaccurate Tacts in Familiar Curiosity Probes	.699*	.812**	.360	.553	.068	.369	__	
8. Percent Mands in Familiar Curiosity Probes	.233	.421	.321	.292	.990**	.585	.164	__

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 41

Correlations across Learned Word-Object Responses and Numbers of Correct Responses for the Two Topographies during Naming Probe Sessions

Variables	1	2	3	4
1. Numbers of Correct Listener Responses in Naming Probes	__			
2. Numbers of Correct Speaker Responses in Naming Probes	.830**	__		
3. Numbers of Mastered Word-Object Responses in Listener Form	.992**	.851**	__	
4. Numbers of Mastered Word-Object Responses in Speaker Form	.813**	.995**	.831**	__

**. Correlation is significant at the 0.01 level (2-tailed).

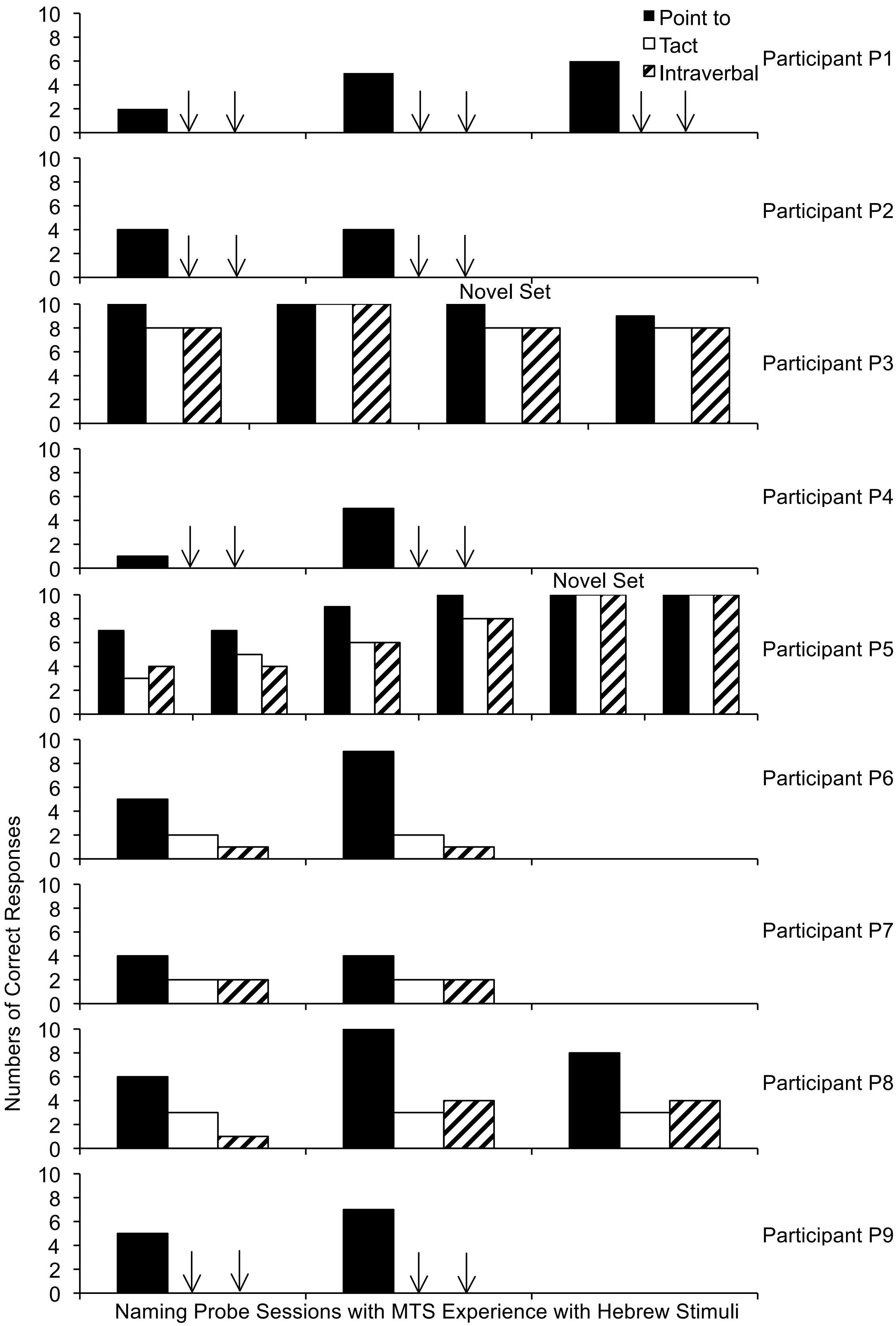


Figure 22. Naming probes following MTS Naming experiences with Hebrew stimuli.

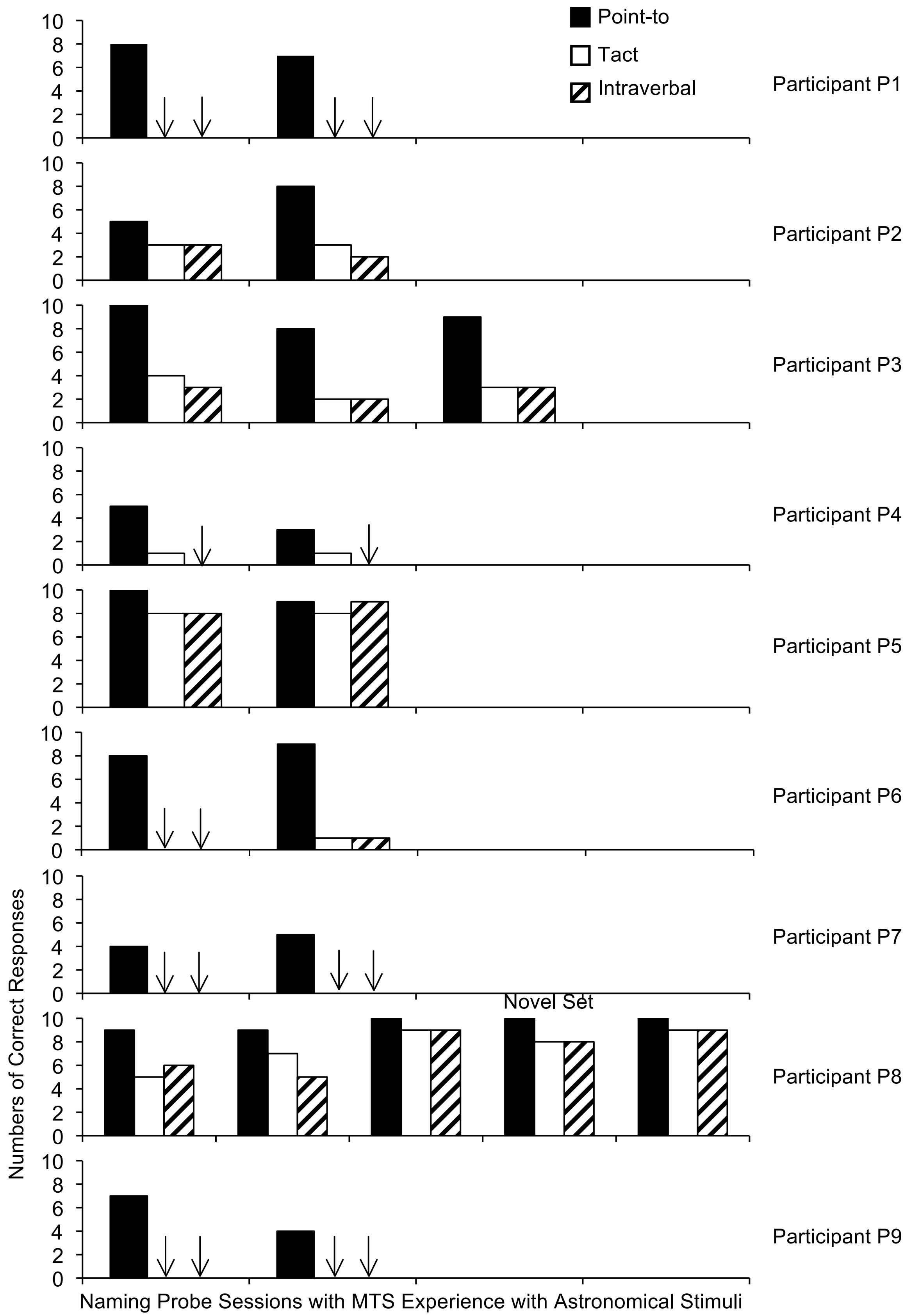


Figure 23. Naming probes following MTS Naming experiences with astronomical stimuli.

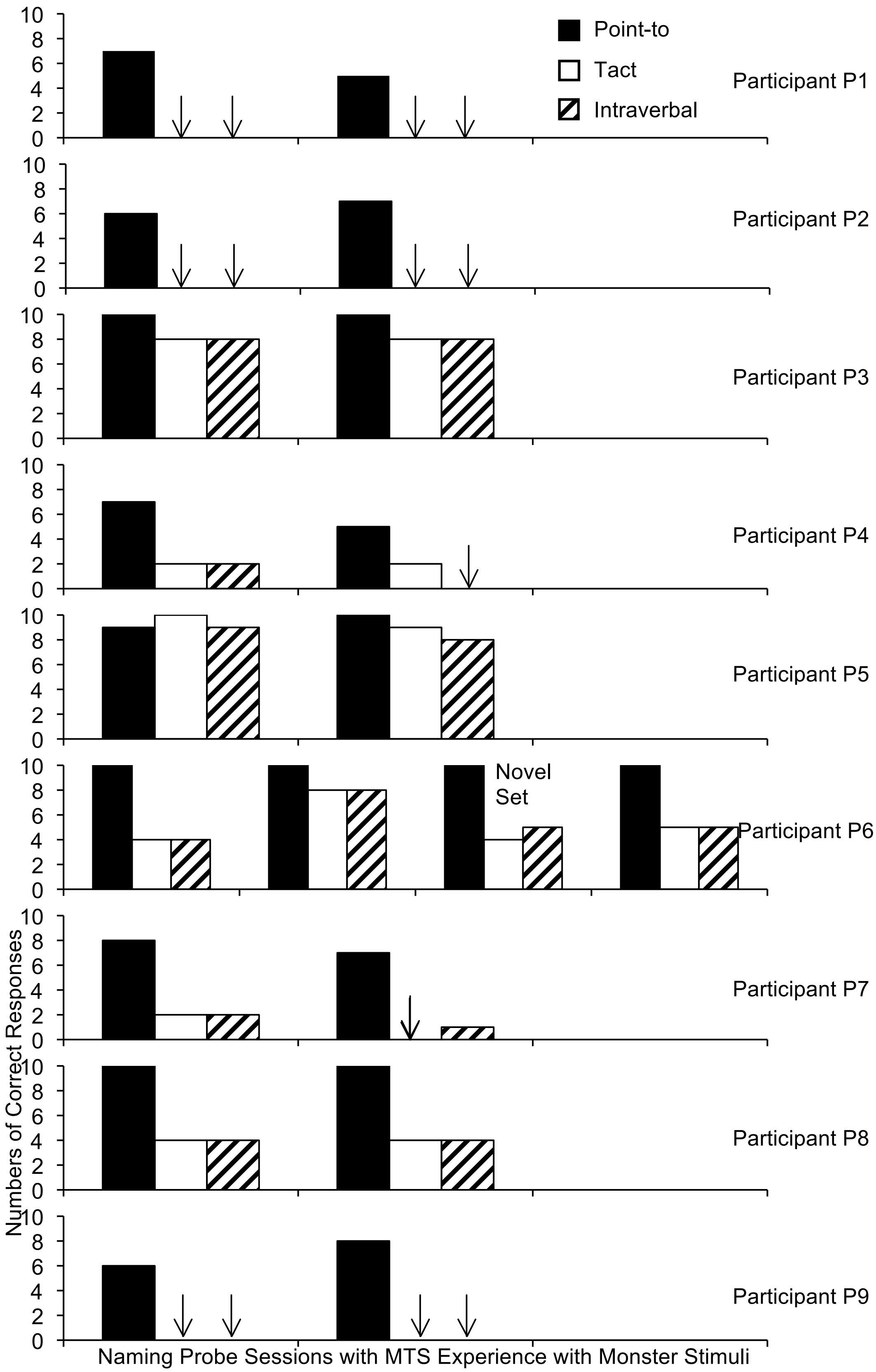


Figure 24. Naming probes following MTS Naming experiences with contrived cartoon monsters.

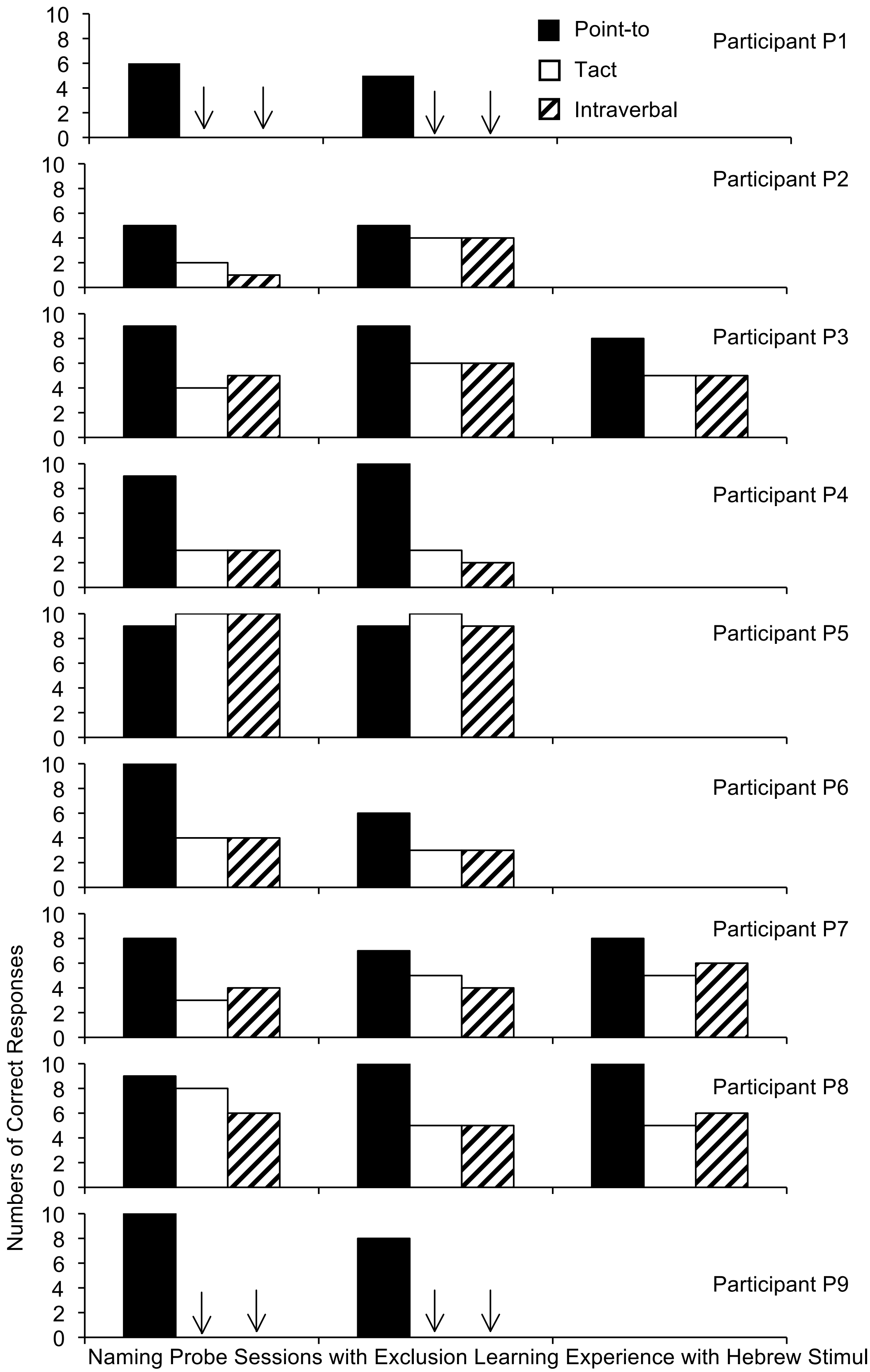


Figure 25. Naming probes following exclusion Naming experiences with Hebrew script.

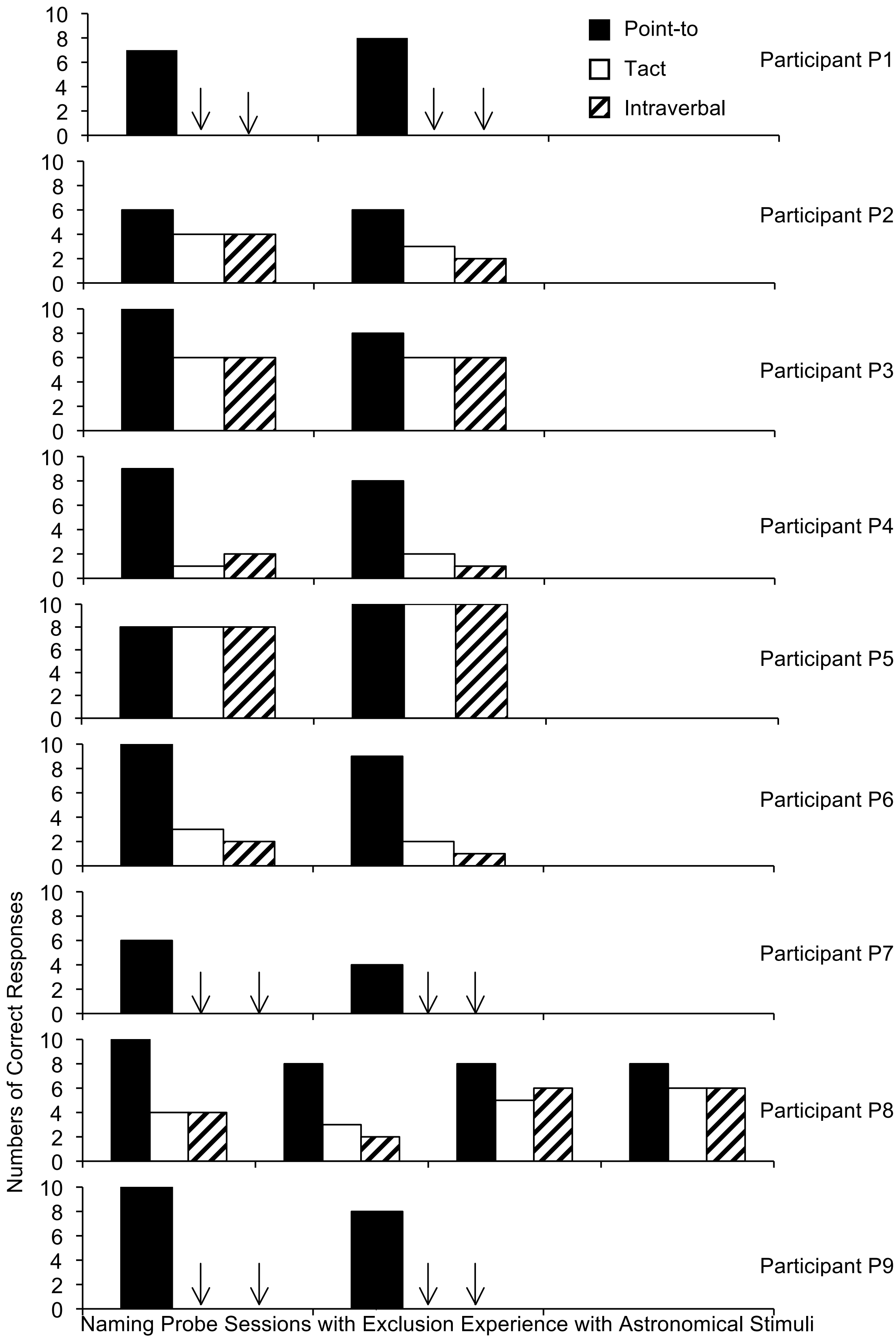


Figure 26. Naming probes following exclusion Naming experiences with astronomical stimuli.

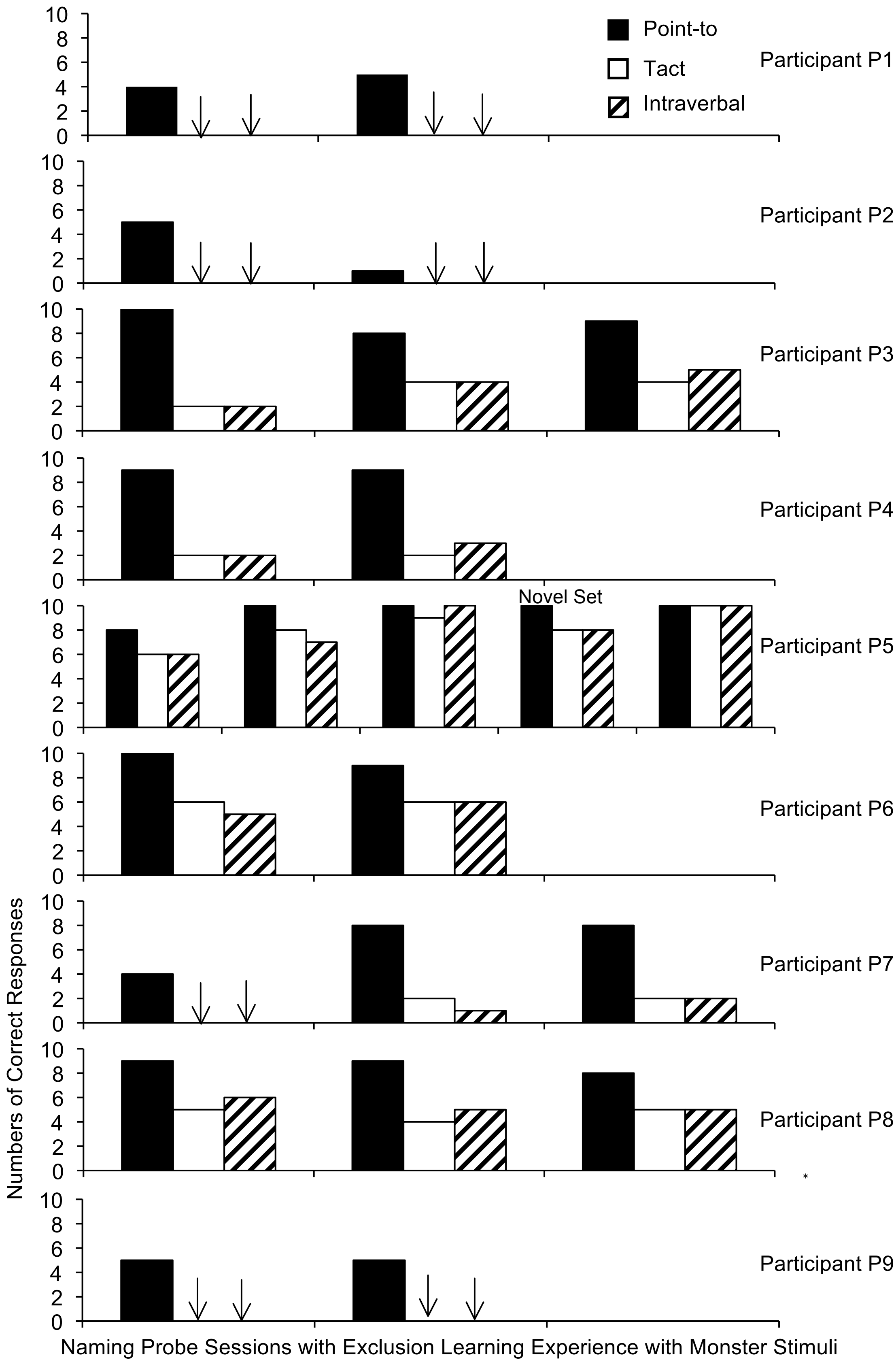


Figure 27. Naming probes following exclusion Naming experiences with contrived cartoon monsters.

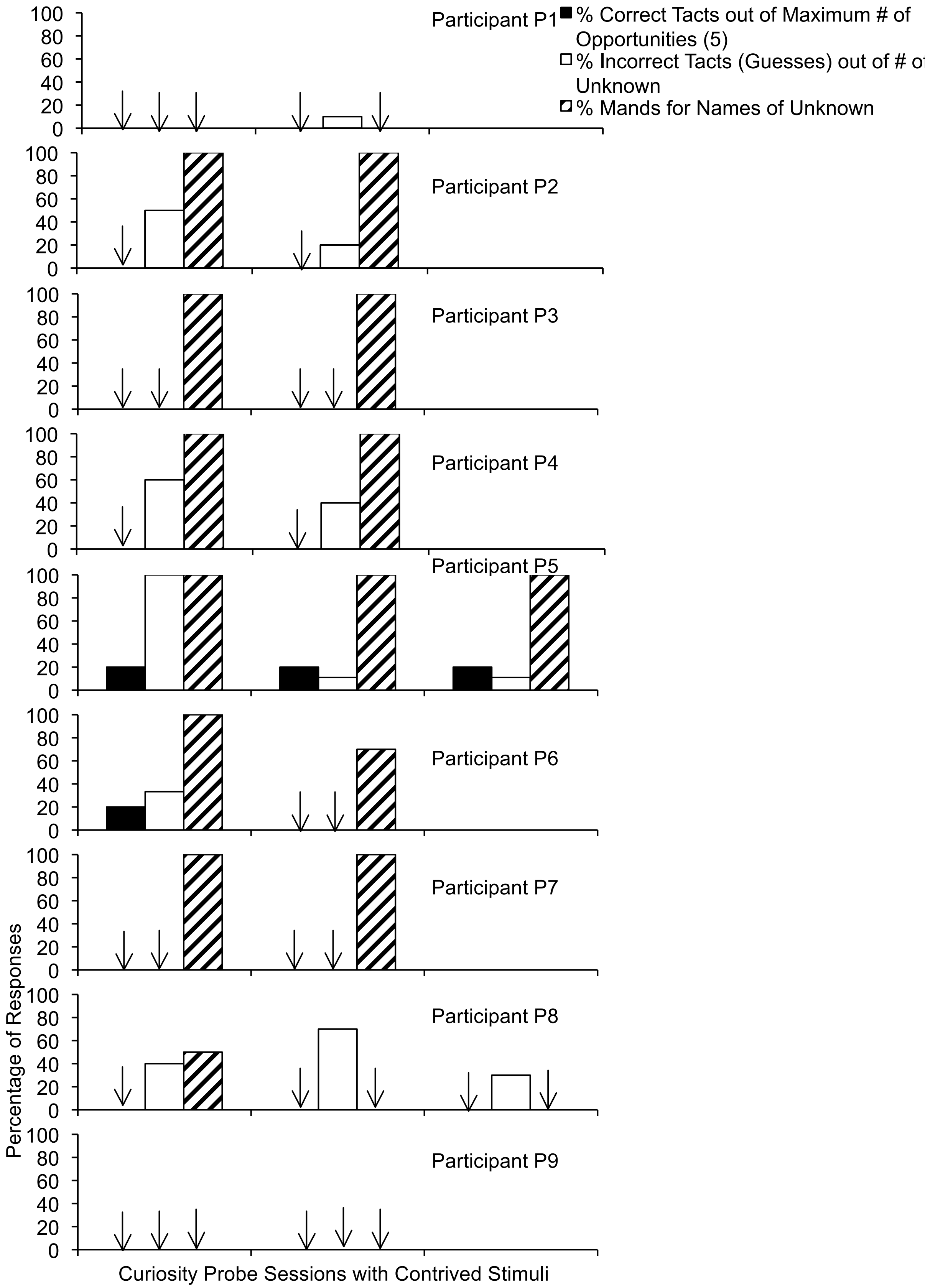


Figure 28. Percentages of responses during curiosity probe sessions with unfamiliar stimuli.

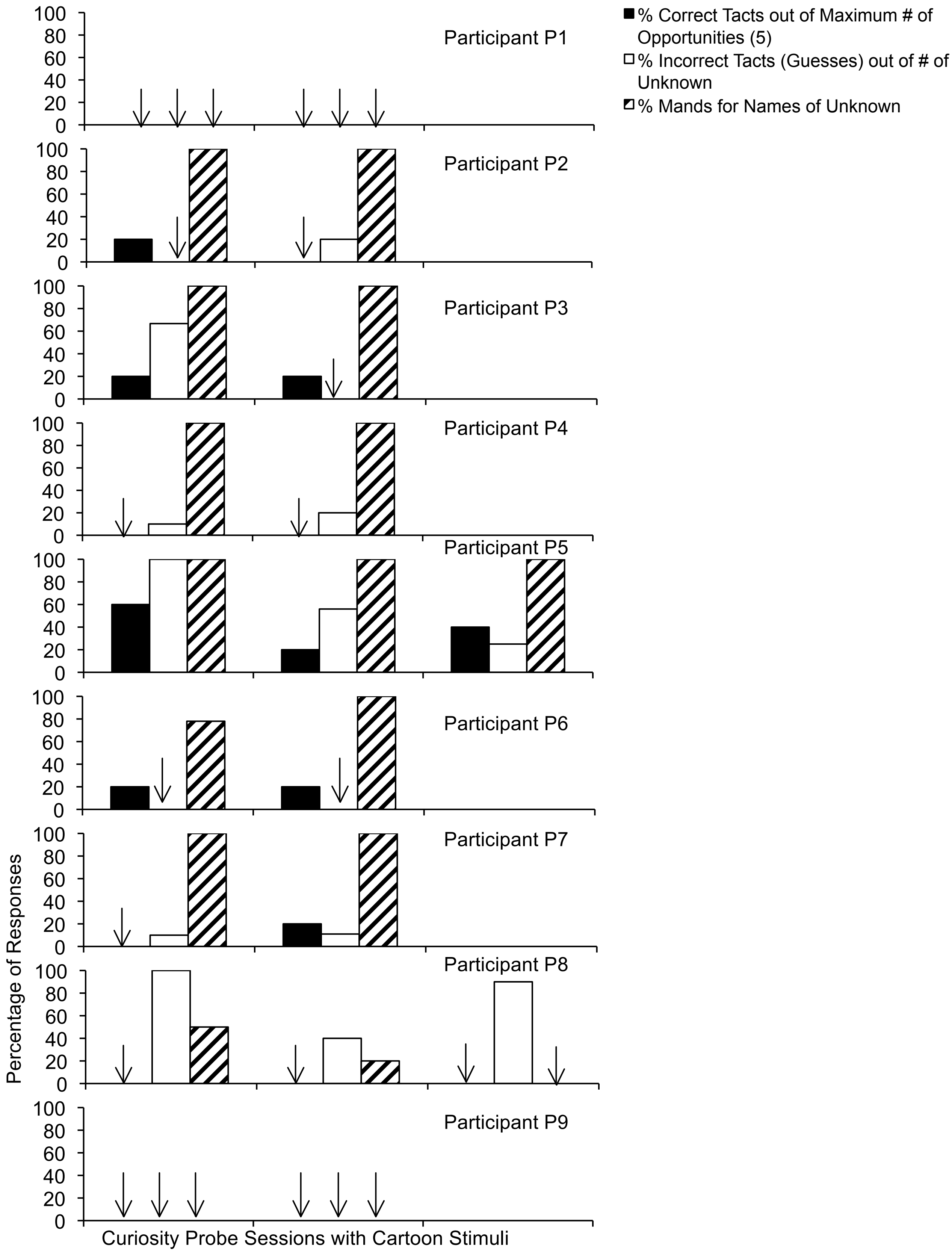


Figure 29. Percentages of responses during curiosity probe sessions with familiar stimuli.

Discussion

In this experiment, I investigated whether stimuli that varied in levels of complexity and familiarity impacted participants' responses during Naming probes and curiosity probes. The curiosity probes assessed the numbers of questions (mands) for the names of unknown stimuli that were presented amongst several known stimuli as well as whether or not a participant learned the name (tact) for the unknown stimulus after having asked for the name. These participants had, prior to this study, demonstrated that they had the Naming capability in repertoire with other types of assessment measures and, although younger, had clearly demonstrated the prerequisite cusps for attaining the capability of Naming within their school program.

In the first experiment, the results showed that there were statistically significant differences in the numbers of listener responses and speaker responses based on the type of Naming experience. But, in the initial experiment, the stimuli for the MTS Naming experiences were more familiar, unknown stimuli whereas the stimuli for the exclusion experience were more unfamiliar and appeared contrived to the participants.

In this study, there were several Naming probes across different types of visual stimuli for both Naming experiences to control for the possible effects of using more or less familiar stimuli in one type of Naming experience. Each participant completed both types of Naming experiences and probe measures for Naming across three types of visual stimuli (Hebrew script, astronomical symbols, and contrived cartoon monsters) until they reached steady levels of responding for the Naming measures. The participants' means for listener responses were greater than their means for speaker responses, demonstrating the independence of the two components of Naming.

Although there was not a large enough sample to conduct an ANOVA, the pattern of the findings suggests that there was an effect or interaction of the level of visual familiarity of the stimuli based on the type of Naming experience. The more unfamiliar stimuli resulted in greater means in untaught listener and speaker responses following the exclusion experiences. Whereas more familiar visual stimuli led to larger means in the Naming probes following MTS experiences.

While there may not have been effects of the type of Naming experience nor type of stimuli alone on the participants' responses during Naming probes, there appeared to be an interaction between Naming experience and the type of stimuli on the numbers of listener responses as well as on the numbers of mastered word-object listener responses. This could be related to the levels of stimuli salience impacting the participants' attention to the target stimuli. The contrived cartoon monsters were more familiar visual stimuli for the participants, but the less familiar stimuli sets (Hebrew script and astronomical stimuli) may have stood out more when placed in a field of known (and familiar) visual stimuli during exclusion experiences.

The participants' means for their numbers of untaught listener and speaker responses following exclusion Naming experiences were greatest with the Hebrew script stimuli ($M_{\text{Hebrew}} > M_{\text{Astronomical}} > M_{\text{Cartoons}}$). This pattern was reversed with the ordering of the means for levels of correct responding in both listener and speaker topographies following MTS Naming conditions ($M_{\text{Cartoons}} > M_{\text{Astronomical}} > M_{\text{Hebrew}}$). For both the listener and speaker responses, the MTS Naming experiences resulted in means that increased as the level of familiarity increased in the visual stimuli. With the exclusionary Naming experience the means for the two topographies increased as familiarity levels decreased in the visual stimuli. The results suggest that the contrast between stimuli in an array may impact responses; therefore, the more a stimulus stands out amongst other stimuli the more likely one is to learn under exclusion conditions. These results showed positive relationships between the participants' listener responses and their speaker responses in Naming probe sessions as well as between their speaker responses in Naming probes and acquired tacts (after participants emitted questions to request the names of the unknown stimuli) in curiosity measures.

CHAPTER V

GENERAL DISCUSSION

Summary of Findings

The three experiments reported herein examined the impact of different Naming experiences and properties of stimuli on language acquisition in adults and children. I also investigated the Naming repertoire related to children's question asking, as a measure of curiosity about their environment.

The results of the first experiment demonstrated and affirmed the independence of the listener and speaker components of Naming. Overall and within each of the two groups, youth and adults, numbers of correct listener responses and numbers of correct listener word-object relations were greater than their respective speaker results. Additionally, adults more readily acquired responses than youth. The adults' repertoires, most significantly the listener, were more balanced and resulted in less variability than the youth's levels. The main effect of Naming experience was shown to be significant in speaker responses for the participants. This experiment provided a glimpse into the general response levels for Naming of the two age groups across two different types of Naming opportunities, MTS experiences and exclusion learning experiences.

In the second experiment, I continued to examine the two types of Naming experiences on the untaught listener and speaker responses but controlled for the type of stimuli by utilizing unfamiliar and unknown stimuli for both Naming experiences. The participants were all elementary-aged youth with disabilities, and they did not have Naming with unfamiliar (contrived) stimuli in repertoire with MTS or exclusion Naming experiences. I also conducted probe sessions to determine levels of question asking behavior for unfamiliar and familiar stimuli as a measure of curiosity to determine if the participants' question asking behavior and their acquisition of names through questions were related to their Naming repertoires. I implemented a stimulus pairing observation procedure as an intervention to establish unfamiliar and novel stimuli as reinforcers. The results were useful in showing that the type of Naming experience in this experiment did not lead to differences in levels of acquisition when I controlled for the familiarity of the stimuli, in comparison to the first experiment.

Although the intervention condition did not fully induce Naming in the second experiment, there were notable effects and observations following treatment. The majority of the participants demonstrated increases in the numbers of correct untaught speaker responses following intervention conditions. Two participants emitted zero mands or questions asking for the names of the unknown stimuli across all of their pre-intervention curiosity probe sessions, and, following intervention, they emitted mand operants to request the names of the unknown stimuli for 100% of their opportunities in the curiosity measures. The participants' numbers of correct tacts after asking questions about the unknown stimuli in the curiosity probes increased slightly for five of the six participants. Additionally, the numbers of inaccurate tacts or "guesses" when the participants did not know the name of the novel stimuli decreased following treatment conditions. It is interesting to note that all six participants acquired the speaker word-object responses during their two stimulus pairing observation intervention phases, but did not demonstrate Naming in the probe conditions. Some of the participants in Experiment 2 learned all five of the speaker word-object responses in a treatment set within six sessions (demonstrating acquisition of a response in 4 to 24 opportunities).

I conducted the third experiment with younger children who had previously demonstrated Naming with other types of assessment measures and, although younger, had clearly demonstrated the prerequisite cusps for attaining the capability of Naming within their school programs. One aspect of the results of the first experiment showed differences in correct untaught listener and speaker responses based on the Naming experiences, but, in the second experiment, this did not appear to be the case when I controlled for the levels of familiarity and complexity of the visual stimuli.

The last experiment examined whether or not properties of the visual stimuli affected the results of Naming assessments following the two types of Naming experiences. I also investigated the young participants' question asking behavior during curiosity probe sessions with familiar and unfamiliar stimuli. The results suggested that the Naming experiences and types of visual stimuli alone did not each appear to impact the dependent variables. Interestingly, though, for both listener and speaker responses, the MTS Naming experiences resulted in means that increased as the familiarity level increased in the stimuli. With the exclusionary Naming experience this pattern was reversed, with greater means shown as familiarity levels decreased in the visual stimuli. As with the other two experiments, the mean numbers of accurate untaught listener responses were greater than their speaker responses. Similar to the first experiment, the young participants showed greater variability in the distribution of their numbers of correct speaker responses compared to the variation demonstrated in their numbers of accurate listener responses. These results showed positive relationships between several variables in the Naming probe measures and curiosity probe measures. Especially notable was the strong correlation between correct untaught speaker responses during Naming probe sessions and the numbers of learned names (after having asked for the names) in curiosity measures.

The outlined experiments focused on the levels of acquisition of untaught responses following different Naming experiences and across varying degrees of collative variables in the visual stimuli. I also studied the possible relation between Naming and question asking behavior. The development of language in children is critical to their future outcomes, and results of the research show that there are variables that can affect language acquisition.

Children typically acquire language rapidly in the first few years of their lives. By two to three years of age, children generally demonstrate significant increases in the rates of learning words, often referred to as a language explosion or vocabulary spurt. Bloom (2000) noted that there exist individual differences among children in their patterns and rates of learning vocal words. The results of my third experiment also showed variation in language acquisition for children, many of who were typically developing children. Although typically developing young children's rates of development and levels of proficiency may differ to some extent (Weisleder & Fernald, 2013), it is apparent that the development of one's language repertoire and of curiosity ("want to know") impacts childhood outcomes and future achievements (Deci & Ryan, 1993; Gillberg & Steffenburg, 1987; Gruber et al., 2014; Howlin et al., 2004; Kang et al., 2009; Kashdan et al., 2011; Reio Jr. & Callahan, 2004; Reio Jr. et al., 2006; Walker et al., 1994; Venter et al., 1992).

The results of the research have demonstrated that there are both genetic and environmental variables that impact and contribute to language development in children. Researchers have examined several factors that have been shown to impact the acquisition of language in children including, but not exclusive to, genetic factors (Oliver & Plomin, 2007), socio-economic status (Hoff-Ginsberg, 1998; Walker et al., 1994), birth order (Coastes & Messer, 1996), educational levels of caregivers (Hoff-Ginsberg, 1991), caregiver-child interactions (Hampson & Nelson, 1993; Tomasello & Farrar, 1986; Tomasello & Todd, 1983), early language environment (Hoff, 2003), parents' quantity of verbal engagement with their infant (Fernald & Weisleder, 2015), child responses during joint attention (Desrochers et al., 1995; Mundy et al., 1995; Ulvund & Smith, 1996; Willoughby et al., 1997), parental roles in joint attention interactions (Tomasello & Farrar, 1986; Tomasello & Todd, 1983), parental input (Hart & Risley, 1995; Huttenlocher et al., 1991; Weizman & Snow, 2001), frequency effects of vocally presented words (Rice et al., 1994; Schwartz & Terrell, 1983), and diversity of caregivers' vocal communication (Huttenlocher et al., 2010).

Horne and Lowe (1996) argued that the capability of Naming is an essential stage in a child's verbal behavior development, which enables the child to acquire verbal operants through bi-directional relations between classes of stimuli and the occasioned speaker-listener behavior. Therefore, once Naming is in repertoire, a child's language can expand exponentially through her capacity to learn during these incidental opportunities (Greer & Ross, 2008). Children's acquisition of incidental language can occur through a variety of opportunities such as caregivers' vocal naming or identification of stimuli in the children's environment or through the mands or questions to obtain information about the unknown or unfamiliar. Learning more about how to induce Naming in individuals who have not yet attained the capability provides additional knowledge on language acquisition in typically developing individuals. For children who do not learn through incidental opportunities and do not ask questions about the unknown, it is important for them to acquire these skills as these cusps can affect their future trajectory and outcomes.

Some scholars have used the term curiosity interchangeably with words such as exploration, intrinsic motivation, sensation seeking, interest, and information seeking. Some have also described curiosity as a prerequisite for motivation (Byman, 2005). The clarity of the meaning of curiosity is further obscured by the use of many different curiosity instruments developed in attempts to quantify curiosity in humans (Byman, 2005). The use of varying definitions and measures make it more difficult to compare results of curiosity studies (Byman, 2005).

In my second and third experiments, I measured the numbers of mands (in the form of vocal questions) for the names of the unknown stimuli in curiosity probe sessions and whether the students who asked for the names learned the names through that experience. Some children appeared to have been taught to ask for names when presented with unknown stimuli, but their questions do not seem to function to learn about the unknown.

Engel (2011) surmised that all infants and young children are eager to learn about the unfamiliar and that these explorations of the unfamiliar are formative and strong in shaping early acquisition of knowledge. Reio et al. (2006) noted that curiosity was found to be highly significant to children's learning. Engel (2011) agreed, noting "the evidence is quite clear: when children are curious, they learn" (p. 628).

Grossnickle (2016) recognized the importance of research in exploring the "the relations of curiosity with educational outcomes and its precursors" (p. 53). Chouinard (2007), also interested in the role of curiosity in language development, suggested that, in order to support the view that children's questions are a significant force in development, children must ask questions. In addition, they need to receive explanatory responses to their questions and demonstrate that they truly want to receive information through asking the questions rather than solely asking questions to obtain attention (Chouinard, 2007). The questions must be related to acquiring information connected to development, and the children must use resulting answers purposefully (Chouinard, 2007).

Arntzen (2012) noted that across research on stimulus equivalence there are many documented factors that impact the outcomes of conditional discrimination training and that the differing results can be attributed to the differences in the training and testing procedures. Some of the variables that he noted to affect the probability of the formation of equivalence classes included: different training structures, the use of instructions, inter-trial interval time, delayed vs. simultaneous MTS, type of stimuli, criteria, response requirements to sample stimulus, arrangements of training and test trials, characteristics of participants, numbers of members or classes, and type of response requirement (Arntzen, 2012).

It is worth noting that many of the participants in the third experiment previously demonstrated the Naming capability at their school with other Naming assessment methods and outside of my study. Across Naming studies there are many inconsistencies with the types of stimuli, training or Naming experiences, and assessment procedures. While some of the methodological parameters may have been implemented for research purposes, it is possible that some of these differences may have resulted in varied outcomes on Naming assessments. There has been no widely agreed upon definition of curiosity, and the operational definitions utilized within studies vary significantly from one to another. The use of varying measures to quantify verbal cusps such as Naming and question asking (curiosity measure) also makes it more difficult to compare the results of the studies.

For example, the properties of stimuli vary across many of the studies. Saunders and Green (1999) suggested that fewer numbers of stimuli included in a class result in decreased numbers of discriminations needed for successful outcomes on equivalence assessments. This, too, could be valid for numbers of stimuli in Naming assessments. Researchers for some studies, especially with younger children, have used three-dimensional objects (Fiorile & Greer, 2007; Gilic & Greer, 2011; Longano, 2008), whereas others have utilized two-dimensional stimuli (Carnerero & Perez-Gonzalez, 2014; Cao, 2016; Feliciano, 2006; Greer et al., 2005; Greer et al., 2007; Hawkins et al., 2009; Hranchuk, 2016; Lo, 2016; Rothstein & Gautreaux, 2007).

Another aspect of stimuli that may contribute to different outcomes of assessments is the number of stimuli per set. It is possible that the use of fewer stimuli per set could lead to demonstrations of Naming more frequently than assessing the same individuals with greater numbers of stimuli in sets. There are studies that report three stimuli per set (Cahill, 2013; Fiorile & Greer, 2007; Gilic & Greer, 2011), four stimuli (Feliciano, 2006; Helou-Care, 2008; Hranchuk, 2016; Longano, 2008), five stimuli (Carnerero & Perez-Gonzalez, 2014; Cao, 2016; Greer, Corwin, & Buttigieg, 2011; Greer et al., 2007; Greer et al., 2005; Hawkins et al., 2009; Lo, 2016), and six stimuli (Rothstein & Gautreaux, 2007) in a set. The numbers of stimuli per set may impact the learning of new responses for the novel stimuli.

There are researchers who have assessed for Naming with unfamiliar (often identified as contrived) novel stimuli and those who have implemented tests for Naming with familiar types of novel stimuli. It is also evident that within the two categories of unfamiliar (contrived) and familiar stimuli there is considerable variation in the levels of familiarity and the complexity of the stimuli. Visual familiarity levels, auditory familiarity levels, complexity, physical similarities, and using the same or different categories of stimuli within sets may impact the acquisition of untaught responses. Some studies tested with real, but unknown, cartoon characters (Gold, 2013), dog breeds (Greer et al., 2005), different types of animals (Carnerero & Perez-Gonzalez, 2014; Greer et al. 2007), monuments (Greer et al., 2005), household objects

(Carnerero & Perez-Gonzalez, 2014; Gilic & Greer, 2007), types of food (Greer et al., 2007), gem stones (Greer et al., 2007), and flowers (Carnerero & Perez-Gonzalez, 2014) to name a few categories. Other experiments have used existing letters or symbols from non-English languages (Cao, 2016; Rothstein & Gautreaux, 2007), and mathematical symbols as well as other unknown symbols (Hranchuk, 2016). Still other researchers have created their own stimuli to ensure novelty (Hawkins et al., 2009). There is a continuum of familiarity levels for stimuli constructed by researchers, for example using made up symbols (Hawkins et al., 2009) and more familiar, researcher-created cartoon characters as used as part of the third experiment in this paper.

There are also different processes used for Naming experiences, varied amounts of exposures for Naming experiences, different criteria for Naming experiences, and differing numbers of stimuli in the fields for listener responses across studies. The learning opportunities prior to the assessment may alter the individual's learning demonstrated in her assessment.

Many reported studies, similar to a portion of the Naming experiences outlined in this paper, used a type of MTS procedure as part of their research (Cao, 2016; Feliciano, 2006; Gilic & Greer, 2011; Greer et al., 2011; Greer et al., 2005; Greer et al., 2007; Hawkins et al., 2009; Helou-Care, 2008; Longano, 2008; Rothstein & Gautreaux, 2007). Others have used exclusionary experiences similar to the one used in a portion of the ones used in this current paper (Greer & Du, 2015). Other examples of procedures implemented for Naming experiences include pairing (Carnerero & Perez-Gonzalez, 2014; Lo, 2016) and incidental, but researcher created, opportunities to observe stimuli with preferred toys (Hranchuk, 2016).

There are studies that set the criteria for Naming experiences at 90% across two sessions (Cao, 2016; Hawkins et al., 2009; Longano, 2008), 90% across two sessions or 100% in one session (Greer et al., 2011; Greer et al., 2007; Greer et al., 2011), a given pre-determined number of opportunities (Lo, 2016), 90% in one session (Gilic & Greer, 2011), 100% across three sessions (Feliciano, 2006), and there are some published studies that do not explicitly state the criteria for mastering the learning experience prior to the Naming assessments (Rothstein & Gautreaux, 2007). Additionally, researchers across studies have conducted the MTS experiences in a field of two (Greer et al., 2011; Greer et al., 2007; Helou-Care, 2008; Longano, 2008), three (Cao, 2016; Gilic & Greer, 2011), or four (Feliciano, 2006; Hawkins et al., 2009) stimuli.

Another variable that may impact the results of Naming assessments, as well as the comparisons of results across the research, is the use and duration of intervals of time between Naming experiences and probe sessions. There are experiments that do not include the written specification of the delays or amounts of time between experiences and tests in their papers (Feliciano, 2006; Gilic & Greer, 2011; Greer et al., 2011; Greer et al., 2005; Greer et al., 2007; Hawkins et al. 2009; Longano, 2008; Rothstein & Gautreaux, 2007). As with the research in this document, there are studies that include a 2 hr delay between achieving criteria for Naming experiences and the initial probes with stimuli sets (Cao, 2016; Gold, 2013; Greer & Du, 2015; Lo, 2016), 30 min delays (Helou-Care, 2016; Mosca, 2014), and 1 hr delays (Hranchuk, 2016). Other distinguishing variables amongst Naming studies that may lead to varying results include the assessment procedure, blocked response topographies or rotation of responses topographies, the number of stimuli in the array for listener responses, the numbers of opportunities, criteria for Naming, as well as conducting probe sessions with novel sets of stimuli if participants demonstrate Naming with sets that were tested more than once. There are individuals who demonstrate criterion-levels of untaught responses due to a practice effect of experiences when they are exposed to a set of stimuli multiple times, as opposed to truly acquiring the capability of Naming.

Limitations

There are several limitations across the three experiments. In the first experiment, which examined Naming results following two different Naming experiences with adults and youth, I used more familiar types of stimuli with the MTS Naming experience compared to the less familiar symbols utilized for the exclusion Naming experiences. The differences in the types of visual stimuli may have affected the numbers of correct untaught responses in both groups.

In the first and third experiments, I investigated group differences and relations. It would have been beneficial and produced stronger results if I had included greater numbers of participants. For the youth participants in all three experiments, in addition to the limitation of the numbers of participants, although they all had previously demonstrated the prerequisite skills for Naming with familiar stimuli, there was a wide variety in the participants' verbal cusps and skills that may have led to differences and greater variation in their results for the Naming and curiosity measures.

I used desktop computers and laptop computers to display the stimuli to increase the rate of presentation, the clarity of the images, and the size of stimuli compared to using table-top or printed two-dimensional stimuli. For many of the youth in this series of experiments, they have an instructional history with school programs being implemented on computer screens. Therefore, some participants may have responded differently than they would have if the procedure reflected a more natural, incidental assessment. It was also harder to ensure that participants attended to the computer screen compared to placing each stimulus individually (for example, as with table top stimuli), as they may have appeared to be looking and attending to the monitor but may only have attended to a portion of the displayed visual stimuli. This may have unintentionally led to presentations without participants attending to all visual stimuli.

Implications

The findings from the three studies provide additional information on methodological variables and variability in assessing verbal cusps and capabilities. The results also suggest that the type of stimuli (familiarity, complexity, salience, category, etc.) impacts the acquisition of language. It is also possible that the "knowledge gap" for participants was either too small or too large to motivate them to respond and learn about the novel stimuli. Kang et al. (2009) and Loewenstein (1994) noted that individuals need some knowledge but not too much in order to bring about the "need to know."

Within the educational context, it is important to take these factors into account when teaching and assessing students and to ensure the presence of sufficient motivation prior to introducing learning opportunities. Identifying the stimuli factors that are most successful for different learning opportunities for each student will improve the educational outcomes. It is important to establish clear operational definitions of terms such as "curiosity" for educational researchers and teaching staff to properly address motivation in their students and enhance their learning success.

The results of these studies along with results from Greer and Du (2015) and Lo (2016) demonstrated that there are multiple types of Naming capabilities, which have different prerequisite skills. Many of the youth participants in the three experiments demonstrated that the Naming capability was in repertoire previously with other Naming procedures and types of stimuli (for example, with more familiar stimuli or preferred stimuli), yet the majority of the participants did not demonstrate Naming in the probe sessions for the outlined three experiments.

The levels of stimuli salience may affect individuals' attention to target stimuli, with less familiar visual stimuli standing out more during exclusion experiences. It is possible that novel, more familiar stimuli may not attract as much attention under exclusion conditions, so the contrast between stimuli may impact learning of responses. The results also lead to the potential conclusion that while the more familiar stimuli typically control it, within exclusion situations the more non-familiar the stimulus is to the comparison stimuli the more likely one is to learn. One must take into account a learner's prior history of what controls her attention.

Young children's achievement of vocal verbal milestones has been demonstrated to have positive relations with their outcomes through childhood and adulthood (Gillberg & Steffenburg, 1987; Howlin, Goode, Hutton, & Rutter, 2004; Walker et al., 1994; Venter, Lord, & Schopler, 1992). For children who demonstrate difficulty in acquiring language, it is important to take into account these variables and utilize the most successful procedures so they can learn through incidental opportunities.

Future Research

I implemented this series of experiments to try to answer the questions of whether or not the type of Naming experience or procedure impacts the learning of untaught responses, if the age groups showed differences following Naming experiences, if the Naming components were independent, if there is greater variation between and within Naming components for different age groups, if there is a relationship between question asking and Naming, and if the collative variables impact learning. Future research should extend Naming and curiosity procedures to include assessments that reliably measure experiences that, although contrived, appear and are experienced as more incidental opportunities. Several participants in these studies were observed in their natural environment to frequently ask questions and learn from those answers about unusual objects or activities in their surroundings. Yet, when assessed with the current procedures, many failed to learn names for novel stimuli or to ask questions about unknown stimuli.

Researchers should also continue to investigate different procedures and compare existing procedures for measuring verbal cusps. This would lead to increased numbers of studies to accurately compare the required prerequisites and demonstrations of the acquisition of particular skills. Additionally, in the future, researchers should assess and determine the reinforcement value of stimuli prior to the start of experimental procedures.

Conclusions

It is significant to consider one's prior history of what controls one's attention across different experiences. The current research shows that levels of stimuli salience may impact the success of instruction, and these levels may vary depending on the learning conditions or experiences. Educational programs and interventions should take into consideration these collative variables to develop successful instruction and induce the capability of language acquisition across different types of experiences and stimuli. Many of the participants in the outlined three studies had demonstrated the Naming capability with other procedures or types of stimuli prior to their participation in the current experiments. The results strengthen support for the existence of sub-types of the Naming capability based on Naming experiences and different types of stimuli.

References

Adamson, L. B. (1995). *Communication development during infancy*. Madison, WI: Brown & Benchmark.

Alexander, K. L., Entwisle, D. R., & Horsey, C. S. (1997). From first grade forward: Early foundations of high school dropout. *Sociology of Education*, *7*(2), 87-107.

Arntzen, E. (2012). Training and testing parameters in formation of stimulus equivalence: Methodological issues. *European Journal of Behavior Analysis*, *13*(1), 123-135.

Aslin, R. N., & Shea, S. L. (1990). Velocity thresholds in human infants: Implications for the perception of motion. *Developmental Psychology*, *26*(4), 589-598.

Barnes, D. (1994). Stimulus equivalence and relational frame theory. *The Psychological Record, 44*(1), 91-124.

Barnes-Holmes, D., & Barnes-Holmes, Y. (2000). Explaining complex behavior: Two perspectives on the concept of generalized operant classes. *The Psychological Record, 50,* 251-265.

Barnes-Holmes, D. (2004). Relational frame theory and stimulus equivalence: Conceptual and procedural issues. *Revista Internacional de Psicología y Terapia Psicológica*, *4*(2), 181-214.

Barnes-Holmes, D., Barnes-Holmes, Y., Hayes, S. C., & McHugh, L. (2004). Relational frame theory: Some implications for understanding and treating human psychopathology. *International Journal of Psychology and Psychological Therapy, 4,* 355-375.

Barnes-Holmes, Y., Barnes-Holmes, D., & Smeets, P. M. (2004). Establishing relational responding in accordance with opposite as generalized operant behavior in young children. *International Journal of Psychology and Psychological Therapy, 4*, 559-586.

Berlyne, D. E. (1950). Novelty and curiosity as determinants of exploratory behaviour. *British Journal of Psychology. General Section*, *41*(1-2), 68-80.

Berlyne, D. E. (1954). A theory of human curiosity. *British Journal of Psychology. General Section*, *45*(3), 180-191.

Bijou, S. W, & Baer, D. M. (1965). *Child development: Vol 2. Universal stage of infancy.* New York: Appleton-Century-Crofts.

Bloom, P. (2000). *How children learn the meanings of words* (Vol. 377). Cambridge, MA: MIT Press.

Boehnke, S. E., Berg, D. J., Marino, R. M., Baldi, P. F., Itti, L., & Munoz, D. P. (2011). Visual adaptation and novelty responses in the superior colliculus. *The European Journal of Neuroscience*, *34*(5), 766–779. http://doi.org/10.1111/j.1460-9568.2011.07805.x

Bowler, L. (2010). The self-regulation of curiosity and interest during the information search process of adolescent students. *Journal of the American Society for Information Science and Technology*, *61*(7), 1332-1344.

Bühler, C., Hetzer, H. & Mabel, F. (1928). Die Affektwirksamkeit von Fremdheitseindrücken im ersten Lebensjahr [Affective effects of impressions of strangeness in the first year of life]. *Zeitschrift für Psychologie, 107,* 30-49. Reprinted in: Graumann, C. F., & Heck- hausen, H. (Eds.). (1973). *Pädagogische Psychologie: Grundlagentexte 1. Entwicklung und Sozialisation* (pp. 138-154). Frankfurt: Fischer.

Byman, R. (2005). Curiosity and sensation seeking: a conceptual and empirical examination. *Personality and Individual Differences*, *38*(6), 1365-1379.

Cahill, C. (2013). *Actions and names: Observing responses and the role of multiple stimulus control in incidental language acquisition* (Doctoral dissertation). Retrieved from Columbia University Academic Commons, http://hdl.handle.net/10022/AC:P:20513.

Cahill, C. S., & Greer, R. D. (2014). Actions vs. words: How we can learn both. *Acta de Investigación Psicológica*, *4*(3), 1717-1746.

Cao, Y. (2016). *The effects of echoic training on the emergence of naming in a second language by monolingual English-speaking preschool children* (Doctoral dissertation). Retrieved from Columbia University Academic Commons, http://dx.doi.org/10.7916/D86T0MMP

Carnerero, J. J., & Pérez-González, L. A. (2014). Induction of naming after observing visual stimuli and their names in children with autism. *Research in Developmental Disabilities*, *35*(10), 2514-2526.

Catania, A. C. (2007). *Learning.* Upper Saddle River, NJ: Prentice Hall, Inc.

Catts, H. W., Fey, M. E., Tomblin, J. B., & Zhang, X. (2002). A longitudinal investigation of reading outcomes in children with language impairments. *Journal of Speech, Language, and Hearing Research*, *45*(6), 1142-1157.

Chavez-Brown, M (2005). *The effects of the acquisition of a generalized word match-to-sample repertoire on the echoic repertoire under mand and tact conditions* (Doctoral dissertation). Retrieved from ProQuest Dissertations (Order No. 3159725).

Choi, J. (2012). *Effects of mastery of auditory match-to-sample instruction on echoics, emergence of advanced listener literacy, and speaker as own listener cusps by elementary school students with ASD and ADHD* (Doctoral dissertation). Retrieved from ProQuest Dissertations (Order No. 3489932).

Chomsky, N. (1959). Review of Skinner's *Verbal Behavior. Language, 35(1),* 26–58.

Chomsky, N. (1986). *Knowledge of language: Its nature, origin and use.* Westport, CT: Praeger Publishers.

Chouinard, M. M. (2007). Children's questions: A mechanism for cognitive development. *Monographs of the Society for Research in Child Development*, *72,* 1–129.

Coates, S., & Messer, D. (1996). The influence of parity on children's speech. *Early Child Development and Care*, *117*(1), 29-43.

Cupchik, G. C., & Berlyne, D. E. (1979). The perception of collative properties in visual stimuli. *Scandinavian Journal of Psychology*, *20*(1), 93-104.

Daly, P. M. (1987). A description of the verbal behavior of students during two reading instruction methods. *The Analysis of Verbal Behavior, 5,* 67-76.

Day, H. I. (1971). The measurement of specific curiosity. In H. I. Day, D. E. Berlyne, & D. E. Hunt (Eds.), *Intrinsic motivation: A new direction in education* (pp. 99-112). New York: Holt, Rinehart, & Winston.

Deci, E. L., & Ryan, R. M. (1992). The initiation and regulation of intrinsically motivated learning and achievement. In A. K. Boggiano & T. S. Pittman (Eds.), *Achievement and motivation: A social-developmental perspective*, (pp. 9-36). Cambridge, England: Cambridge University Press.

Delgado, J. A. P., & Oblak, M. (2007). The effects of daily intensive tact instruction on the emission of pure mands and tacts in non-instructional settings by three preschool children with developmental delays. *Journal of Early and Intensive Behavior Intervention*, *4*(2), 392-411.

Dember, W., & Earl, R. (1957). Analysis of exploratory, manipulatory, and curiosity behaviors. *Psychological Review*, *64*(2), 91-96.

Desrochers, S., Morissette, P., & Ricard, M. (1995). Two perspectives on pointing in infancy. In C. Moore & P. J. Dunham (Eds.), *Joint attention: Its origins and role in development* (pp. 85–101). Hillsdale, NJ: Erlbaum.

Dixon, L. S. (1977). The nature of control by spoken words over visual stimulus selection. *Journal of the Experimental Analysis of Behavior, 27,* 433-442.

Dollard, J., & Miller, N. E. (1950). *Personality and psychotherapy: An analysis in terms of learning, thinking, and culture.* New York: McGraw-Hill.

Durkin, K., & Conti-Ramsden, G. (2010). Young people with specific language impairment: A review of social and emotional functioning in adolescence. *Child Language Teaching and Therapy*, *26*(2), 105-121.

Drash, P. W., High, R. L, & Tudor, R. M. (1999). Using mand training to establish an echoic repertoire in young children with autism. *The Analysis of Verbal Behavior, 16,* 29-44.

Engel, S. (2011). Children's need to know: Curiosity in schools. *Harvard Educational Review*, *81*(4), 625-645.

Feliciano, G. M. (2006). *Multiple exemplar instruction and the listener half of naming in children with limited speaker abilities* (Doctoral dissertation*)*. Retrieved from ProQuest Dissertations (Order No. 3213505).

Fernald, A., & Weisleder, A. (2015). Twenty years after "meaningful differences," it's time to reframe the "deficit" debate about the importance of children's early language experience. *Human Development*, *58*(1), 1-4.

Ferrari, C., de Rose, J. C., & McIlvane, W. J. (1993). Exclusion vs. selection training of auditory-visual conditional relations. *Journal of Experimental Child Psychology, 56,* 49-63.

Finkel, A. S., & Williams, R. L. (2001). A comparison of textual and echoic prompts on the acquisition of intraverbal behavior in a six-year-old boy with autism. *The Analysis of Verbal Behavior, 18,* 61-70.

Fiorile, C. A., & Greer, R. D. (2007). The induction of naming in children with no echoic-to-tact responses as a function of multiple exemplar instruction. *The Analysis of Verbal Behavior, 23,* 71-87.

Fowler, H. (1965). *Curiosity and exploratory behavior*. New York: Macmillan.

Gilic, L. (2005). *Development of naming in two-year-old children* (Doctoral dissertation). Retrieved from ProQuest Dissertations (Order No. 3188740).

Gilic, L., & Greer, R. D. (2011). Establishing Naming in typically developing two-year-old children as a function of multiple exemplar speaker and listener experiences. *The Analysis of Verbal Behavior*, *27*(1), 157–177.

Gillberg, C., & Steffenburg, S. (1987). Outcome and prognostic factors in infantile autism and similar conditions: A population-based study of 46 cases followed through puberty. *Journal of Autism and Developmental Disorders*, *17*(2), 273-287.

Gold, L. D. (2013). *A functional analysis on the effects of an observational intervention using a peer-yoked contingency game board on the induction of observational performance, observational acquisition and naming* (Doctoral dissertation). Retrieved from Columbia University Academic Commons, http://hdl.handle.net/10022/AC:P:20568.

Gottlieb, J., Oudeyer, P.-Y., Lopes, M., & Baranes, A. (2013). Information seeking, curiosity and attention: computational and neural mechanisms. *Trends in Cognitive Sciences*, *17*(11), 585–593. http://doi.org/10.1016/j.tics.2013.09.001

Gray, P. (2013). *Free to learn: Why unleashing the instinct to play will make our children happier, more self-reliant, and better students for life*. New York: Basic Books.

Greene, F. M. (1964). Effect of novelty on choices made by preschool children in a simple discrimination task. *Child Development*, *35*(4), 1257-1264.

Greer, R. D. (1998). Teaching operations for verbal behavior (A draft and a work in progress). Unpublished manuscript, Yonkers, NY: CABAS®.

Greer, R. D., Corwin, A., & Buttigieg, S. (2011). The effects of the verbal developmental capability of naming on how children can be taught. *Acta de Investigacion Psicologia*, *1*(1), 23-54.

Greer, R. D., & Du, L. (2010). Generic instruction versus intensive tact instruction and the emission of spontaneous speech. *Journal of Speech-Language Pathology & Applied Behavior Analysis*, *5*(1), 1-19.

Greer, R. D., & Du, L. (2015). Experience and the onset of the capability to learn names incidentally by exclusion. *The Psychological Record*, *65*(2), 355-373.

Greer, R. D., & Keohane, D. D. (2005). The evolution of verbal development in young children. *Behavior Development Bulletin, 1,* 31-48.

Greer R. D., & Longano, J. (2010). Naming a rose: How we may learn to do it. *The Analysis of Verbal Behavior, 26,* 73–106.

Greer, R. D., Nirgudkar, A., & Park, H. (2003). The effect of multiple exemplar instruction on the transformation of mand and tact functions. Paper presented at the International Conference of the Association for Behavior Analysis, San Francisco, CA.

Greer, R. D., & Ross, D. E. (2008). *Verbal behavior analysis: Inducing and expanding new verbal capabilities in children with language delays*. Boston: Pearson Education.

Greer, R.D., & Speckman, J. (2009). The integration of speaker and observing responses: A theory of verbal development. *Psychological Record, 59, 449-488.*

Greer, R.D., Stolfi, L., Chavez-Brown, M., & Rivera-Valdes, C. (2005). The emergence of the listener to speaker component of naming in children as a function of multiple exemplar instruction. *The Analysis of Verbal Behavior, 21*, 123–134.

Greer, R.D., Stolfi, L., & Pistoljevic, N. (2007). Acquisition of naming for 2-dimensional stimuli in preschoolers: A comparison of multiple and single exemplar instruction. *European Journal of Behavior Analysis, 8,* 119–131.

Greer, R.D., Yuan L, & Gautreaux, G. (2005). Novel dictation and intraverbal responses as a function of a multiple exemplar instructional history. *The Analysis of Verbal Behavior, 21,* 99–116.

Grossnickle, E. (2016). Disentangling curiosity: Dimensionality, definitions, and distinctions from interest in educational contexts. *Educational Psychology Review*, *28*(1), 23-60. doi:10.1007/s10648-014-9294-y

Gruber, M. J., Gelman, B. D., & Ranganath, C. (2014). States of curiosity modulate hippocampus-dependent learning via the dopaminergic circuit. *Neuron*, *84*(2), 486-496.

Haith, M.M. (1980). *Rules that babies look by: The organization of newborn visual activity*. Hillsdale, NJ: Erlbaum.

Hampson, J., & Nelson, K. (1993). The relation of maternal language to variation in rate and style of language acquisition. *Journal of Child Language*, *20*(2), 313-342.

Harris, M. (1992). *Language experience and early language development*. East Sussex, U.K: Lawrence Erlbaum Associates Ltd.

Harrison, P. (2001). Curiosity, forbidden knowledge, and the reformation of natural philosophy in early modern England. *Isis*, *92*(2), 265-290.

Hart, B. & Risley, T. R. (1995). *Meaningful differences in the everyday experience of young American children*. Baltimore: Paul H. Brookes Publishing Co.

Hawkins, E., Kingsdorf, S., Charnock, J., Szabo, M., & Gautreaux, G. (2009). Effects of multiple exemplar instruction on naming. *European Journal of Behavior Analysis*, *10*(2), 265-273.

Hayes, S. C., Barnes-Holmes, D., & Roche, B. (2001). *Relational frame theory: A post-Skinnerian account of language and cognition.* New York: Plenum Press.

Hebb, D. O. (1955). Drives and the CNS (conceptual nervous system). *Psychological Review*, *62*(4), 243-254.

Helou-Care, Y. (2008). *The effects of the acquisition of naming on reading comprehension with academically delayed middle school students diagnosed with behavior disorders* (Doctoral dissertation). Retrieved from ProQuest Dissertations (Order No. 3317559).

Holden, C. (2004). The origin of speech. *Science, 303*(5662), 1316-1319.

Hoff, E. (2003). The specificity of environmental influence: Socioeconomic status affects early vocabulary development via maternal speech. *Child Development*, *74*(5), 1368-1378.

Hoff, E. (2006). How social contexts support and shape language development. *Developmental Review, 26,* 55–88.

Hoff-Ginsberg, E. (1991). Mother-child conversation in different social classes and communicative settings. *Child Development*, *62*(4), 782-796.

Hoff-Ginsberg, E. (1998). The relation of birth order and socioeconomic status to children's language experience and language development. *Applied Psycholinguistics*, *19*(4), 603-629.

Horne, P. J., & Lowe, C. F. (1996). On the origins of Naming and other symbolic behavior. *Journal of the Experimental Analysis of Behavior, 65,* 185-241.

Horne, P. J., & Lowe, C. F. (1997). Toward a theory of verbal behavior. *Journal of the Experimental Analysis of Behavior, 68,* 271-296.

Howlin, P., Goode, S., Hutton, J., & Rutter, M. (2004). Adult outcome for children with autism. *Journal of Child Psychology and Psychiatry*, *45*(2), 212-229.

Hranchuk, K. S. (2016). *Instructional demonstrations are more effective than consequences alone for children with Naming* (Doctoral dissertation). Retrieved from Columbia University Academic Commons, http://dx.doi.org/10.7916/D8SX6D5Z.

Hsee, C., Ruan, B., & Lu, Z. Y. (2015),"Creating Happiness By First Inducing and Then Satisfying a Desire: the Case of Curiosity", in *NA - Advances in Consumer Research,* 43, Eds. Kristin Diehl and Carolyn Yoon, Duluth, MN: Association for Consumer Research, (pp. 287-291).

Hull, C. L. (1943). The problem of intervening variables in molar behavior theory. *Psychological Review*, *50*(3), 273.

Huttenlocher, J., Haight, W., Bryk, A., Seltzer, M., & Lyons, T. (1991). Early vocabulary growth: Relation to language input and gender. *Developmental Psychology*, *27*(2), 236-248.

Huttenlocher, J., Waterfall, H., Vasilyeva, M., Vevea, J., & Hedges, L. V. (2010). Sources of variability in children's language growth. *Cognitive Psychology*, *61*(4), 343–365. http://doi.org/10.1016/j.cogpsych.2010.08.002

James, W. (1890). *Principles of Psychology*. New York: Holt.

Johnson, C. J., Beitchman, J. H., & Brownlie, E. B. (2010). Twenty-year follow-up of children with and without speech-language impairments: Family, educational, occupational, and quality of life outcomes. *American Journal of Speech-Language Pathology*, *19*(1), 51-65.

Kang, M. J., Hsu, M., Krajbich, I. M., Loewenstein, G., McClure, S. M., Wang, J. T. Y., & Camerer, C. F. (2009). The wick in the candle of learning epistemic curiosity activates reward circuitry and enhances memory. *Psychological Science*, *20*(8), 963-973.

Kaplan, F., & Oudeyer, P. Y. (2007). In search of the neural circuits of intrinsic motivation. *Frontiers in Neuroscience*, *1*(1), 225-236.

Kashdan, T. B. (2004). Curiosity. In C. Peterson & M. E. P. Seligman (Eds.), *Character strengths and virtues: A handbook and classification* (pp. 125–141). New York: Oxford University Press.

Kashdan, T. B., Afram, A., Brown, K. W., Birnbeck, M., & Drvoshanov, M. (2011). Curiosity enhances the role of mindfulness in reducing defensive responses to existential threat. *Personality and Individual Differences*, *50*(8), 1227-1232.

Kashdan, T. B., Gallagher, M. W., Silvia, P. J., Winterstein, B. P., Breen, W. E., Terhar, D., & Steger, M. F. (2009). The curiosity and exploration inventory-II: Development, factor structure, and psychometrics. *Journal of Research in Personality*, *43*(6), 987-998.

Kashdan, T. B., & Roberts, J. E. (2004). Social anxiety's impact on affect, curiosity, and social self-efficacy during a high self-focus social threat situation. *Cognitive Therapy and Research*, *28*(1), 119-141.

Kashdan, T. B., Rose, P., & Fincham, F. D. (2004). Curiosity and exploration: Facilitating positive subjective experiences and personal growth opportunities. *Journal of Personality Assessment*, *82*(3), 291-305.

Kastak, C. R., & Schusterman, R. J. (2002). Sea lions and equivalence: Expanding classes by exclusion. *Journal of Experimental Analysis of Behavior, 78,* 449-465.

Kelley, A.E., Cador, M., and Stinus, L. (1989) Exploration and its measurement. A psychopharmacological perspective, in A.B. Boulton, G.B. Baker, and A.J. Greenshaw (eds.), *Neuromethods, Volume 13: Psychopharmacology,* Humana Press, Clifton, pp. 95-144.

Kempermann, G., Gast, D., & Gage, F. H. (2002). Neuroplasticity in old age: Sustained fivefold induction of hippocampal neurogenesis by long-term environmental enrichment. *Annals of Neurology*, *52*(2), 135-143.

Kidd, C., & Hayden, B. Y. (2015). The psychology and neuroscience of curiosity. *Neuron*, *88*(3), 449-460.

Kinney, D. K., & Kagan, J. (1976). Infant attention to auditory discrepancy. *Child Development, 47*, 155–164.

Kobayashi, S., Ohashi, Y., & Ando, S. (2002). Effects of enriched environments with different durations and starting times on learning capacity during aging in rats assessed by a refined procedure of the Hebb-Williams maze task. *Journal of Neuroscience Research*, *70*(3), 340-346.

Kuhl, P. K. (2000). A new view of language acquisition. *Proceedings of the National Academy of Sciences of the United States of America, 97*(22), 11850-11857.

Law, J., Rush, R., Schoon, I., & Parsons, S. (2009). Modeling developmental language difficulties from school entry into adulthood: Literacy, mental health, and employment outcomes. *Journal of Speech, Language, and Hearing Research*, *52*(6), 1401-1416.

Litman, J. (2005). Curiosity and the pleasures of learning: Wanting and liking new information. *Cognition and Emotion*, *19*(6), 793-814.

Litman, J. A., & Jimerson, T. L. (2004). The measurement of curiosity as a feeling of deprivation. *Journal of Personality Assessment*, *82*(2), 147-157.

Loewenstein, G. (1994). The psychology of curiosity: A review and reinterpretation. *Psychological Bulletin*, *116*(1), 75-98.

Lo, C. (2016). *How the listener half of naming leads to multiple stimulus control* (Doctoral dissertation). Retrieved from Columbia University Academic Commons, http://dx.doi.org/10.7916/D8C82988.

Longano, J.M. (2008). *The effects of echoic behavior and a second order classical conditioning procedure as the reinforcement history of emergent naming* (Doctoral dissertation), Retrieved from ProQuest Dissertations (Order No. 3317585).

Longano, J. M., & Greer, R. D. (2015). Is the source of reinforcement for Naming multiple conditioned reinforcers for observing responses? *The Analysis of Verbal Behavior*, *31*(1), 96–117. http://doi.org/10.1007/s40616-014-0022-y

Lowenkron, B. (1988). Generalization of delayed identity matching in retarded children. *Journal of the Experimental Analysis of Behavior, 50,* 163–172. doi:10.1901/jeab.1988.50-163

Lowenkron, B., & Colvin, V. (1992). Joint control and generalized nonidentity matching: Saying when something is not. *The Analysis of Verbal Behavior*, *10*, 1-10.

Luke, N., Greer, R. D., Singer-Dudek, J., & Keohane, D. D. (2011). The emergence of autoclitic frames in atypically and typically developing children as a function of multiple exemplar instruction. *The Analysis of Verbal Behavior*, *27*, 141-156.

Marion, C., Vause, T., Harapiak, S., Martin, G. L., Yu, C. T., & Sakko, G. (2003). The hierachical relationship between several visual and auditory discriminations and three verbal operants among individuals with developmental disabilities. *The Analysis of Verbal Behavior, 19,* 91-105.

McCay-Peet, L., Lalmas, M., & Navalpakkam, V. (2012). On saliency, affect and focused attention. In *SIGCHI Conference on Human Factors in Computing Systems, ACM,* 541-550.

McDougall, W. (1908). *An introduction to social psychology.* London: Methuen.

McIlvane, W. J., Bass, R. W., O'Brien, J. M., Gerovac, B. J., & Stoddard, L. T. (1984). Spoken and signed naming of foods after receptive exclusion training in severe retardation. *Applied Research in Mental Retardation, 5,* 1-27.

McIlvane, W. J., Kledaras, J. B., Munson, L. C., King, K. A., de Rose, J. C., & Stoddard, L. T. (1987). Controlling relations in conditional discrimination and matching by exclusion. *Journal of the Experimental Analysis of Behavior, 48,* 187-208.

McIlvane, W. J., & Stoddard, L. T. (1981). Acquisition of matching-to-sample performances in severe mental retardation: Learning by exclusion. *Journal of Mental Deficiency Research, 25,* 33-48.

McKean, C., Mensah, F. K., Eadie, P., Bavin, E. L., Bretherton, L., Cini, E., & Reilly, S. (2015). Levers for language growth: Characteristics and predictors of language trajectories between 4 and 7 years. *PloS One*, *10*(8), e0134251.

Mehler, J., Jusczyk, P., Lambertz, G., Halsted, N., Bertoncini, J., & Amiel-Tison, C. (1988). A precursor of language acquisition in young infants. *Cognition, 29,* 143-178.

Menon, S., & Soman, D. (2002). Managing the power of curiosity for effective web advertising strategies. *Journal of Advertising*, *31*(3), 1-14.

Messer, D. J. (1994). *The development of communication: From social interaction to language*. New York: John Wiley & Sons.

Miguel, C. F., Carr, J. E., & Michael, J. (2002). The effects of a stimulus-stimulus pairing procedure on the vocal behavior of children diagnosed with autism. *The Analysis of Verbal Behavior, 18,* 3-13.

Moerk, E. L. (1986). Environmental factors in early language acquisition. In G. J. Whitehurst (Ed.), *Annals of Child Development* (Vol. *3*, pp. 191-235): JAI Press.

Moerk, E. L. (1989). The LAD was a lady and the tasks were ill-defined. *Developmental Review*, *9*, 21-57.

Moerk, E. L. (1990). Three-term contingency patterns in mother–child verbal interactions during first-language acquisition. *Journal of the Experimental Analysis of Behavior*, *54*(3), 293–305. http://doi.org/10.1901/jeab.1990.54-293

Mosca, K. N. (2015). *Incidental learning of two languages by bilingual Swedish- and English-speaking children, monolingual English-speaking children and monolingual English-speaking adults*, (Doctoral dissertation). Retrieved from Columbia University Academic Commons http://dx.doi.org/10.7916/D84748Z2.

Mundy, P., Kasari, C., Sigman, M., & Ruskin, E. (1995). Nonverbal communication and early language acquisition in children with Down syndrome and in normally developing children. *Journal of Speech, Language, and Hearing Research*, *38*(1), 157-167.

Mussel, P. (2010). Epistemic curiosity and related constructs: Lacking evidence of discriminant validity. *Personality and Individual Differences*, *49*(5), 506-510.

Mussel, P., Winter, C., Gelleri, P., & Schuler, H. (2011). Explicating the openness to experience construct and its subdimensions and facets in a work setting. *International Journal of Selection and Assessment*, *19*(2), 145-156.

Nuzzolo-Gomez, R., & Greer, R. D. (2004). Emergence of untaught mands or tacts of novel adjective-object pairs as a function of instructional history. *The Analysis of Verbal Behavior*, *20*, 63–76.

Oliver, B. R., & Plomin, R. (2007). Twins' Early Development Study (TEDS): A multivariate, longitudinal genetic investigation of language, cognition and behavior problems from childhood through adolescence. *Twin Research and Human Genetics*, *10*(1), 96-105.

O'keefe, J., & Nadel, L. (1978). *The hippocampus as a cognitive map*. Oxford: Clarendon Press.

Oudeyer, P.-Y., & Kaplan, F. (2007). What is intrinsic motivation? A typology of computational approaches. *Frontiers in Neurorobotics*, *1*, 6. http://doi.org/10.3389/neuro.12.006.2007

Pavlov, I. P. (1927). *Conditional reflexes: An investigation of the physiological activity of the cerebral cortex*. London: Oxford University Press.

Pereira-Delgado, J., & Oblak, M. (2007). The effects of daily intensive tact instuction on the emission of pure mands and tacts in non-instructional settings by three preschool children with developmental delays. *Journal of Early and Intensive Behavior Intervention, 4*(2), 392-411.

Perez-Gonzalez, L. A., Garcıa-Asenjo, L., Williams, G., & Carnerero, J. J. (2007). Emergence on intraverbal antonyms in children with pervasive developmental disorder. *Journal of Applied Behavior Analysis, 40,* 697–701.

Pinker, S. (1995). Language acquisition. In L. R. Gleitman & M. Liberman (Eds.), *Language: An invitation to cognitive science, Vol 1* (2nd ed., pp. 135-182). Cambridge, MA: The MIT Press.

Pinker, S. (1994). *The language instinct*. New York: William Morrow & Company.

Pistoljevic, N. (2008). *The effects of multiple exemplar and intensive tact instruction on the acquisition of naming in preschoolers diagnosed with autism and other language delays* (Doctoral dissertation). Retrieved from ProQuest Dissertations (Order No. 3317598).

Pistoljevic, N., & Greer, R.D. (2006). The effects of daily intensive tact instruction on preschool students' emission of pure tacts and mands in non-instructional setting. *Journal of Early and Intensive Behavioral Interventions, 3*(1), 103–120.

Pisula, W. (2009). *Curiosity and information seeking in animal and human behavior*. Boca Raton, FL: Brown Walker Press.

Pluck, G., & Johnson, H. L. (2011). Stimulating curiosity to enhance learning. *GESJ: Education Sciences and Psychology*, *2*(19), 24-31.

Reio Jr, T. G., & Callahan, J. L. (2004). Affect, curiosity, and socialization-related learning: A path analysis of antecedents to job performance. *Journal of Business and Psychology*, *19*(1), 3-22.

Reio Jr, T. G., Petrosko, J. M., Wiswell, A. K., & Thongsukmag, J. (2006). The measurement and conceptualization of curiosity. *The Journal of Genetic Psychology*, *167*(2), 117-135.

Reilly-Lawson, T. L. (2008). *Phonemic control as the source of derived relations between Naming and reading and writing* (Doctoral Dissertation). Retrieved from ProQuest Dissertations (Order No. 3317602).

Rice, M. L., Oetting, J. B., Marquis, J., Bode, J., & Pae, S. (1994). Frequency of input effects on word comprehension of children with specific language impairment. *Journal of Speech, Language, and Hearing Research*, *37*(1), 106-122.

Richter, C. P. (1922). A behavioristic study of the activity of the rat. *Comparative Psychology Monographs*, *1,* 1-55.

Roid, G.H. (2003). *Stanford–Binet Intelligence Scales*. 5th ed. Itasca, IL: Riverside Publishing.

Rosales-Ruiz, J., & Baer, D. M. (1997). Behavioral cusps: a developmental and pragmatic concept for behavior analysis. *Journal of Applied Behavior Analysis*, *30*(3), 533–544. http://doi.org/10.1901/jaba.1997.30-533.

Rosenzweig, M. R., & Bennett, E. L. (1996). Psychobiology of plasticity: effects of training and experience on brain and behavior. *Behavioural Brain Research*, *78*(1), 57-65.

Ross, D. E. & Greer, R. D. (2003). Generalized imitation and the mand: inducing first instances of speech in young children with autism. *Research in Developmental Disabilities, 24,* 58-74.

Rothstein, M. B., & Gautreaux, G. G. (2007). The effects of a peer-yoked contingency on observational learning and the collateral emergence of naming. *Journal of Early and Intensive Behavior Intervention*, *4*(2), 453-471.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *The American Psychologist*, *55*(1), 68-78.

Ryff, C. D. (1989). Happiness is everything, or is it? Explorations on the meaning of eudaimonic well-being. *Journal of Personality and Social Psychology, 57*, 1069–1081.

Salapatek, P., & Kesson, W. (1966). Visual scanning of triangles by the human newborn. *Journal of Experimental Child Psychology, 3,* 155-167.

Saunders, R. R., & Green, G. (1999). A discrimination analysis of training-structure effects on stimulus equivalence outcomes. *Journal of the Experimental Analysis of Behavior*, *72*(1), 117-137.

Schauffler, G., & Greer, R.D. (2006). The effects of intensive tact instruction on audience-accurate tacts and conversational units. *Journal of Early and Intensive Behavioral Interventions, 3*(1), 120–132.

Schoon, I., Law, J., Rush, R., & Parsons, S. (2010). Children's language ability and psychosocial development: A 29-year follow-up study. *Pediatrics*, *126*(1), e73-e80.

Schwartz, R. G., & Terrell, B. Y. (1983). The role of input frequency in lexical acquisition. *Journal of Child Language*, *10*(1), 57-64.

Schmitt, F. F., & Lahroodi, R. (2008). The epistemic value of curiosity. *Educational Theory*, *58*(2), 125-148.

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

Sidman, M. & Cresson, O. (1973). Reading and cross modal transfer of stimulus equivalence in severe retardation. *American Journal of Mental Deficiency, 77*(5), 515-523.

Sidman, M., & Tailby, W. (1982). Conditional discrimination vs. matching to sample: an expansion of the testing paradigm. *Journal of the Experimental Analysis of Behavior, 37*(1), 5-22.

Silvia, P. J. (2006). *Exploring the psychology of interest*. New York: Oxford University Press.

Silvia, P. J. (2012). Curiosity and motivation. *The Oxford Handbook of Human Motivation*, 157-166.

Simon, H. A. (2001). "Seek and ye shall find": How curiosity engenders discovery. In K. Crowley, C. Schunn, & T. Okada (Eds.), *Designing for science: Implications from everyday, classroom, and professional settings* (pp. 5–20). Mahwah, NJ: Lawrence Erlbaum.

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

Slocum, S. K., & Tiger, J. H. (2011). An assessment of the efficiency of and child preference for forward and backward chaining. *Journal of Applied Behavior Analysis*, *44*(4), 793–805. http://doi.org/10.1901/jaba.2011.44-793

Snyder, L. S., & Lindstedt, D. E. (1985). Models of child language development. In E. Schopler & G. B. Mesibov (Eds.), *Communication problems in autism* (pp.17-36). New York: Plenum.

Sokolov, E. N. (1963). *Perception and the conditioned reflex*. New York: Macmillan.

Speckman-Collins, J. M., Park, H. L., & Greer, R. D. (2007). Generalized selection-based auditory matching and the emergence of the listener component of naming. *Journal of Early and Intensive Behavior Intervention, 4*(2), 412-429.

Speckman-Collins, J. & Greer, R. D. (2012). Multiple exemplar instruction and the emergence of generative production of suffixes as autoclitic frames. *The Analysis of Verbal Behavior*, *28*(1), 83-99.

Spielberger, C. D., & Starr, L. M. (1994). Curiosity and exploratory behavior. In H. F. O'Neil, Jr. & M. Drillings (Eds.), *Motivation: Theory and research* (pp. 221–243). Hillsdale, NJ: Lawrence Erlbaum Associates.

Strickland, L. (2014). *Monster Clip Art* [PNG]. Retrieved from http://www.mycutegraphics.com/graphics/monster-images.html

Sundberg, M. L., & Michael, J. (2001). The benefits of Skinner's analysis of verbal behavior for children with autism. *Behavior Modification, 25*(5), 698-724.

Sundberg, M. L., Michael, J., Partington, J. W., & Sundberg, C. A. (1996). The role of automatic reinforcement in early language acquisition. *The Analysis of Verbal Behavior, 13,* 21-37.

Tarbox, J., Madrid, W., Aguilar, B., Jacobo, W., & Schiff, A. (2009). Use of chaining to increase complexity of echoics in children with autism. *Journal of Applied Behavior Analysis, 42,* 901-906.

Tomanoga, M. (1993). Tests for control by exclusion and negative stimulus relations of arbitrary matching-to-sample in “symmetry-emergent” chimpanzee. *Journal of the Experimental Analysis of Behavior, 59*, 215-222.

Tomasello, M., & Farrar, M. J. (1986). Joint attention and early language. *Child Development*, *57*(6), 1454-1463.

Tomasello, M., & Todd, J. (1983). Joint attention and lexical acquisition style. *First Language*, *4*(12), 197-211.

Tomblin, J. B. (2008). Validating diagnostic standards for specific language impairment using adolescent outcomes. In C. F. Norbury, J. B. Tomblin, & D. V. M. Bishop (Eds.), *Understanding developmental language disorders: From theory to practice* (pp. 93–114). Hove, England: Psychology Press.

Tsiouri, I., & Greer, R.D. (2003). Inducing vocal verbal behavior in children with severe language delays through rapid motor imitation responding. *Journal of Behavioral Education, 12*(3), 185-206.

Tsiouri, I., & Greer, R. D. (2007). The role of different social reinforcement contingencies in inducing echoic tacts through motor imitation responding in children with severe language delays. *Journal of Early and Intensive Behavior Intervention*, *4*(4), 629-647.

Ulvund, S. E., & Smith, L. (1996). The predictive validity of nonverbal communicative skills in infants with perinatal hazards. *Infant Behavior and Development*, *19*(4), 441-449.

Venter, A., Lord, C., & Schopler, E. (1992). A follow-up study of high-functioning autistic children. *Journal of Child Psychology and Psychiatry*, *33*(3), 489-597.

Voss, H. G., & Keller, H. (1983). *Curiosity and exploration: Theories and results*. New York: Academic Press.

Walker, D., Greenwood, C., Hart, B., & Carta, J. (1994). Prediction of school outcomes based on early language production and socioeconomic factors. *Child Development*, *65*(2), 606-621.

Wechsler, D. (2014). *Wechsler intelligence scale for children* (5th ed.). Bloomington, MN: Pearson.

Weisleder, A., & Fernald, A. (2013). Talking to children matters early language experience strengthens processing and builds vocabulary. *Psychological Science*, *24*(11), 2143-2152.

Weizman, Z. O., & Snow, C. E. (2001). Lexical output as related to children's vocabulary acquisition: Effects of sophisticated exposure and support for meaning. *Developmental Psychology*, *37*(2), 265-279.

Williams, G. & Greer, R. D. (1993). A comparison of verbal-behavior and linguistic-communication curricula for training developmentally delayed adolescents to acquire and maintain vocal speech. *Behaviorology, 1,* 31-46.

Willoughby, J., Mundy, P., & Claussen, A. (1997). Joint attention, other nonverbal communication skills, and language development in infants at risk due to prenatal cocaine exposure. In *Biennial Meeting of the Society for Research in Child Development, Washington, DC*.

Yoon, S-Y., & Bennett, G. M. (2000). Effects of a stimulus-stimulus pairing procedure on conditioning vocal sounds as reinforcers*. The Analysis of Verbal Behavior, 17*, 75-88.

Appendix

Adult and Youth Participants' Numbers of Correct Untaught Listener and Speaker Responses

Following the Two Types of Naming Experiences in Experiment 1.

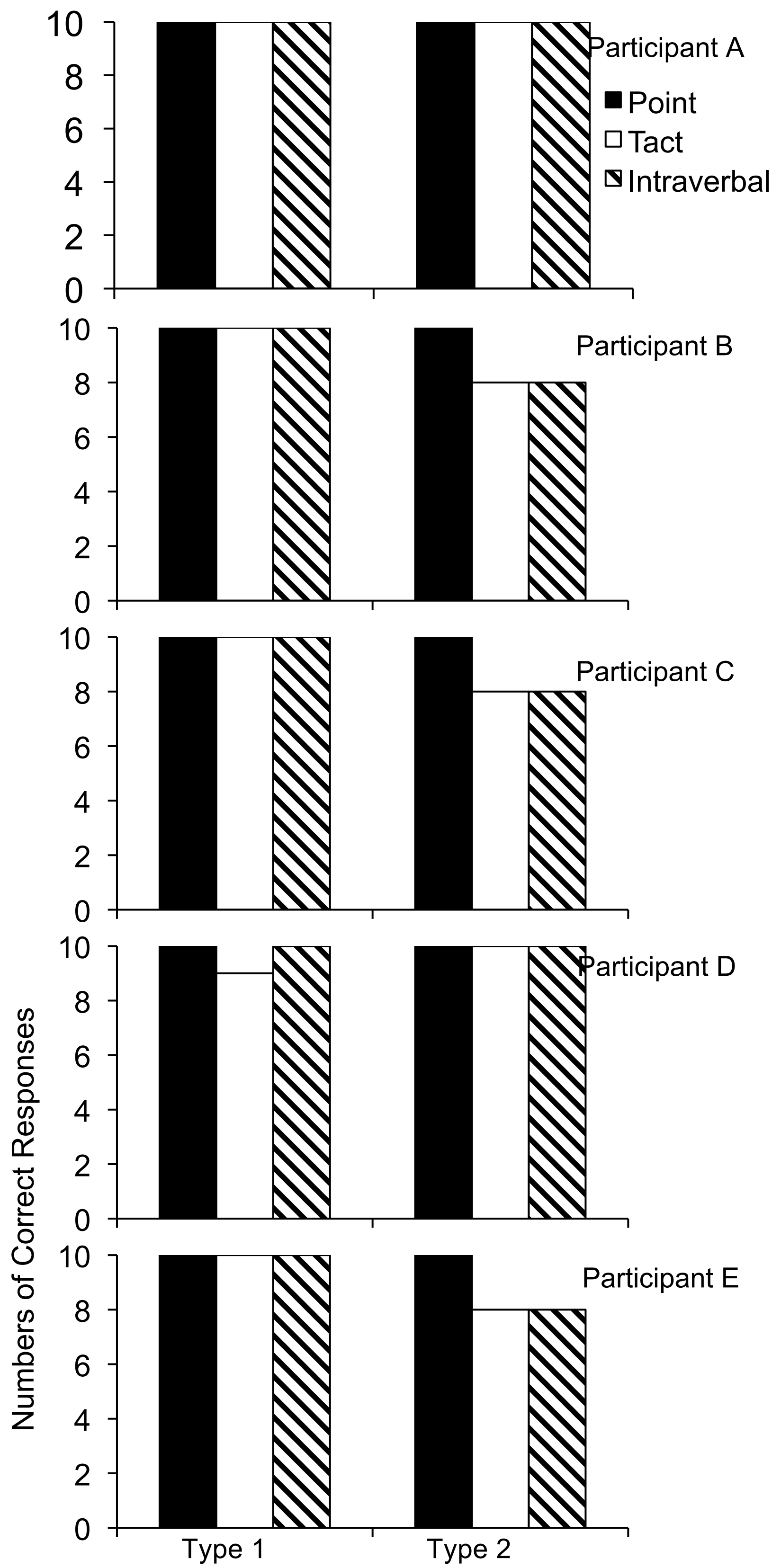


Figure A1. Adult Participants A – E's numbers of correct untaught listener and speaker responses following the two types of Naming experiences.

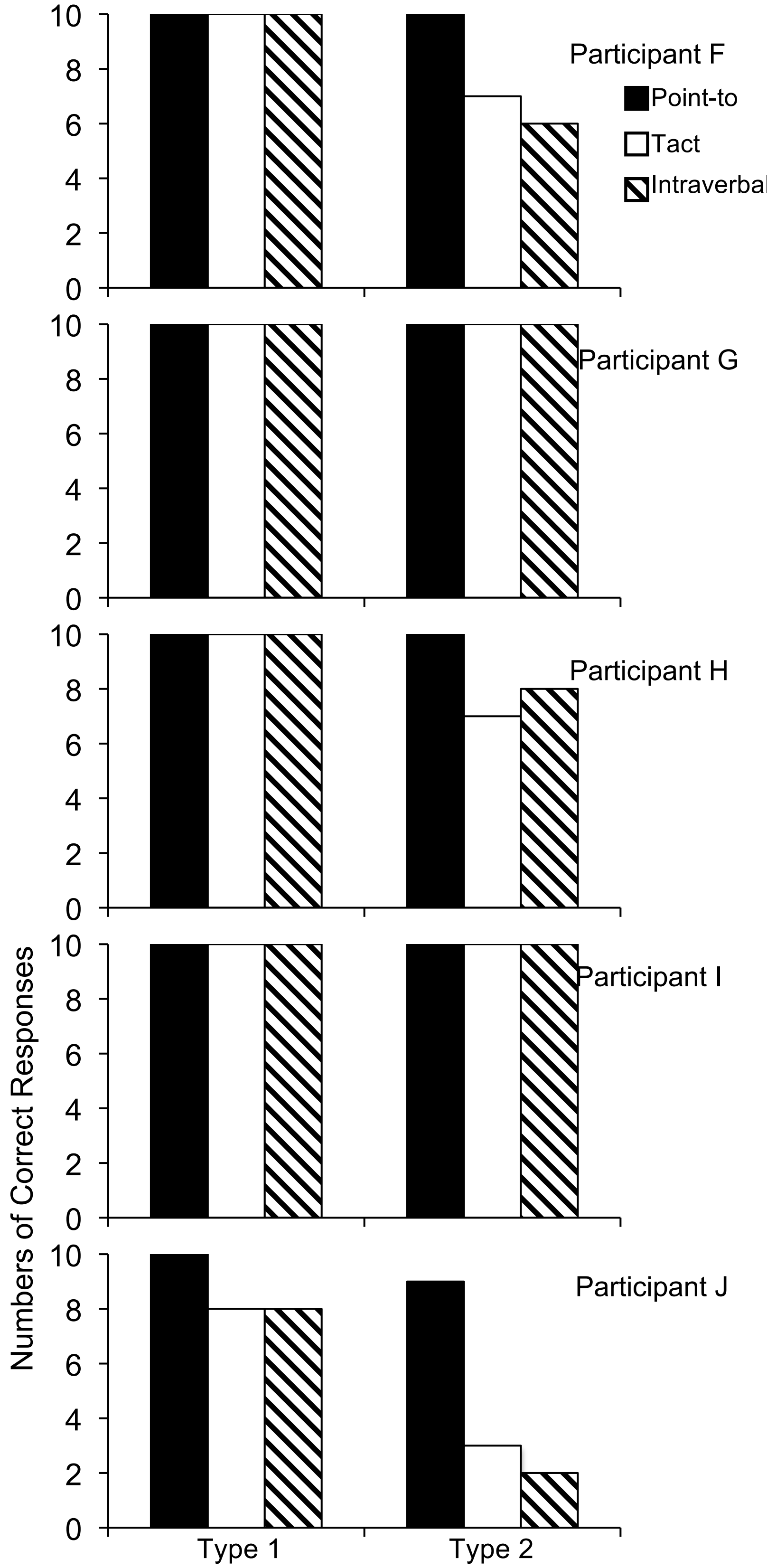


Figure A2. Adult Participants F – J's numbers of correct untaught listener and speaker responses following the two types of Naming experiences.

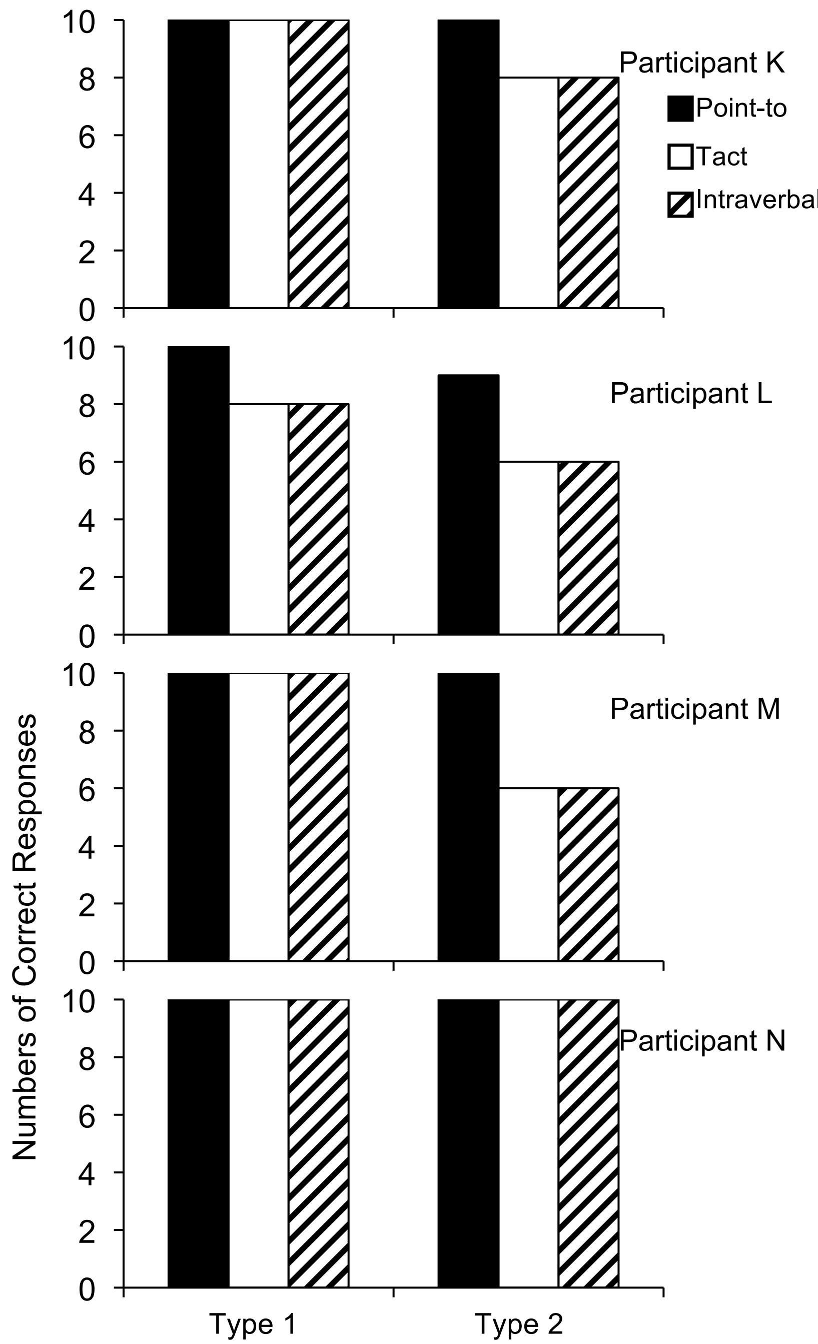


Figure A3. Adult Participants K – N's numbers of correct untaught listener and speaker responses following the two types of Naming experiences.

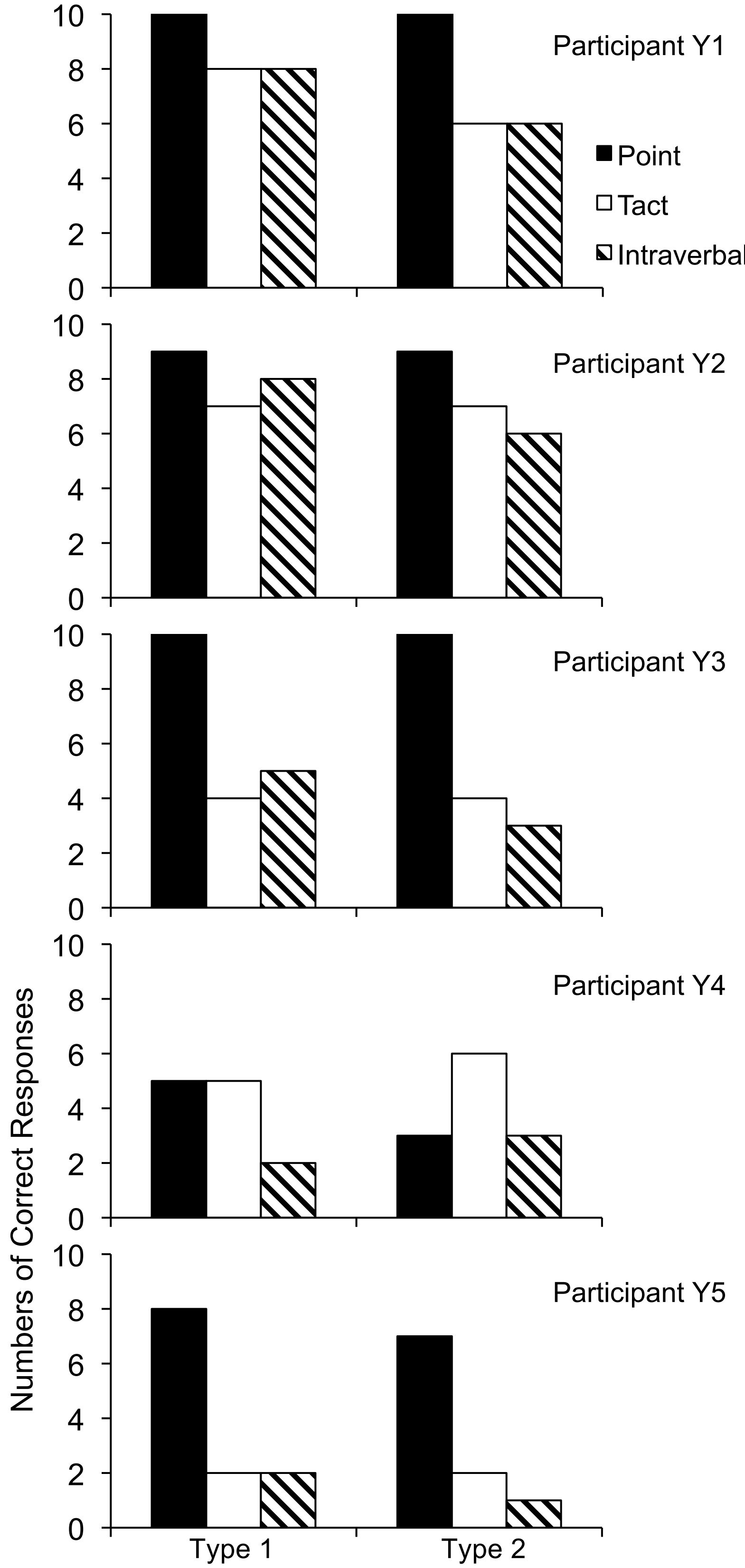


Figure A4. Youth Participants Y1 – Y5's numbers of correct untaught listener and speaker responses following the two types of Naming experiences.

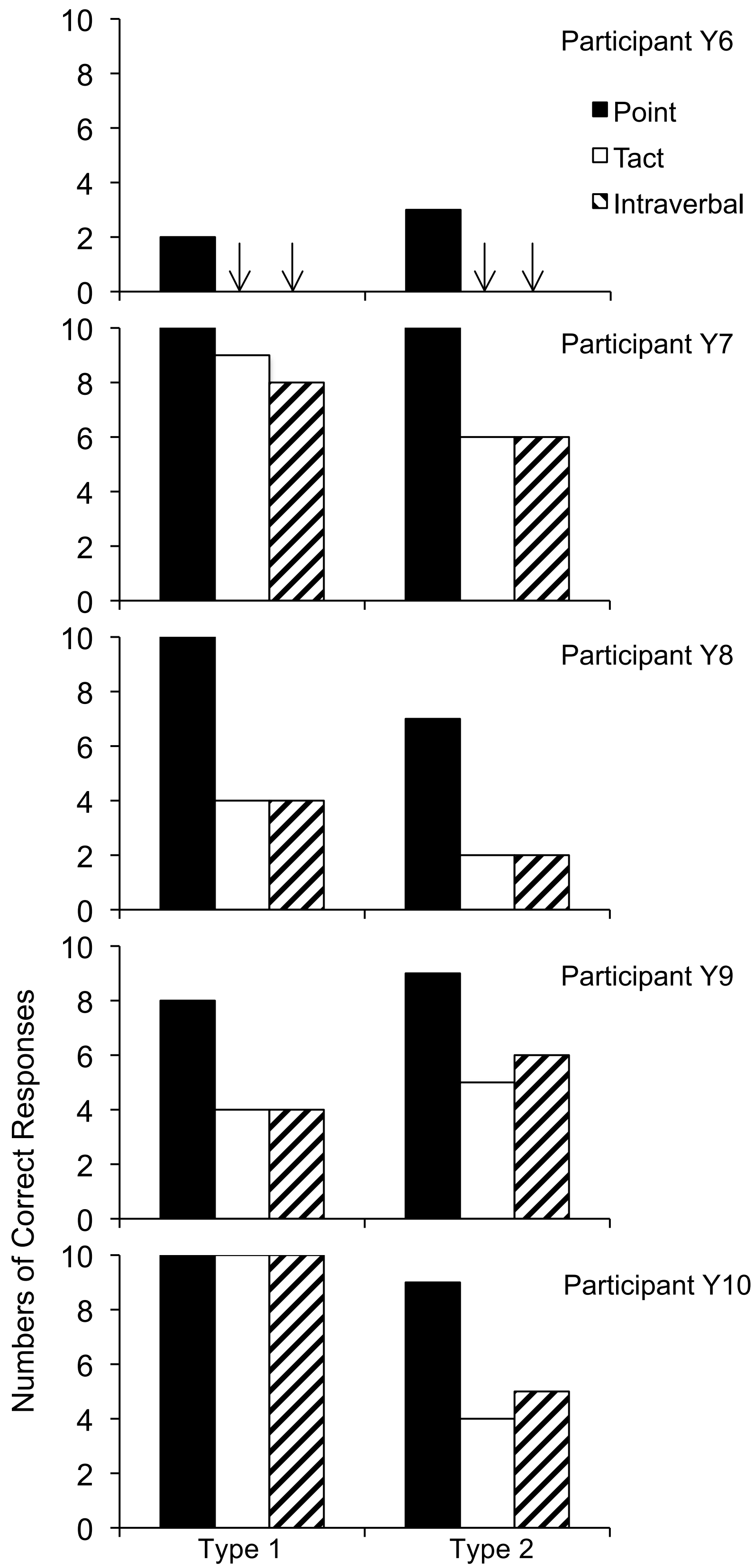


Figure A5. Youth Participants Y6 – Y10’s numbers of correct untaught listener and speaker responses following the two types of Naming experiences.

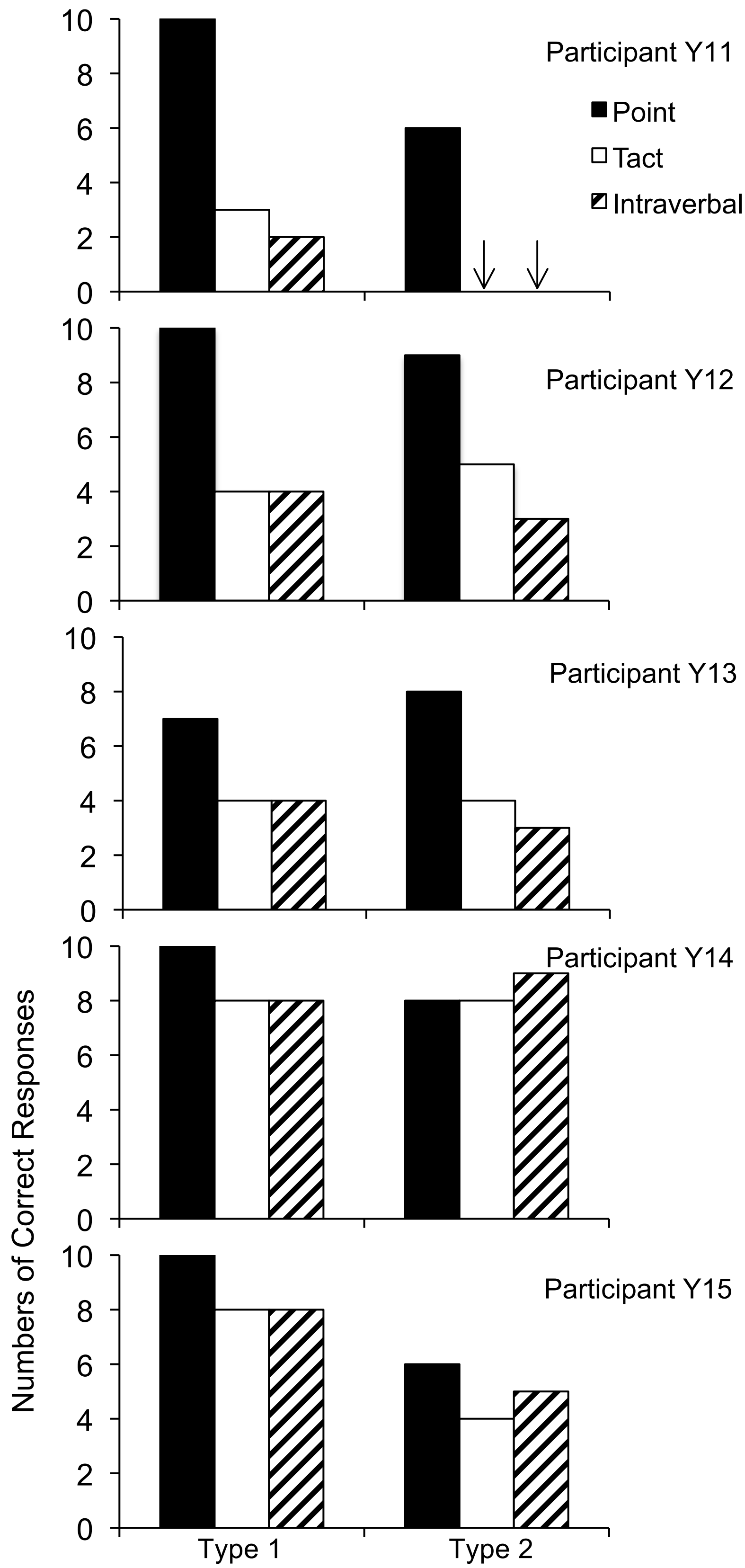


Figure A6. Youth Participants Y11 – Y15's numbers of correct untaught listener and speaker responses following the two types of Naming experiences.

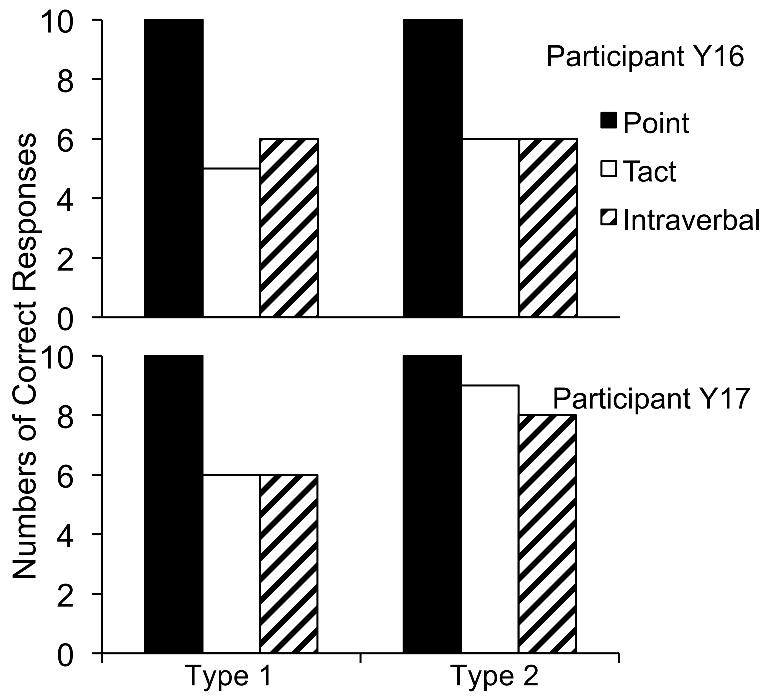


Figure A7. Youth Participants Y16 – Y17's numbers of correct untaught listener and speaker responses following the two types of Naming experiences.