An Investigation into the Speaker-as-own-Listener Repertoire

and Reverse Intraverbal Responding

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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

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I conducted 2 experiments investigating the relations between speaker-as-own-listener cusps and responding to bidirectional or reverse intraverbals. Speaker-as-own-listener cusps include, Naming, Say-Do Correspondence and Self-Talk Fantasy Play. During a pilot experiment, I found the source of the problem in 2 participants’ learning was their deficient speaker-as-own-listener repertoires. Although both participants in the pilot study had the Full Naming capability in repertoire, they lacked Say-Do and Self-Talk. Following a Self-Talk Immersion intervention, Say-Do was induced for both participants and coincidentally, correct responses to bidirectional or reverse intraverbals emerged. In Experiment I, I continued examining relations between the speaker-as-own-listener (SOL) repertoire and intraverbal responding with a statistical analysis of 35 Early Intervention (EI) and Preschool students recruited from CABAS® model schools who functioned at listener and speaker levels of verbal behavior. Findings from Experiment I indicated that the presence of Say-Do Correspondence and Self-Talk were significantly correlated to correct responses to reverse intraverbals. Experiment II was a functional analysis, during which 4 participants were selected from an EI classroom due to their similar levels of verbal behavior, deficient SOL repertoire, and because they could not respond to reverse intraverbals. Results indicated a functional relation between the presence of Say-Do Correspondence and Self-Talk and correct responses to intraverbal probes for all 4 participants.
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ACKNOWLEDGEMENTS

I would not be here without the unconditional love and support from my family. I thank my parents and grandparents for teaching me to try and try again and when one fails, dust yourself off and try once more. I am proud of the strong lineage of women I come from and only hope to contribute.

I am incredibly thankful to Dr. Stavra Romas, my partner in crime—to say you are my friend and teammate is an understatement. Stavra, you have supported me through all my endeavors and I can only hope to repay the favor.

I am also appreciative of the inspiration and encouragement I have received from my supervisors and mentees over the past years. Thank you especially to Susan Buttigieg, Lin Du, Jen Longano, Erika Byers, Tynisha Coleman, Victoria Difigola, and Kate Cameron.

Thank you Dr. Jeanne Speckman, you have always been a mentor and significant role model. Thank you for your continued guidance and support.

Thank you Dr. Greer for constantly challenging me and making strive for excellence.

I am so grateful for my committee, Dr. Greer, Dr. Wang, Dr. Speckman, Dr. O’Connell, and Dr. Matthews. I appreciate your interest and sponsorship in my research.

Last, but most definitely not least, I thank my true loves, my number 1 and number 2 boys, for all they have endured during this process: the stress, the late nights, and cranky behavior on my part. You two bring everything into focus for me. I love you both dearly. Steve and Levi, you are my lights of my life. I am incredibly fortunate to have you boys in my life.
DEDICATION

To my goddaughter and niece Sammy,

*Be true to who you are*

*and always reach for the stars*
Chapter I

INTRODUCTION AND REVIEW OF THE LITERATURE

Introduction

Complex listener and speaker repertoires are unique to the human species (Greer & Keohane, 2005; Rehfeldt & Barnes-Holmes, 2009); it is the joining of these initially independent repertoires that makes the individual “truly verbal” (Barnes-Holmes, Barnes-Holmes, & Cullinan, 2000; Greer, 2008; Greer & Keohane, 2005; Greer & Ross, 2008, Hayes, Barnes-Holmes, & Roche, 2001; Speckman & Greer, 2009). According to Verbal Behavior Development Theorists (VBDT), the fusion of these once separate repertoires emerges during the individual’s speaker-as-own-listener status, when the individual rotates between acting as his or her own listener and speaker within the skin. Skinner (1957) proposed his conceptual theory of language based on characteristic operant control, focusing on six speaker functions: the mand, tact, echoic, intraverbal, autoclitic, and textual response. Although Skinner argued the tact was the most crucial verbal operant for socialization, research is also indicative of the complex and unique nature of the intraverbal and its essential role in the social world.

An intraverbal is a verbal response that has no point-to-point correspondence with the antecedent stimulus (Skinner, 1957), therefore intraverbals take on a myriad of forms from reciting the alphabet to writing an answer to the fill-in-the-blank. In the following review of literature I will address the significance of the intraverbal as well as the listener and speaker repertoires joining and acquiring joint stimulus function within the same
skin, highlighting the overt to covert behavior continuum and the advanced development of these repertoires. In addition, I will compare the literature found in Skinnerian-based studies to similar theories in other scientific approaches, such as the Theory of Mind (ToM) and executive functioning discussed by several developmental and cognitive psychologists.

**Language Development**

**Verbal Behavior**

In his seminal work *Verbal Behavior* (1957), B.F. Skinner described a radical behaviorist approach to language development. Skinner’s theory of verbal behavior focuses on the function of language, rather than structural or mentalistic explanations or causations. He defined verbal behavior as social behavior and wrote that verbal behavior is “the behavior of an individual which achieves its effect on the world through someone else’s behavior” (Skinner, 1957, p. viii). In his treatment of language development, Skinner (1957; 1974; 1986) defined various listener and speaker repertoires, and hypothesized that they initially develop separately. An individual cannot be considered “truly verbal” until the listener and speaker repertoires join together within the skin (Barnes-Holmes, et al., 2000; Greer, 2008; Greer & Keohane, 2005; Greer & Ross, 2008, Hayes, et al., 2001; Speckman & Greer, 2009). Many extensions of Skinner’s work have arisen out of the field of verbal behavior development and the developmental phenomenon that explains the fusion of listener and speaker repertoires. This speaker-as-own-listener repertoire is a critical component of language development in verbal behavior theory.
Extensions of Verbal Behavior. Skinner initially proposed an approach to language that was an alternative to the mentalistic approaches, but his work was more theory, limited by lack of empirical research (Hayes, et al., 2001). Stimulus Equivalence and Relational Frame theorists attempt to fill this “void” in the research—to bring experimentally demonstrated evidence to Skinner’s theory of Verbal Behavior and expand it to include derived relations and how derived relations are formed (Hayes, et al., 2001). Additionally, Greer and Ross (2008) proposed Verbal Behavior Developmental Theory (VBDT) as an extension of Skinner’s verbal behavior theory, with an emphasis on understanding the developmental trajectory of verbal behaviors.

Stimulus Equivalence (SE) and Relational Frame Theory (RFT) emerged around the same time in order to fill the “void” or capture the “white whale” in Skinner’s analysis of verbal behavior (Hayes et al., 2001). Sidman and colleagues focused on equivalence relations, whereas RFT theorists such as Hayes and Barnes-Holmes directed their research to all derived relations, not only equivalent relations, or frames of coordination (Hall & Chase; 1991; Hayes, et. al., 2001) Both theories set out to extend or expand upon Skinner’s analysis of verbal behavior, and in particular, his theories on the acquisition of language. How do we learn to call things names? How do we derive relations or infer? Both theories also set out to bring a behavioral approach to a subject that previously was dominated by linguists such as Chomsky (Hayes, et. al., 2001; Rehfeldt & Barnes-Holmes, 2009).

According to the Association of Contextual Behavioral Sciences, SE is an empirical phenomenon, whereas RFT is a behavioral theory about how that phenomenon (and others) emerges. In addition, Sidman’s account of SE is a descriptive one, whereas
RFT attempts to offer a functional explanation (Hayes et al., 2001). The Verbal Behavior Development Theory assumes all those points and focuses on incidental language acquisition, or Naming, as the source for rapid language development between the ages of 2 and 3.

**Stimulus Equivalence.** According to Rehfeldt and Barnes-Holmes (2009), stimulus equivalence promotes learning through the development of stimulus classes. When two or more stimuli control common responses, the stimuli are part of a stimulus class of equivalence (Sidman, 1971). Sidman and Tailby (1982) demonstrated equivalence between stimuli using tests of reflexivity, symmetry and transitivity.

Reflexivity is like a mirror; it posits $A=A$, an identical matching of two stimuli (in the absence of training). Symmetry relations suggest if $A$ is related to $B$, then $B$ is related to $A$; the reverse match (in the absence of training). Transitivity means if $A$ is related to $B$ and $B$ is related to $C$, then $A$ and $C$ must also be related. Sidman borrowed these terms from the mathematical definition of equivalence and combined them with behavior psychology (Hall & Chase, 1991). However, Sidman and colleagues never distinguished what the relation was or in other words, how the stimuli were being compared, therefore since $A$, $B$, and $C$ are all members of the same equivalence class; they are interchangeable (Hall & Chase, 1991).

**Relational Frame Theory.** Hayes, Barnes-Holmes, and Roche (2001) developed Relational Frame Theory (RFT) to expand on Skinner’s theory and speak to the complexities of verbal behavior development. In RFT, verbal behavior is defined as arbitrary stimulus relations that occur during relational responding, or responses emitted within a frame. Behavior is only considered verbal if both the listener and the speaker
participate in the frame. RFT theorists argue we learn to manipulate our environment with sounds and symbols and practice, and we do this at a very early age. We manipulate our environment by attempting to interpret the meaning of words and actions around us by deriving relations, and we are able to practice due to the multiple exemplars or experiences presented in our daily lives (Hayes, et. al., 2001).

Relational frames are defined as types of relational responding that become generalized operants through multiple exemplar training (Blackledge, 2003; Hayes et al 2001; Rehfeldt & Barnes-Holmes, 2009). Just as SE theorists “coined” terms to define the abstractions of derived responding (reflexivity, symmetry, and transitivity), RFT theorists proposed terms to best describe their theory on derived relations as well (Blackledge, 2003; Hayes et al 2001) which include: mutual entailment, combinatorial entailment, and transformation of stimulus function.

Mutual entailment is very similar to Sidman’s term symmetry. However, when using RFT terms the specific relation, is stated based on the relational frame. Mutual entailment is demonstrated if stimulus A is somehow related to stimulus B, and the person then derives that B is in turn, somehow related to A (bidirectional relation) without direct training (Hayes et. al, 2001; Blackledge, 2003). Combinatorial entailment is similar to Sidman’s term, transitivity, where three or more stimuli are required. RFT defines combinatorial entailment as if A is somehow related to B, and B is somehow related to C, then A and C must somehow be related as well (depending on the relational frame); therefore there are multiple derived relations possible (i.e. B-A, and A-C).

Transformation of stimulus function is when the function of a stimulus changes or is transformed due to how it is related to other stimuli (Hayes et al., 2001).
Relational frames include: the frame of coordination, which aligns with Sidman’s stimulus equivalence, frame of opposition, frame of distinction, frame of comparison, hierarchy, spatial, temporal and deictic. Coordination relational frames often use the indicators, “is same as”, and “is equivalent to”, or “like”. An oppositional frame uses indicators such as, “is opposite of” or “is the reverse of”. According to Rehfeldt et al. (2009) the frame of coordination is not only the most commonly used, it is also the first to emerge.

**Verbal Behavior Development Theory.** The Verbal Behavior Development Theory (Greer & Keohane, 2005; Greer & Ross, 2008; Greer & Speckman, 2009; Greer & Longano, 2010) outlines a developmental trajectory of listener and speaker repertoires, and defines speaker-as-own-listener cusps necessary to become truly verbal. VBDT proposes the acquisition of developmental *cusps* (Rosales-Ruiz & Baer, 1996) which allow children to contact new contingencies in their environment, as well as *cusps that are also capabilities*, which allow children to learn in new ways that they could not previously. The presence of particular behavioral cusps allow individuals to contact contingencies in their environment that they could not contact prior to the induction or emergence of the cusp. Say-Do Correspondence (SDC) and Self-Talk (ST) are identified as behavioral cusps in the speaker-as-own-listener repertoire, whereas Naming is identified as a speaker-as-own listener cusp that is also a capability (Greer & Keohane, 2005; Greer & Ross, 2008; Greer & Speckman; 2009).

**Levels of Verbal Behavior.** The Verbal Behavior Development Theory details a framework of developmental cusps and capabilities for listener and speaker repertoires as well as an overall trajectory of verbal development (Greer & Keohane, 2005; Greer &
Ross, 2008; Greer & Speckman; 2009). “The broad verbal developmental fractures include: listener, speaker, speaker-listener, speaker-as-own listener (self-talk, conversational units and naming), reader, writer, writer as own reader exchanges, and advanced verbal mediation” (Greer & Keohane, 2005, p. 10). The VBD theory provides a curriculum based on levels of verbal behavior. The evolution of verbal milestones start at the pre-listener stage, during which the individual is completely dependent on others for survival, and progresses to listener, speaker, speaker-as-own-listener, reader, writer, and more advanced stages of verbal development (Greer & Keohane, 2005; Greer & Ross, 2008). Each stage or status increases the individual’s level of independence and the degree to which he or she is considered social; however, it is not until the acquisition of a speaker-as-own listener repertoire that the individual is considered truly verbal. The focus of this paper is on the speaker-as-own-listener status.

Hart and Risley’s Observation of Language Development

Hart and Risley’s longitudinal study and observations of the daily lives of 42 children, ages 1-2, revealed several developmental benchmarks and milestones in a child’s trajectory of development. According to their observations, vocalizations occur between 7-10 months, such as babbling, and around 11 months words start to emerge. Between 20-28 months, at the start of what experimenters identified as the “stay and play” phase, parent-child interactions are laden with discussions about daily tasks. Caregivers tend to discuss seemingly simple and mundane routines to help the child make sense of the activity. The staying and playing phase emerges at the same time children begin learning independency—they start wanting to dress themselves and pick out their
clothes, potty-training, and navigating the use of utensils occurs. These activities provide ample opportunities through which the parent and child can interact and comment on.

Significant physical gains are made during the “staying and playing” phase as well, such as developed hand-eye coordination and fine and gross motor skills. During this stage, the parent starts to hear more “No’s” and “No, I do” as the child attempts to gain more independence (Hart & Risley, 1999). Hart and Risley noted that near the end of this phase, caregivers leave their children alone to engage in solitary play, or what Hart and Risley refer to as “practicing alone.” This is the perfect setting to find the child emitting self-talk conversational units as she plays by herself with only her stuffed animals or dolls. During the practicing phase, around 24-28 months, children replace “I wanna” with “I’m gonna” indicative of Say-Do Correspondence. According to the authors, language and independence advance significantly in children between 34-36 months as they start to recall and comment on past events and announce their future plans, demonstrating the emergence of Say-Do Correspondence.

The Speaker-as-own-listener Repertoire

The Speaker-as-own listener repertoire is present if individuals demonstrate verbal governance of their own behavior (Greer, 2008; Greer & Keohane, 2005; Greer & Ross, 2008, Speckman & Greer, 2009). Speaker-as-own-listener (SOL) behavior is the correspondence between verbal behavior; non-vocal verbal behavior and vocal verbal behavior (Greer, 2008; Greer & Keohane, 2005; Greer & Ross, 2008, Speckman & Greer, 2009). Presence of the SOL repertoire is the deciding point at which one is considered truly verbal (Greer, 2008; Greer & Keohane, 2005; Greer & Ross, 2008, Greer & Speckman, 2009). Children with SOL in repertoire emit sequelics (partial conversations)
and conversational units (social exchanges or verbal episodes) across settings, ask their peers, caregivers, and teachers questions, and develop control over their speaker behavior depending on their particular audience (Greer & Keohane, 2005; Greer & Ross, 2008, Greer & Speckman, 2009). Verbal behavior is social behavior and thus requires a listener and a speaker (Greer & Keohane, 2005; Greer & Ross, 2008, Greer & Speckman, 2009; Skinner, 1957). The listener and speaker can operate as two different individuals or within-the-skin of one individual. The ability to mediate one’s own behavior and the behavior of others and reciprocate the mediation is the crux of the SOL repertoire.

The emergence of speaker-as-own-listener cusps can be easily observed across most free-play setting in a preschool, play rooms in the home, or on the playgrounds with neuro-typically developing children. The children pretending to cook food in the play kitchen and taking orders from one another, engaging in reciprocal conversations or verbal episodes; the little girl playing with her dolls, pretending the baby is crying and then feeding the baby, and rocking the baby; the children using the jungle gym as “house” and taking on the roles of familial roles of Mom, Dad, and kids—these are all displays of the emergence of the speaker-as-own-listener developmental status during which the children are acting as both the listener and the speaker in mediating the behavior of others and their own behavior as well. Skinner most notably stated, “Once a speaker also becomes a listener, the stage is set for a drama in which one man plays several roles” (1957, p.433).

Problems occur when the individual is missing prerequisites, which prevent or inhibit him or her from fully developing the speaker-as-own listener repertoire. Perhaps just as apparent as the presence of this crucial repertoire is the lack of it. A child with
independent and underdeveloped listener and speaker repertoires requires direct and explicit instruction, is not able to transfer stimulus control from listener to speaker or vice versa, and is therefore limited in his or her capacity to mediate the behaviors of others and self (Greer & Keohane, 2005; Greer & Ross, 2008, Greer & Speckman, 2009).

Speaker-as-own-listener cusps, such as Say-Do Correspondence (SDC) and Self-Talk (ST), are precursors for self-awareness, thinking, problem solving and perspective taking (Greer & Ross, 2008; Hayes, et al., 2001; Novak & Peleáz, 2004; Skinner, 1957; Skinner 1974). Greer and Ross (2008) argued that SDC or self-directed behavior was the foundation for self-management and in combination with the cusp of self-talk fantasy play, develops audience control. Furthermore, Greer (2008) stated,

When print is joined to say and do other experiments suggests how verbally governed behavior (i.e., the capability to follow or respond to vocal or written verbal stimuli) and verbally governing behavior (the capability to evoke others to behave by spoken or written verbal stimuli) leads to following or the production of algorithms in complex problem solving associated with various modes of inquiry such as the methods of authority, logic, and science. (p. 377)

In addition, Horne and Lowe (1996) and Greer and Keohane (2005) argued that the SOL junction occurs in the phenomenon of Naming. The capability of Naming is essential to learning incidentally from one’s environment. According to the VBDT, typically functioning children are able to reach these milestones through multiple exemplar experiences provided in their daily lives, while other children, such as those with special needs may, require additional support in the form of procedures or protocols in order to induce them (Greer & Keohane, 2005; Greer & Ross, 2008, Greer & Speckman, 2009).
Prerequisites for speaker-as-own-listener cusps and capabilities are: early observing responses (for example, attending to and observing voices, faces, and two-dimensional and three-dimensional stimuli), conditioned reinforcement for observing responses (significant for hear-say and say-do), preverbal foundational cusps, listener repertoires, and basic speaker repertoires. The three main cusps and capabilities of this repertoire include: Naming (Greer & Ross, 2008; Greer, Stolfi, & Pistoljevic, 2006; Greer, Stolfi, Chavez-Brown & Rivera-Valdes, 2005; Horne & Lowe, 1996; Longano & Greer, 2010; Woolslayer & Greer, 2013), Say-Do Correspondence (Greer & Ross, 2008; Israel & O’Leary, 1973; Luciano, Herruzo & Barnes-Holmes, 2001; Paniagua & Baer, 1982; Risley & Hart, 1968), and Self-Talk Fantasy Play (Greer & Ross, 2008; Lodhi & Greer, 1989; Greer & Speckman, 2009).

Naming

Incidental language acquisition is an incredible phenomenon which sets the stage for progressive development from babbling at 6-months of age to speaking in full sentences and acquiring language at rapid rates by age 3 (Greer & Longano, 2010; Greer & Ross, 2008; Hart and Risley, 1995). According to Hart and Risley, by age three children can produce approximately 1,100 words. According to VBDT researchers, the rapid acceleration of vocabulary around age three is thought to be a function of the onset of Naming (Greer and Ross, 2008; Greer & Speckman, 2009; Longano & Greer, 2010; Woolslayer & Greer, 2013).

Naming is present when the child is able to learn word-object relations incidentally with few exposures to these relations in their environment (Greer & Ross, 2008; Greer & Speckman, 2009). Moreover, once Naming emerges children can learn
word-object relations as a listener and be able to produce the same relations as a speaker or vice versa. Horne and Lowe (1996) first proposed the theory of Naming as an extension of Skinner’s (1957) speaker-as-own-listener repertoire. In their proposal, Horne and Lowe described Naming as “the basic unit of verbal behavior” in which a child acquires incidental learning through a process of listener behavior followed by echoic responding. What sets Naming apart from the layperson’s custom of verbally naming objects and items in their environment, is that Naming is a verbal developmental capability in which the individual is able to learn incidentally from his or her environment (Greer & Gilic, 2011; Greer & Ross, 2008; Greer & Speckman, 2009), hence several behaviorists distinguish Naming as a cusp that is also a capability with capitalization (Greer & Gilic, 2011; Greer & Ross, 2008).

Greer and Ross (2008) define naming as “a phenomenon through which students acquire tacts and listener responses without direct instruction” (p. 297). The presence or induction of Naming allows the child to acquire vocabulary 4-10 times faster than without Naming in repertoire since children can now learn through incidental experiences (Greer & Ross, 2008). Naming is considered a capability because it allows children to learn in new ways that they could not before its attainment (Greer and Ross, 2008). Naming is a vital capability to have in repertoire and lacking this cusp could be detrimental to a child’s ability to learn in a general education classroom considering the fact that students in a general education classroom need to transfer stimulus control from one stimulus class (e.g. textual responding) or modality to another (i.e. writing).

According to Horne and Lowe the name relation occurs around the age of two. However, Gilic and Greer (2011) tested 19 typically developing children ages 2-3 and
found while all three-year olds demonstrated the presence of Full Naming with 3-dimensional stimuli, while only 2 out of 10 two-year olds demonstrated the presence of Naming. Typically, the listener component of Naming develops first and the speaker emerges then after, which is consistent with research indicating the listener vocabulary develops before speaker vocabulary at a rate of 2-4 times faster (Benedict, 1977; Woolslayer & Greer, 2013).

Woolslayer and Greer (2013) investigated what happens to the listener vocabulary that is acquired prior to Naming. Using participants with developmental delays or disabilities, experimenters conducted probes for hundreds of tacts, induced Naming, and then conducted probes to see if the listener vocabulary immediately joined the speaker. Results of the study demonstrated that listener responses learned before the induction of Naming, did in fact join the speaker once the capability of Naming was established. Furthermore, Woolslayer’s dissertation provides evidence to the separate development of listener and speaker repertoires (Benedict, 1977; Greer & Ross, 2008, Greer & Speckman, 2009). Once both listener and speaker components of Naming have developed, the child is said to have the Full Naming capability (Greer & Ross, 2008; Greer & Speckman, 2009).

**Identifying Naming.** Although Naming occurs in most neuro-typical developing children through a history of multiple exemplars provided by their environment, some children who come from low socio-economic backgrounds and those who have developmental delays/disabilities require interventions to induce the capability of Naming and allow them to contact the contingencies of their environment and thus learn at faster rates and in new ways.
Horne and Lowe (1996) originally proposed that the prerequisites for Naming included listener behavior (hear/do), speaker behavior (hear or see/say), and tacting (see/say). Similarly, Catania (2007) suggested that listener behavior, point-to response topography, echoic behavior, and history of tact (e.g. identifying or labeling in the presence of the stimulus) and intraverbal (responding to a stimulus during which the response lacks point-to-point correspondence with the antecedent is intraverbal responding, such as responding to a question) instruction were prerequisites for the capability of Naming. Other possible prerequisites include intraverbal responding and generalized matching (Greer & Longano, 2010; Greer & Ross, 2008; Greer & Speckman, 2009; Longano & Greer, 2014).

There are several different procedures that allow one to test for the presence of Naming. Greer et al. (2005) were the first to experimentally demonstrate that the acquisition of the untaught listener and speaker responses could result from a Naming experience via match-to-sample trials. Match-to-sample is often used to provide a Naming experience as it ensures the student is sharing in joint attention; that is, it is used to certify the student is observing the visual stimulus, as he matches, while also hearing the auditory stimulus (the name of the stimulus). Longano and Greer (2014) later referred to this procedure as the Joint Attention Condition (JAC) in their study investigating the source of reinforcement for Naming. Carnerero has conducted several studies in which the Naming experience is a pairing procedure or what Longano and Greer refer to as the Incidental Condition (IC) (Carnerero & Pérez-González, 2014; Carnerero & Pérez-González, 2015; Longano & Greer, 2014). During the pairing procedure, the stimuli are presented as tact presentations in which the experimenter points to the stimulus (visual).
as he tacts it (auditory); however these are not learn unit presentations, therefore the pairings are not conseuated. Similarly, Cahill (2014) presented her novel objects and actions to her participants in a similar IC or pairing procedure format.

**Inducing Naming.** Researchers have identified several procedures that can induce or lead to the emergence of Naming, such as multiple exemplar instruction (Greer et al., 2005), an auditory matching procedure for the listener component of Naming (Chavez-Brown, 2005; Speckman-Collin et al., 2007), an auditory matching procedure that can induce Full Naming (Choi & Greer, 2012), Intensive Tact Instruction (Delgado & Oblak, 2007; Pistoljevic, 2008), and through simultaneous treatment of echoics and a stimulus-stimulus pairing procedure (Longano, 2008). More recent developments from VBDT have demonstrated that Naming can occur following delayed phonemic responding (Shanman & Greer, 2015) and repeated probes with novel stimuli (Lo & Greer, 2016). In a recent study, Longano and Greer compared JAC to IC (although it was not the focus of their study) and post Naming experience data demonstrated more correct responses to the Naming probes following the JAC or also known as the match-to-sample procedure.

The most researched and widely used method to induce Naming with those who lack it, is multiple exemplar instruction (MEI), in which children are taught to respond to the stimuli under multiple response topographies. During MEI, instructional trials or learn units, are rotated among the different target stimuli (usually 4 or 5 with different exemplars of each target) and four response topographies: match, point (select), tact (produce the name of the visual stimulus presented without a vocal antecedent from the instructor), and impure tact (produce the name of the visual stimulus presented following
an intraverbal response, such as “What is this?”). Criterion for mastery of MEI is 90% accuracy across all response topographies across two consecutive sessions or 100% accuracy of responding across all response topographies in one session.

Although Horne and Lowe provided an empirically testable definition of Naming (Longano & Greer, 2010), Greer, Stolfi, Chavez-Brown and Rivera-Valdes (2005) were the first to test this theory in an experiment with preschool age children with mild disabilities. Results from the seminal study indicated Naming could be induced through Multiple Exemplar Instruction (MEI). Greer, Stolfi, and Pistoljevic (2006) added to the literature on the effects of MEI on Naming when they induced Naming in children as young as two who had language delays and did so using 2-dimensional stimuli. Fiorile and Greer (2007) also used MEI to induce Naming in 2-year olds with autism. In fact, according to Longano and Greer (2014) over 32 participants, who range in levels of verbal behavior, have acquired Naming following the MEI procedure, and that only includes information provided by published studies.

**Say-Do Correspondence**

Say-Do is quite literally the correlation between what a person says he or she would do and what the person later does. Many examples can be seen when children are playing and interacting with one another or with caregivers, such as the little boy announcing to his teachers that he is going to go down the slide once he gets to recess, and does, or when a child playing with her dolls and in pretend play, informs her parent that her baby is crying and she has to go feed it and then picks up her baby doll and proceeds to feed it a bottle. Do-report or do-say is also under the umbrella of this correspondence cusp. Examples of do-say are: the child telling you what he or she ate for
breakfast, reflecting on what he or she did in school that day, or recalling what he or she just played with in the toy area. Isreal and O’Leary (1973), Paniagua and Baer (1982) and Luciano, Herruzo, and Barnes-Holmes (2001) did not distinguish say-do and do-say as separate entities; therefore, for the purposes of this literature review, say-do correspondence will refer to both say-do and do-say behaviors.

Skinner (1957) did not include Say-Do Correspondence (SDC) in his account of Verbal Behavior; however he did allude to the behavioral cusp when he discussed verbal responses to the speaker’s own behavior (do-say) such as self-descriptive verbal behavior and responses to present behavior. Much of Skinner’s account of verbal behavior in response to one’s own behavior involves the matter of private events (a.k.a. covert verbal behavior). Skinner defined “self-tacts” as verbal behavior controlled by other behavior of the speaker whether it is in the past (do-say), present (say-as-do), or future (say-do) and he noted that the evoking stimuli may or may not be private (p. 139). Private events and the overt-to-covert continuum are discussed in further detail later on in this paper.

According to Paniagua and Baer (1982) SDC is the verbal community relying on the individual to be truthful. Will the individual adhere to the promise he or she made? It is important to note that several interruptions can take place between the ‘promise’ and the follow-through and researchers have been quick to recognize and attempt to account for this. Through initial training or sequence of instruction, researchers have included and even reinforced intermediate behaviors that predictably lead to the target behavior. For example Paniagua (1990) detailed the ‘Immediate Reinforcement of Intermediate Behavior’ model and with the following example: the individual makes a statement, such as, “I’m going to paint” and his or her intermediate behaviors such as, setting up the easel
and picking up the brushes, are reinforced as long as the intermediate behaviors correspond with the stated behavior. Paniagua (1990) detailed several correspondence models or training techniques detailed in the *Inducing Say-Do* section below.

Over the past four decades correspondence training procedures have been used to modify the behavior for a range of individuals for various purposes, including evaluating the impact of correspondence training on expanding children’s use of toys and play materials (Baer, Detrich, & Weninger, 1988; Baer, Williams, Osnes, & Stokes, 1985; Ireal & O’Leary, 1977; Risley & Hart; 1968) approvals and cooperative play skills (Osnes, Guevrement, & Stokes, 1986, 1987; Rogers-Warren & Baer, 1976), social skills (Ralph & Birnbrauer, 1986), snack preference (Baer, Blount, Osnes, & Stokes, 1987), vocational skills (Crouch, Rusch, & Karlan, 1984; Paniagua, 1985), daily-living skills (Paniagua, 1985), academic and performance behaviors in a school setting (Isreal & O’Leary, 1973; Keogh, Burgo, Whitman, & Johnson, 1983; Rocca & Gross, 1996; Weninger & Baer, 1990; Whitman, Scibak, Butler & Johnson, 1982) and self-management (Karoly & Dirks, 1977).

**Identify Say-Do Correspondence.** Say-Do Correspondence is present when the individual can function as a listener to his or her own verbal behavior and/or accurately report or recall one’s prior behavior (Greer & Ross, 2008; Isreal & O’Leary, 1973; Paniagua & Baer, 1982; Luciano et al., 2001). According to Greer and Ross (2008), the relation between the vocal verbal and non-vocal verbal behavior of a student is present if the student can follow his own directions; for example, the student’s vocal behavior, “I am going to play the guitar,” is followed by the student going to the guitar and playing it (the non-vocal verbal behavior). To test for the presence of SDC, the author suggests that
the experimenter arrange a few toy options for a child to play with and ensure that the
child is able to identify each toy item. Prior to allowing the child to play, the
experimenter asks him or her, “Which toy are you going to play with?” then allow the
child access to the toys. If the child does in fact play with the toy he/she had identified,
that would be indicative of SDC (Paniagua & Baer, 1982; Greer & Ross, 2008).

**Inducing Say-Do Correspondence.** Paniagua (1990) identified several models of
SDC training techniques that stress the importance of when the reinforcement is
delivered: Reinforcement of a Report, Reinforcement of Do-Report Correspondence,
Reinforcement of Report-Do Correspondence, Reinforcement Set-Up Upon Report,
Immediate Reinforcement of Intermediate Behavior, and Reinforcement Set-up Upon
Intermediate Behavior.

Reinforcement of a report can be immediate or delayed. During this procedure the
reinforcer follows a report of past behavior or promise of future behavior. Most essential
to this model is that, in both cases (say-do or do-say) the reinforcer is delivered
*contingent only on the report* and thus regardless of the actual occurrence or
correspondence of the nonverbal behavior. Risley and Hart (1968) originally identified
this model as *Reinforcement of Content* and during their seminal study, the authors found
that this condition alone did not function to produce changes in nonverbal behavior. Israel
and O’Leary (1973) replicated the study in a group design format and had the same
results for the reinforcement of content model. However, Rogers-Warren and Baer (1976)
found moderate increases in reporting and small increases in actual behavior in their first
experiment during the “Package 1” condition in which reinforcement was delivered
contingent only on the report.
Paniagua (1990) identified Reinforcement of Do-Report Correspondence and Reinforcement of Report-Do Correspondence as the two most common methods to reinforce verbal-nonverbal relationships. Overall, Risley and Hart, Israel and O’Leary, and Rogers-Warren and Baer all found the reinforcement for the positive correspondence to be more effective than reinforcement for content. During the reinforcement of do-report correspondence training the reinforcer is delivered contingently upon the positive correspondence between doing and saying. Risley and Hart employed this training model in part of their seminal study, during which they observed children playing with different materials (i.e. painting and playing with blocks) and then later asked them to recall what play material they chose to engage with. Israel and O’Leary (1973) found the do-say training sequence produced greater correspondence than the say-do training in their comparison. During the reinforcement of report-do or say-do correspondence training the reinforcer is delivered contingently upon the positive correspondence between the report of future behavior and its fulfillment. Paniagua, Morrison, and Black (1990) recorded children’s reports or predictions regarding their future hyperactivity or control and delivered reinforcement when their initial report positively corresponded with their subsequent behavior.

During the Reinforcement Set-Up Upon Report training procedure the reinforcer is presented or shown to the individual after the report and before the opportunity to do. Karoly and Dirks (1977) used this procedure by showing the participants the snacks they would reward them with if they followed through on their reports. Israel and O’Leary (1973) also used this procedure in part of their study when they delivered a cup with
preferred snacks once the children made a report, and if their subsequent action positively correlated with the initial report, they were allowed to eat the snacks in the cup.

During the Immediate Reinforcement of Intermediate Behavior, intermediate or preceding behaviors are reinforced. For example, if an individual states that he or she is going to go for a run, the preceding behaviors of putting on his or her sneakers, stretching and warming-up would be reinforced. This training procedure allows for the exampled individual to recant his or her promise, maybe it was too cold out and the individual decided to stay inside instead. As long as the intermediate behaviors correspond with the promised future behavior, the individual receives reinforcement.

Reinforcement Set-up Upon Intermediate Behavior was most notably investigated during Paniagua and Baer’s (1982) experiments during which a token was delivered to the child after each intermediate behavior. Paniagua and Baer compared do-say correspondence, say-do correspondence, set-up upon promise and set up upon intermediate behavior conditions in three experiments. Experimenters found, regardless of sequence of conditions, the set-up upon promise and set up upon intermediate behavior conditions were the most effective correspondence models. Paniagua and Baer concluded, “there is a well-articulated chain of events operating between the corresponding events” (p. 796) and their study highlighted the significance of where the reinforcement is applied during the correspondence training.

Other interventions used to teach correspondence between vocal verbal and non-vocal verbal behaviors include elements of Paniagua’s models in combination with corrective feedback and errorless teaching (Luciano, Barnes-Holmes & Barnes-Holmes, 2002), modeling (Rogers-Warren & Baer, 1976), teaching through a sequence of faded
prompts and across several settings in effort to generalize the effects of SDC (Luciano et al., 2001), and auditory play-back (Greer & Ross, 2008).

**Self-Talk Fantasy Play**

Beyond Lodhi and Greer’s (1989) seminal study in self-talk fantasy play, little behavioral research has been conducted investigating this essential behavioral cusp. Lodhi and Greer empirically identified self-talk conversational units in typically developing kindergarteners as they played with anthropomorphic toys, such as dolls (Greer & Keohane, 2005). Experimenters found that significantly more verbal operants occurred overall in the anthropomorphic condition in comparison to the non-anthropomorphic condition. Moreover, self-talk conversational units only occurred in the anthropomorphic condition.

Greer and Ross (2008) defined self-talk behavior as the individual enacting the roles of both the listener and speaker within-in-the-same, or quite simply, “the phenomenon of children talking to themselves when engaged in solitary play” (Greer & Ross, 2008, p. 187) and identified self-talk a key stage for typical development. The authors argued that self-talk is similar to a conversational unit, except a self-talk conversational unit is not a true social exchange because it only requires one person, “individuals are not truly social until they can engage in conversational units with others” (p.189). Self-talk is a crucial prerequisite to thinking, audience control, and perspective taking (Greer & Ross, 2008; Novak & Peláez, 2004). However, according to Greer and Ross, to be truly social, there must be a shift from verbal behavior being reinforced by one’s self to being reinforced by another. Hart and Risley (1999) eloquently defined talking as a “social dance in which what each partner does governs what the other does”
Inducing Self-Talk. If the self-talk behavioral cusp is missing, Greer and Ross (2008) suggest modeling self-talk conversational units with puppets or anthropomorphic toys for the child to imitate. The behavioral literature is lacking in the area of self-talk fantasy play and procedures to induce it if the cusp is missing. Much research has been conducted in effort to investigate the effects of fantasy-play or pretend play on overall development, however the majority of this research resides in the field of cognitive and developmental psychology.

Accounts of Speaker-as-own-listener Behavior in Other Scientific Theories

Vygotsky’s Account of Private Speech. Cognitive and Developmental psychologists refer to overt Say-Do Correspondence and Self-Talk as private speech. Private speech, or speaking aloud to oneself, is a phenomenon of child development that Vygotsky interpreted as the critical transitional process between speaking with others and thinking for oneself. According to Vygotsky (1987) the self that extends beyond the skin, becomes private. Manfra and Winsler (2006) stated,

Private speech emerges in the toddler years, peaks in frequency during early childhood, and then gradually reduces in prominence throughout the early elementary school years, all the while following a shift from overt (out loud) self-talk, to partially-internalized speech (whispers), to full covert (silent, inner) speech or verbal thought. (p. 537)

Just as speaker-as-own-listener cusps such as, Say-Do and Self-Talk are prerequisites for self-management, thinking and perspective taking (Greer & Ross, 2008; Novak & Peláez, 2004), Vygotsky (1934/1987) suggested that private speech is an important mediator in
the development of cognitive abilities. Private speech facilitates cognitive processes such as imagination, thinking, and self-awareness (Manfra & Winsler, 2006). Moreover, private speech is a tool used for problem solving and aids in clarifying, articulating, and decision-making (Clark, 2004; Vygotsky, 1934/1987; Winsler, Diaz, & Montero, 1997).

Vygotsky-based developmental psychologists are interested in language in relation to self-regulation and self-reflection (Manfra & Winsler, 2006). According to these psychologists, private speech or speaker-as-own-listener behavior, develops between ages 3-4; and where 3 year olds exhibit in more pretend or fantasy play, 4 year olds tend to emit self-talk during problem solving activities; and self-talk becomes almost entirely internalized by age 8 (Bailey & Brooks, 2003).

Vygotsky argued that “prior to mastering his own behavior, the child begins to master his surrounding with the help of speech” (Vygotsky, 1978, p. 25) which is in line with the VBDT’s trajectory of verbal development where a speaker repertoire must be intact before the development of the speaker-as-own-listener repertoire.

**Executive Functions.** Executive functions are a set of processes that relate to managing oneself and one's resources in order to achieve a goal (Robinson, Goddard, Dritschel, Wisley, & Howlin, 2009). Executive functions include impulse control, emotional control, flexible thinking, working memory, self-monitoring, planning and prioritizing, and organization (Morin, 2014). According to the Center on the Developing Child at Harvard University, executive functioning is an umbrella term for the neurologically-based skills involving mental control and self-regulation. The Center on the Developing Child argues children are not born with executive functions, rather, executive functions develop through conditions in the individual’s environment and
relationships with others, or as Skinner would put it, the verbal community.

Executive functions play a vital role in an individual’s development across cognitive, communication, adaptive, and social-emotional domains (Isquith, Crawford, Espy, & Gioia, 2005). That being said, the presence or absence of executive functions has been an investigated interest for Cognitive Psychologists for almost three decades. Psychologists argue that deficits in executive functioning are the source of many developmental disorders (Isquith, et al., 2005; Robinson, et al., 2009).

**The Development of SOL Cusps into More Advanced Repertoires**

Skinner identified problem solving, consciousness, and thinking as covert operant activities along with imaging, sensing, and ideas (Moore, 2008; Skinner, 1976). Skinner argued that to think is to behave. He also argued that covert operant activities are verbal behaviors because they mediate the future behavior of the individual (see Covert to Overt section below). The entire covert activity process is a behavioral sequence (Moore, 2008).

**Perspective-taking.** According to Skinner, “social reinforcement leads the individual to know himself” (p. 140), and self-descriptive verbal behavior further leads to the development of self-awareness or what William James (1890) referred to as “self-as-knower” (Novak & Peláez, 2004). According to Novak and Peláez, first one learns to perceive one’s self through one’s own eyes (e.g. the you, you know) before one develops “self-as-known” which is the public you or how you think others perceive you.

As the child matures, speaking to one’s self comes under audience control and the self-talk transforms to the covert activity of thinking (Greer & Ross, 2008; Hart & Risley, 1999). Both Skinner and Greer and Ross exemplify this transition with reading behaviors.
Beginning readers tend to textually respond aloud as they are still learning to read, however, once the textual responding becomes more fluent the behaviors become covert, hence, silent reading (Greer & Ross, 2008; Skinner, 1957).

The SOL repertoire is an essential prerequisite for “thinking, self-editing, and other complex verbal behavior” (Greer & Ross, 2008, p. 189). Editing one’s own speaker behavior due to audience control is a sign of self-editing and the emergence of perspective-taking. In fact, Greer and Ross recommend teaching deictic functions (e.g. I-You, Here-There, Now-Then) to further develop perspective-taking behaviors.

Other advancements or developments in the SOL repertoire are self-rules or self-instructions. Self-rules are “beliefs and expectations that influence our behavior… correlate with competencies including academic, cognitive, and emotional” (Rehfeldt & Barnes-Holmes, 2009, p. 336). Novak and Peláez suggested that SOL behaviors lead to the development of morals and ethics; for example, if a student sees the teacher’s answer sheet for the midterm exam left on her desk and no one else is in the classroom, should she look at it or leave it be? This dilemma becomes a covert activity that eventually results in an ethical or unethical decision.

**Theory of Mind.** Premack and Woodruff (1978) coined the term “theory of mind” as they watched Sarah, a chimpanzee, infer the motivations and intentions of a man in their experimental lab (Baron-Cohen, S., Leslie, A.M., Frith, Uta, 1985). Does the autistic child have a “theory of mind”? (Novak & Peláez, 2004). Sarah was even able to predict the man’s actions. Cognitive and developmental scientists define Theory of Mind (ToM) as the ability to understand the mental states of others. Novak and Peláez defined ToM as the capacity to “behave as if they and others have private thoughts that are distinct from
their public behaviors” (p. 308). Theory of Mind is typically measured with false-belief tasks during which individuals are asked questions about their current situation, context, or mood and are then asked to depict those same details about another person. Simply put, ToM is putting yourself in someone else’s shoes. The literature of ToM is closely aligned with what behaviorists refer to as, perspective taking.

**Problem Solving.** According to Skinner, problem solving occurs “when some condition will be reinforcing [to an individual] but he lacks a response that will produce it. He will solve the problem when he emits such a response” (Skinner, 1976, p. 123). Problem solving most always involves changing the environment (Moore, 2008; Skinner, 1976). However, problem solving is more than just emitting the response, which is the solution; problem solving consists of the steps and processes it took to make that response more probable. In agreement with Skinner, Moore argued that problem solving isn’t necessarily about the solution; it is about the process to finding that solution. Moore (2008) wrote that the most essential feature of problem solving is the “generation of additional discriminative stimulation to guide effective behavior in an otherwise ambiguous situation” (p. 228).

**Consciousness.** According to Skinner, self-descriptive verbal behavior leads to self-awareness and eventually, “through the gradual growth of a verbal community—the individual becomes ‘conscious’” (p.140). The verbal community (i.e. society) reinforces contingencies in one’s history, essentially shaping how one behaves and thinks. Consciousness is a relation that pertains to something that individuals do, not something they possess (Moore, 2008). The relation being the individual’s response to the discriminative control derived from their own behavior and the variables that result in
that behavior. Moore defines consciousness as a “state of affairs” where one’s behavior or properties of that behavior set the occasion for subsequent behavior. As Skinner (1945) considered it, being conscious is “a form of reacting to one’s own behavior” (p. 277).

The Overt to Covert Continuum

Skinner argued that thought is behavior, whether verbal or nonverbal, covert or overt (Skinner, 1957; Skinner, 1976). Therefore, since thought is behavior and behavior is action, thought and other private events are subject to analysis in a behavioral dimension and “ultimately accounted for in terms of controlling variables” (Skinner, 1957, p. 449). Skinner did not view thought as some mysterious mental process responsible for behavior, but rather the very behavior itself (Skinner, 1957). Any behavior that modifies, mediates, or effects subsequent behavior in the same individual or another, is verbal, regardless of its dimensions. Since all behavior is subject to examination, so too should within-the-skin behavior be examined (Skinner, 1976).

Private events originate and are maintained by reinforcement from the verbal community (Catania, 2007; Skinner 1957; Skinner; 1976). Catania (2007) proposed describing or tacting private events could be taught through extension from tacts based upon events to which the verbal community has access, in other words, using metaphors. The verbal community can attempt to teach internal distinctions by teaching responses descriptive of internal conditions through associating them with public conditions (Skinner, 1976). In a well-developed, effective verbal community, one will find coordinating functions or interlocking contingencies (Skinner, 1957). The verbal community uses public information, associates it with private stimuli, and thus teaches the individual how to describe private stimuli. For example, if an individual sees a child
fall down, he might be quick to respond, “Are you okay? That must have hurt.” By associating the public event (the fall) and the subsequent crying with private stimuli (the child’s pain) the adult teaches the child how to describe his private events (Skinner, 1957; Skinner, 1976).

**Why Behavior Becomes Covert.** Overt speech becomes covert speech under the influence of society. According to Skinner, operant behavior almost always begins in a form that affects the outside world (Skinner, 1957). Therefore, behaviors are initially formed or developed overtly and can become covert in order to avoid punishment or for convenience (Moore, 2008). Once audience control is established overt self-talk behaviors often become covert in order to avoid punishment, such as embarrassment from one’s peers. Behavior also becomes covert when the strength of the value needed for overt emission drops and controlling variables are deficient (Moore, 2008; Skinner, 1957).

Reading starts as an overt behavior which is reinforced by the verbal community as one learns to read, but then becomes a covert activity because of its relation to the public environment (in other words, one develops audience control) and reading silently is faster (Moore, 2008). There is practical value in the privacy of covert behavior (Moore, 2008; Skinner, 1957). “Verbal behavior can easily become covert because it does not require environmental support” (Skinner, 1976, p. 31). According to Moore (2008), verbal behavior can occur at a covert level because it doesn’t require the presence of a particular physical environment for its execution; rather, the individual’s behavior can be affected by private consequences. Using covert verbal behavior, one can act without
committing one’s self, redo, or try again, based on private consequences and no one else has to know.

**The Continuum.** Covert behavior can transition back to its overt form for several reasons. According to Moore (2008) the individual typically reverts to overt responding when he or she encounters a challenging task, either in vocal or written form. Distracting stimuli, such as public stimuli or events in the environment that are more dynamic than the subtle covert behavior, can result in a challenge and difficulty for an individual trying to complete a task in a covert fashion.

Skinner argued there is nothing that can be done covertly, that cannot be done overtly (Moore, 2008). Furthermore, covert responses do not cause overt responses and vice-versa; they are the product of common variables (Moore, 2008; Skinner, 1957; Skinner, 1976). Covert behavior does not explain overt behavior, rather, it is just more behavior to be explained (Moore, 2008; Skinner, 1974; Skinner, 1976).

**Intraverbal Responding**

Intraverbals, one of the functions of speech proposed by Skinner (1957), are defined as a form of verbal behavior in which the response to the controlling stimulus lacks point-to-point correspondence. For example, if the verbal stimulus was “what is the weather like today?” and the response was “sunny,” there is no point-to-point correspondence and thus this is considered an intraverbal. Formally controlled operants, such as the echoic or transcription, do not require comprehension or meaning, as it is only the formal properties of the stimulus that control the response. In contrast, the intraverbal, a thematically controlled operant, is not constrained to the formal properties of the
stimulus, and thus responding to an intraverbal requires comprehension of the antecedent stimulus.

Intraverbal responses are often associated with common academic responses (i.e. answering questions) and perhaps more importantly, within conversation, further validating the importance of emitting this form of verbal behavior. According to Greer and Ross (2008) “Intraverbal discourse with others is a critical component of socialization that culminates in the emission of conversational units, and if this is missing, then we must induce it” (p. 167). Greer and Ross (2008) identified self-talk conversational units, conversational units, and perspective taking as intraverbal capabilities for social interactions. Children with native disabilities and those from low socioeconomic backgrounds often lack certain verbal cusps and capabilities and have insufficient language experiences (Pistoljevic & Greer, 2006, p. 103). Therefore, there is a significant importance to develop effective methods to teach intraverbal behavior.

Types of Intraverbals

Intraverbals range in complexity. First intraverbals develop from simple chains of verbal stimuli, to fill-ins, answering questions, and stating categories (Axe, 2008). Axe defines a simple intraverbal as one that does not require conditional discriminations. In a simple intraverbal relation, one only needs to respond to one verbal stimulus. For example, “what do you eat?” and “what do you drink?” are simple intraverbals. Whereas, “what do you eat that is green” or “what do you drink in the morning?” are conditional discriminations because “one verbal stimulus alters the evocative effect of the second verbal stimulus and they collectively evoke and intraverbal response” (Axe, 2008, p.
In order to respond to a conditional discrimination in the intraverbal relation, one must come under the control of two or more verbal stimuli.

Questions are asked in a variety of ways, using various antecedents, and one should be able to answer questions regardless of the way in which the questions are asked (Dickes & Kodak, 2015). For example, if an individual can respond, “meow” to the antecedent, “what sound does a cat make?” he or she should be able to answer the bidirectional relation, “What animal says ‘meow’?”

Sundberg and Sundberg (2011) published a pivotal descriptive analysis of intraverbal development in typical developing children and children with autism. The experimenters conducted an 80-item intraverbal subtest of increasing complexity with 39 typical functioning children and 71 children with autism ranging in age from 23 months to 15 years old. Prior to Sundberg and Sundberg’s study, Poon and Butler (1972) conducted the only other group design study examining the complexity and overall development of intraverbal behavior. Findings from Poon and Butler’s study indicated that age was significantly correlated with responding to increasingly more complex intraverbal behavior. Sundberg and Sundberg’s group analysis provided more empirical support to Poon and Butler’s findings, as their results also indicated age was a significant factor in responding to increasingly more complex intraverbals.

Sundberg and Sundberg had another important finding as well, perhaps more enlightening than the age and complexity correlation, and that was that the types of errors that were commonly made among the participants correlated with their scores on the intraverbal subtest. For example, children who scored a 24-28 on the intraverbal subtest who were able to respond to some simple intraverbals such as songs and fill-ins,
commonly made the same errors such as echoic responding and pointing during more difficult intraverbal tasks. According to Axe (2008) echoic responding and over-selectivity, or the failure to respond to multiple stimuli presented in the intraverbal, are the two most common errors made in intraverbal responding.

In another example, children who scored 50-69 on Sundberg and Sundberg’s test, who had an established intraverbal repertoire consisting of 1000s of intraverbal relations, consistently had difficulty with compound conditional discriminations that involved only verbal stimuli, or what the authors refer to as verbal conditional discriminations. For an example of verbal conditional discrimination the authors refer to Catania’s (2007) description of the autoclitic “I doubt”, put in context with the sentence “the coffee is ready”, “I doubt” modifies the evocative effect of “the coffee is ready” Overall, the more verbal stimuli added to an intraverbal increases the likelihood of more modifications and thus discriminations that need to be made, increasing the complexity in responding (Axe, 2008; Sundberg & Sundberg, 2011).

According to Eikeseth and Smith (2013) simple intraverbals are intraverbals evoked by discriminative stimuli in a three-term contingency, such as “ready-set… go” and “ABC...” whereas, intraverbals requiring conditional discriminations involve a fourth term because the discriminated operant comes under contextual control, “in conditional discriminations, the conditional stimulus determines the function of the antecedent stimulus in a discriminated operant” (p. 126).

More complex intraverbals require convergent and/or divergent multiple control. Skinner discussed convergent and divergent multiple control in his analysis of verbal behavior,
Two facts emerge from our survey of the basic functional relations in verbal behavior: (1) the strength of a single response may be, and usually is, a function of more than one variable and (2) a single variable usually affects more than one response. (p. 227)

Convergent multiple control is the control of a single response evoked by two or more variables and divergent multiple control is the bolstering of more than one response by one single variable (Michael, Palmer, & Sundberg, 2011).

Simple intraverbals shift to more complex intraverbals as the stimulus control goes from one discriminative stimulus to multiple stimuli. The simple intraverbal question, “What do you eat?” becomes increasingly more difficult to answer when the additional stimulus, “with” is added to form the question, “What do you eat with?” As the overall complexity of the intraverbal increases, so do the prerequisites required to respond to each intraverbal (Axe, 2008; Cihon, 2007; Eikeseth & Smith, 2013; Michael, Palmer, & Sundberg, 2011; Sundberg & Partington, 1998; Sundberg & Sundberg, 2011).

**Prerequisites for Intraverbal Responding**

According to Cihon (2007) intraverbal responding requires strong verbal repertoires across other verbal operants, such as the echoic and tact, and a strong imitation repertoire. Sundberg and Partington (1998) argued that a reliable speaker repertoire is essential to intraverbal responding, suggesting that individuals have at least 50 different mands and tacts in repertoire. In order to learn and respond to intraverbals, one must have a strong listener repertoire as well (Axe, 2008; Eikeseth & Smith, 2013; Sundberg & Partington, 1998; Sundberg & Sundberg, 2011). In fact, Eikeseth and Smith recommend teaching discriminations as a listener, first starting with responding to two-
step directions, two simple verbal stimuli, then teaching the individual to select multiple objects from an array to teach discrimination among several stimuli and responding in a correct sequence.

A crucial prerequisite is to have established reinforcers in place (Cihon, 2007); social reinforcement is essential since intraverbals are established and maintained by generalized reinforcers.

Prerequisites for more complex intraverbals include: a) sorting and categorizing objects by feature, function, and class (Kisamore, Carr, & LeBlanc, 2011; Sundberg & Sundberg, 2011), b) accurate and fluent responding to events and activities in the present (Sundberg & Sundberg, 2011), c) a history of simple discriminations between nouns and verbs and other general verbal discrimination training (Sundberg & Sundberg, 2011), d) preposition tacts, such as with, in, or on (Dickes & Kodak, 2015), e) and a history of responding to more basic intraverbals such as song fill-ins, word associations, and “what” questions (Axe, 2008).

**Participant Screening Procedures.** It is essential that the aforementioned prerequisites be in place in order to effectively teach intraverbal responding. One of the greatest limitations identified across several studies on intraverbal responding, lies in the screening and selection processes for potential participants. Numerous studies have included participants who, more than likely, were missing fundamental prerequisite skills required to learn intraverbals, especially the more complex, multiply controlled intraverbals. For example, Mellor, Barnes, and Rehfeldt (2015) used a self-echoic assessment (Esche, Esche, McCart, Petursdottir, 2010) to determine if responding to intraverbal tests corresponded to a strong echoic repertoire. Yet, having an efficient
echoic repertoire is a crucial prerequisite for intraverbal responding, therefore those individuals that demonstrated weak echoic repertoires should not have been selected for the study.

Kisamore, Karsten, and Mann (2016) also used an echoic assessment in order to compare echoic repertoires to results on the intraverbal tests and evidently the participant with the lowest echoic score required more intervening procedures than the other participants who scored twice as high on the echoic assessment. Moreover, Kisamore et al. (2016) attempted teaching complex, multiply controlled intraverbals such as, “What is an animal that is red?” however, the authors did not mention if the participants had the prerequisites of sorting and categorizing in repertoire.

Another overall critique of the selection process in the majority of intraverbal studies is the lack of inclusion criteria and limited participant information, especially for studies using typically functioning individuals. Miguel, Petursdottir, and Carr (2005) selected six typical-functioning preschoolers for their study analyzing the effects of multiple-tact and receptive discrimination training on thematically related intraverbals, however, the authors did not describe the participants beyond their age. Coon and Miguel (2012) also used typically-functioning participants in their study, yet gave limited descriptions about the participants’ other skills and repertoires. In contrast, Carroll and Kodak (2015) detailed how they selected individuals for their study who had 150 simple intraverbals in repertoire and who were able to categorize, yet were unable to respond to novel combinations of intraverbals. Furthermore, Vedora and Conant (2015) described their participants’ length of utterances, number of independent tacts and mands in repertoire, and number of simple intraverbals in repertoire. As discussed prior, there is a
wide range of types of intraverbals and their complexities, therefore experimenters who include participant descriptions and inclusion criteria provide essential information to those who seek to replicate their findings.

**Teaching Intraverbals**

Luciano (1986) trained verbal behavior to three individuals using an errorless discrimination procedure or prompt delay, to transfer tact behavior to intraverbal behavior. Intraverbal behavior increased as a result of this prompt delay procedure.

Other procedures that have been implemented in order to teach intraverbal responding include: instructive feedback (Carroll & Kodak, 2015), auditory tact and auditory imaging instruction (Mellor, Barnes & Rehfeldt, 2015), tact and “receptive” discrimination training (Bellos-Diaz & Pérez-González, 2015; Ma, Miguel, & Jennings, 2016; Miguel, Petursdottir, & Carr, 2005; Pérez-González & Asenjo, 2016; Pérez-González, Herszlikowicz, & Williams, 2008; Petursdottir, Carr, Lechago, & Almason, 2008; Petursdottir, Olafsdottir, & Aradottir, 2008), multiple exemplar instruction (Greer, Yuan, & Gautreaux, 2005) mand and tact training (Sundberg, San Juan, Dawdy, & Arguelles, 1990), peer mediated interventions (Bell, Young, Salzberg, & West, 1991; Kamps, Barbetta, Leonard, & Delquadri, 1994; Krantz, Ramsland, & McClannahan, 1989) direct training (Sundberg et al., 1990; Wong & Woolsey, 1989), high-probability request sequence (Davis et al., 1998), video modeling (Sherer, Pierce, Paredes, Kisacky, Ingersoll, & Schreiman, 2001), Direct Instruction sequencing (Cihon, 2007; Englemann & Carnine, 1982) and through problem-solving procedures during which a rule is established and used as a self-prompt for responding (Kisamore, Carr, & LeBlanc, 2011; Sautter, LeBlanc, Jay, Goldsmith, & Carr, 2011). However, the most utilized procedure
to teach intraverbals is a transfer of stimulus control procedure using echoics, tacts, or textual responses (Braam & Poling, 1983; Coon & Miguel, 2012; Dickes & Kodak, 2015; Kodak, Fuchtman, & Paden, 2012; Luciano, 1986; Miguel et al., 2005; Parrington & Bailey, 1993; Sundberg et al., 1990; Vedora & Conant, 2015; Watkins, et al., 1989).

“This operant includes perhaps the most diverse group of responding…” (Sautter & LeBlanc, 2006) which is why there are so many different procedures used to teach intraverbal responding. As addressed prior, there are simple intraverbals which only require responding to one variable, reverse or bidirectional intraverbals which consist of nonhierarchal structures, verbal conditional discriminations, more complex hierarchal intraverbal relations such as categories, and even combinations. The success of a particular intervention is dependent on the type of intraverbal responding one is targeting.

In my review of the research on intraverbals, two types of studies were apparent: 1) studies that investigated emerged bidirectional or reverse intraverbals and 2) studies investigating hierarchal categorical intraverbal relations.

**Reverse Intraverbals.** Vedora and Conant (2015) measured intraverbal responding to both reverse or bidirectional intraverbals (i.e. function/object and function/body part relations) and open-ended categorical intraverbals (i.e. “Name a fruit”) in their comparison of prompting tactics for teaching intraverbals. The experimenters found that the most effective prompting tactic (i.e. echoic or visual prompt) was dependent on the participants’ particular instructional histories. Mellor, Barnes, and Rehfeldt (2015) also measured responses to bidirectional intraverbals (for example, “What does a cat say?” and, “What animal says, ‘meow’?”) and open-ended categorical intraverbals relative to the bidirectional intraverbals, for example the authors asked

**Emerged Intraverbals.** A majority of intraverbal studies focus on derived relational responding. Much of the work conducted by Pérez-González and Miguel involve teaching reflexive and/or symmetrical relations and testing for the emergence of symmetrical and/or transitive relations. These studies involved training across multiple exemplars, abstraction and the merging of untaught relations (Barnes-Holmes, Barnes-Holmes, Smeets, Cullinan & Leader, 2004). Moreover, Barnes-Holmes et al. stated that when verbal humans are taught interrelated conditional discriminations, the stimuli become related in untrained ways. According to Relational Frame Theorists, verbal humans can respond to abstractions between and among stimuli.

In demonstrational studies, Pérez-González, Herszilowicz, and Williams (2008) taught participants country/city and city/park relations and tested for the emergence of
city/country, park/city, country/park and park/country relations. Ma, Miguel, and Jennings (2016) taught relations among state birds and state flowers using a match-to-sample procedure and tested for emerged relations.

**Categorical Intraverbals.** Carroll and Kodak (2015) investigated the effectiveness of instructive feedback on categorical intraverbals. Participants were required to list at least three members of specified categories, such as occupations, food, or emotions, when presented with the antecedent, “tell me some (category)” Following instructive feedback with a prompt delay, participants responded to the categorical intraverbal with correct and even novel responses.

Miguel, Petursdottir and Carr (2005) used a “multiple-tact and receptive discrimination training” procedure to teach categorical intraverbals (musical instruments, kitchen items, and tools) to 6 typically functioning preschoolers. Whereas, Partington and Bailey (1998) used a transfer of stimulus control procedure to teach 4 typically functioning preschoolers to respond to categorical intraverbals for fruits, toys, furniture and cleaning items.

Sautter, LeBlanc, Jay, Goldsmith, and Carr (2011) and Kisamore, Carr, and LeBlanc (2011) taught their participants to use specific problem-solving strategies in order to teach categorical intraverbals with subcategories. Participants in the Sautter et al. (2011) study used a self-prompting strategy with intraverbal chains to learn different farm, zoo, and oceanic animals, land, water, and air vehicles, and appliances, dishes, and utensils found in the kitchen. Participants in the Kisamore et al. (2011) study were taught the same intraverbal categories and subcategories using a visual imaging strategy. During
both experiments, participants performed best when prompted or reminded to use the problem-solving strategy.

**Pilot Study**

The findings from a pilot study indicated a correlation between the presence of Say-Do Correspondence and correct responding to reverse intraverbals for object/function relations. Following several interventions, interventions that had been effective for several other students, two students were unable to emit intraverbal responses. Even after directly teaching the intraverbal responses for object-to-function and function-to-object relations, transformation of stimulus function to other object/function relations did not occur and therefore these two particular students were unable to emit intraverbal responses for novel or untaught object/function relations. Both students demonstrated the Naming capability for non-contrived and contrived stimuli, however, following a verbal behavior assessment, it was discovered that the students were missing Say-Do Correspondence and Self-Talk—two thirds of the speaker-as-own-listener repertoire.

Following a Self-Talk Immersion Procedure (STIP), during which Say-Do Correspondence emerged, vocal verbal operants increased for both participants. Results were significant for Participant A, who emitted conversational units during post-intervention probes, when she had not done so before. Although, Self-Talk Conversational Units did not emerge for either participant, speaker-as-own-listener tacts and initiations with peers increased. Please refer to Tables 1 and 2 for preliminary data findings.
Table 1

_Pilot Participant’s Relevant Cusps/Capabilities_

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age</th>
<th>Gender</th>
<th>Development</th>
<th>Speaker-as-own-Listener Repertoire</th>
<th>Verbal Operants</th>
<th>Pre-Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Listener</td>
<td>Speak</td>
<td>as Own Listener</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Say-Do</td>
<td>Self-Talk</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>2.8</td>
<td>F</td>
<td>IFSP; ICD-10 indicating dyspraxia</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>no</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>yes</td>
<td>yes</td>
<td>5/20</td>
</tr>
<tr>
<td>B</td>
<td>3</td>
<td>M</td>
<td>IFSP; ICD-10 indicating mixed rec/exp. language disorder</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>yes</td>
<td>yes</td>
<td>5/20</td>
</tr>
</tbody>
</table>

Table 2

_Pilot Participant’s Induced Cusps Following Self-Talk Immersion Procedure_

<table>
<thead>
<tr>
<th>Participant</th>
<th>Speaker-as-own-Listener Repertoire</th>
<th>Verbal Operants</th>
<th>Post-Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Naming</td>
<td>Say-Do</td>
<td>as Own Listener</td>
</tr>
<tr>
<td></td>
<td>Listener</td>
<td>Self-Talk</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>no</td>
<td>13/20</td>
</tr>
<tr>
<td>B</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>no</td>
<td>14/20</td>
</tr>
</tbody>
</table>

Rationale and Purpose of Study

The research discussed thus far suggests that a speaker-as-own-listener repertoire is essential to becoming a truly verbal or social being and the foundation for more advanced repertoires such a perspective taking and problem solving. In addition, there is a substantial body of research examining the significance of intraverbal responding as it relates to establishing a fluent social repertoire. Speaker-as-own-listener cusps and
intraverbals are often discussed on the same pages in books and journals, and yet no one, to my knowledge, has tested whether intraverbal responding is related to a verbal behavior developmental cusp.

In the following experiments I investigated the relationship between speaker-as-own-listener cusps and reverse intraverbal responding. Several studies have used conditional discrimination training (Kisamore et al., 2016; Ma et al., 2016; Miguel et al., 2005; Pérez-González & Asenjo, 2016; Petursdottir et al., 2008) or transfer of stimulus control procedures (Diaz & Pérez-González, 2015; Luciano, 1986; Mellor et al., 2015; Partington & Bailey, 1993; Pérez-González et al., 2008; Vedora & Conant, 2015) to teach intraverbals and have had mixed results. However, since no one has linked intraverbal responding to speaker-as-own-listener cusps, no one has conducted a functional analysis of inducing missing SOL cusps to see if that affects intraverbal behavior. In Experiments I and II, I examine reverse intraverbals; including object-to-function and function-to-object relations, animal sounds and the reverse relation, and body parts-to-function and function-to-body parts relations, during pre- and post-intervention probes where speaker-as-own-listener cusps were induced.

Following the results from the pilot study, I sought to further investigate the relationship between speaker-as-own-listener cusps and intraverbal responding. I conducted a group analysis to test whether Say-Do Correspondence and Self-Talk Fantasy Play were vital for reverse intraverbal responding in other students who functioned at similar levels of verbal behavior and demonstrated the same prerequisites as the students in the pilot study. Findings from the pilot study demonstrated a correlation between the SOL repertoire and reverse intraverbal responding. More specifically, results
from the pilot study indicated that the presence of Naming did not enable participants to respond to intraverbals, however the remaining SOL cusps of Say-Do Correspondence and Self-Talk, did have an effect on intraverbal responding.

Experiment I attempted to answer the following questions: 1) is the SOL repertoire necessary for individuals to respond to intraverbals? 2) If so, what specific SOL cusps are significantly related to intraverbal responding? And, 3) is there one cusp that is the most vital to have in repertoire in order to respond to intraverbals?
Chapter II

EXPERIMENT I: GROUP DESIGN

Method

Participants

Participants for this experiment included 35 children, 10 females and 25 males, who ranged in age from 2 to 5.4 years old ($M= 3.62$, $SD= .88$). The median age was 3.7 years old. Participants were recruited from a CABAS® (Comprehensive Application of Behavior Analysis to Schooling) accredited school. Participants attended either an early intervention (EI) or Preschool (Pre-K) classroom.

The EI classroom used an integrated, or inclusive, model; that is, students with IFSPs (Individual Family Service Plans) received instruction alongside their typically developing peers. An IFSP is similar to an IEP (Individualized Education Plan) in that it is a plan for special services for children with developmental delays. However, an IFSP includes more family oriented goals, whereas an IEP focuses on educational goals. Of the 13 EI participants, 9 had IFSPs and 4 were typically developing. Participants with IFSPs received specialized and group instruction as well as other services, such as occupational therapy, speech, and physical therapy, as determined by the IFSP.

Participants selected from the Pre-K were also taught adhering to the same CABAS® model. Of the 22 Pre-K participants, 20 had IEPs and 2 were typically functioning. Participants in the Pre-K also received services of speech, occupational therapy, and/or physical therapy if indicated on their IEP.
**Inclusion Criteria.** In order to participate in this group analysis study, participants were required to have several verbal developmental cusps and capabilities in repertoire and function at listener and speaker levels of verbal behavior. Prerequisites included generalized imitation, independent mands and tacts, a history of tact instruction, an echoic repertoire with at least 70% full echoics, and a history of responding to simple intraverbals such as yes/no questions. See Figure 1 for the intake form used for participant recruitment.

**POTENTIAL PARTICIPANT INTAKE FORM**

**Prerequisites:** students must have a listener and speaker repertoire (independent mands and tacts) and emit basic intraverbals (i.e. What’s your name? How old are you? What’s your teacher’s name? What school do you go to?)

**Phase 1: Verbal Cusps/Capabilities Assessment**

<table>
<thead>
<tr>
<th>Name</th>
<th>SOL</th>
<th>Emits CU in NIS?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Phase 2: Object/Function Intake**

**Prerequisites:** Must have used objects before and be able to tact objects

**Note:** Please write down any/all responses during intraverbal probes. Provide IOA

**INCLUDE STUDENT NAME/AGE/IFSP OR IEP?**

<table>
<thead>
<tr>
<th>Object</th>
<th>Function</th>
<th>Intraverbals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Object</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Function</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“What do you do with a spoon?”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“What do you eat with?”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Object</th>
<th>Function</th>
<th>Object</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>spoon</td>
<td>eat</td>
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<tr>
<td>pencil</td>
<td>write</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>toy</td>
<td>play</td>
<td></td>
<td></td>
</tr>
<tr>
<td>book</td>
<td>read</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 1.** The potential participant intake form used for participant recruitment.
Sample Breakdown of Cusps and Capabilities. Of the overall 35 participants, 17% were typical developing while the remaining 83% had either IFSPs or IEPs. Sixty-six percent of the sample met criterion on the object/function relation intraverbal probe. Out of the sample, 37% of the participants demonstrated Full Naming, 46% demonstrated the listener component of Naming, and 17% did not demonstrate any component of Naming. Seventy-four percent of the sample demonstrated the presence of Say-Do Correspondence and 57% demonstrated Self-Talk Conversational Units during either verbal operant probes and/or self-talk probes in contrived solitary play. Sixty percent of the sample emitted conversational units with peers across non-instructional settings.

Of the 66% of the participants who met criterion on the intraverbal probe, all had at least one of the three speaker-as-own-listener cusps in repertoire. More specifically, of the 23 participants able to respond to intraverbals 13% did not have any component of Naming, 87% had the listener half of Naming in repertoire, and 30% demonstrated Full Naming. All 23 of the participants who met criterion on the intraverbal probe demonstrated Say-Do Correspondence and 18/23 or 78% demonstrated Self-Talk. See Figure 6 for a graphical depiction of the sample breakdown.
**Figure 2.** The percentage of speaker-as-own-listener cusps in repertoire for the sample of participants used in Experiment II.

**Experimental Settings and Materials**

Measurements for Naming, Say-Do, Self-Talk, and Conversational Units were conducted in the participants’ classroom. Additional measurements for the presence of Self-Talk were conducted in the Integrated EI classroom. During the Self-Talk probes, participants sat on a large rug, approximately 6 feet by 4 feet, on the floor and had access to beanbag chairs as well. See Appendix A for a picture of the setting where most Self-Talk probes were conducted. Participants were given a choice of what toys to play with and were then instructed to *have fun playing*, while the experimenter excused herself and monitored the participant from behind a partition or sat at a desk on the far end of the room.

Participants choose from five of six different play scenes to engage with for 3 minutes at a time. The options included: puppets, animals and farm house, dolls and transformers and dollhouse, dolls and kitchen utensils and food, vehicles and race track,
baby dolls and stroller, and dinosaurs. See Appendix B for photos of the toys used. Self-Talk probes were video-recorded using the Photo Booth application on a MacBook Pro for interobserver agreement.

**Dependent Measures**

The dependent variables measured in the current experiment were the same as in the pilot study (refer to Tables 1 and 2). Participants were tested for the presence or absence of all three speaker-as-own-listener cusps (Naming, Say-Do, and Self-Talk) and were tested on intraverbal responses to object/function relations. Consequences and feedback were not delivered during probe sessions. See Table 3 for participants’ demographics and results across variables.

**Table 3**

*Participant’s Results Across Variables*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age</th>
<th>Development (1=IFSP/IEP, 2=Typical)</th>
<th>Naming (0=No Naming, 1=Listener, 2=Full)</th>
<th>Say-Do (0=not present, 1=in rep.)</th>
<th>Self-Talk CU (0=not present, 1=in rep.)</th>
<th>CU with peers (0=not present, 1=in rep.)</th>
<th>Performance on Intraverbal Functions Probe</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>2</td>
<td>2.5</td>
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<td>8</td>
<td>2.75</td>
<td>2</td>
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<td>90</td>
</tr>
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<td>9</td>
<td>2.8</td>
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<td>11</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>30</td>
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<td>15</td>
<td>4.6</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>100</td>
</tr>
</tbody>
</table>
Assessing Verbal Behavior. All participants were students selected from a CABAS® (www.cabasschools.org) educational program. In CABAS® schools, students are assessed using the International Curriculum and Inventory of Repertoires for Children from Preschool Through Kindergarten (C-PIRK©) (Greer, 2013) and the Verbal Behavior Development Assessment (VBDA©) several times a year to ensure that the students’ needs are being met and that their instruction is appropriate to their needs and verbal behavior. All long-term and short-term instructional objectives are measured and selected based on the as C-PIRK© as well as the student’s Individualized Educational Plan (IEP) or Individual Family Service Plan (IFSP) goals. The C-PIRK© is a criterion-referenced assessment used to identify over 300 preschool and kindergarten skills a student has in repertoire across Academic, communication, community of reinforcers,
and self-management domains. As students acquire new cusps and capabilities and contact new contingencies in their environment, assessments must be conducted to certify that the instruction is appropriate and fitting for the student’s current level of verbal behavior. Each student has a Verbal Behavior Pyramid (Greer & Keohane, 2005; Greer & Ross, 2008) that is continuously updated so teachers, supervisors, and parents can easily reference that particular child’s verbal repertoire.

Participants in the current study were assessed for relevant cusps and capabilities (Naming, Say-Do, Self-Talk, and Conversational Units) prior to the intraverbal probe. If the participant had not been assessed recently for any of the relevant cusps or capabilities, or there was no interobserver agreement collected on the most recent assessments, the experimenter conducted a verbal behavior assessment with interobserver agreement.

**Naming.** Participants were assessed for the presence or absence of the listener and speaker components of Naming following a match-to-sample (MTS) (Greer et al., 2005) or a pairing procedure (Carnerero & Pérez-González, 2014; Carnerero & Pérez-González, 2015; Longano & Greer, 2014) Naming experience. During the MTS Naming experience, participants match five target stimuli using four exemplars of each target stimulus, for a total of 20 trials. Criterion for the MTS is 90% accuracy across two consecutive sessions. Following two-hours, probes for the listener and speaker components of Naming are measured. Participants were required to select, tact, and intraverbally respond to the five stimuli. Criterion for Naming following the MTS Naming experience was 80% accuracy or identifying 4/5 novel stimuli.

The pairing procedure Naming experience presented in a storybook format was commonly used for participants under the age of 3, who we required to identify 3/4 novel
stimuli, or respond with 75% accuracy. During this Naming experience, experimenters “read” a story to the participants pointing to and tacting four novel stimuli. Participants were required to emit six observing responses, attend to the stimulus as the experimenter pointed to and tacted it, per target stimulus, for a total of 24 observing responses. Following a two-hour period, probes were conducted to measure the presence of Naming. The Listener component of Naming was demonstrated if the participant could accurately select the novel stimuli in an array of three. The speaker component of Naming was demonstrated if the participant could accurately produce the name or tact the stimuli when presented with the visual stimulus. Again, no consequences were delivered during probe sessions.

**Say-Do Correspondence.** Say-Do was defined as the positive correspondence between what one says he/she will do and what he/she actually does. Say-Do Correspondence (SDC) was assessed by presenting at least 10 opportunities for the participant to select which toy or object they were going to play with, before being allowed to follow-through on that ‘promise’. This was assessed across multiple non-instructional settings. The teacher would put out 4-5 toys for the participant to play with, and point them out, for example “There are blocks, dolls, puzzles, and cars” then ask the participant which one he or she would play with, “Which one are you going to play with?” In another example, before entering the playground for recess, the experimenter would ask, “What are you going to do first?” or “What are you going to play on?” A correct response was recorded if the toy/activity/object the participant played with corresponded with the stated behavior or promise. For example, if the participant announced he/she was going to go down the slide and did so upon entering the
playground, a correct SDC response would be recorded. However, if the participant stated he/she would play on the slide and upon entering the playground, he/she goes on the seesaw instead, an incorrect response would be recorded because the participant’s action did not correspond with his/her previous statement. Incorrect responses were also scored if the participant did not vocally respond to the question, either by not answering or by only pointing or gesturing to a particular toy/item (regardless if this was the toy/item they later engaged with). Criterion was set at 80% correspondence across 10 consecutive opportunities to respond.

**Self-Talk.** Self-Talk was defined as overtly rotating between listener and speaker within-one’s-own-skin. Self-talk Conversational Units (STCU) were defined as conversational units within-the-skin. According to Greer and Ross (2008), three instances of ST in a 10-minute solitary play condition was criterion for the presence of self-talk. During this experiment only one instance of a full STCU was required to meet criterion for the presence of self-talk. Self-talk conversational units had to be emitted during either the VO probes or during the solitary self-talk probes in order to be considered viable during this study.

**Verbal Operants.** During verbal operant probes all speech functions emitted across non-instructional settings were measured, with a particular focus on the emission of conversational units and self-talk conversational units. Conversational units were defined as a social exchange between two or more individuals during which each individual rotated the roles of the speaker and listener at least twice during the episode. For example, one student directs another, “Let’s make some sandwiches”, the other student responds, “Okay!” pretends to make a sandwich and gives it to the first student
saying, “Mmm yummy, you try” and the peer says, “thank you” and pretends to eat the sandwich. Self-talk Conversational Units (STCU) were defined as conversational units within-the-skin. In order to emit an instance of self-talk, the participant needed to rotate between his and her own listener and speaker.

**Intraverbal Responding.** During Experiment I, five object/function reverse intraverbals were measured, for a total of 10 questions. The probe questions consisted of object-to-function, “What do you do with (object)?” and function-to-object, “What do you use to (function) with?” questions for the following relations: spoon/eat with, car/drive, pencil/write with, toy/play with, and book/read. Participants were first asked the five object-to-function questions, such as, “What do you do with a spoon?” following which they were asked the five function-to-object questions, i.e. “What do you eat with?”

Prior to the reverse intraverbal probe for object/function relations, the potential participant was required to have the following discriminations in repertoire for each of the object/function relations: a) selection responses for the objects and functions, b) tact responses for the objects and functions, and c) the potential participant must have demonstrated use of the object in the corresponding function, for example, the individual needed to have used a spoon to eat. See Figure 3 for a depiction of the known and tested relations.
Figure 3. Examples of the known relations and probed intraverbal relations for spoon/eat with. The known relations are: A-B (selection responses for objects and functions) and B-C (tact response for object). The probed relations are A1-C2 for object to function and A2 to C1 function to object.

The target responses referred to above were scored as correct as well as any other answer that was an appropriate response to the question. For example, answering “a fork” to the question, “What do you eat with” would be an acceptable response. A second experimenter reviewed all non-target responses during probe sessions in which interobserver agreement was not collected in order to have agreement on the responses. For an example of other acceptable participant responses, see Table 4. An incorrect response was recorded if the participant responded incorrectly, did not vocally respond but attempted to demonstrate the action or point to the object, or did not respond at all. Criterion was 80% accurate responding to the probe questions.
Table 4

*Accepted Responses to Reverse Intraverbal Probes for Object/Function Relations*

<table>
<thead>
<tr>
<th>Target Object Response</th>
<th>spoon</th>
<th>car</th>
<th>pencil</th>
<th>toy</th>
<th>book</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other Accepted Responses</td>
<td>fork, knife, my hands</td>
<td>boat, bus, school bus, bike</td>
<td>crayon, pen, marker</td>
<td>my blocks, dolls, cars, Mickey,</td>
<td>stories</td>
</tr>
<tr>
<td>Target Function Response</td>
<td>eat with</td>
<td>drive</td>
<td>write with</td>
<td>play with</td>
<td>read</td>
</tr>
<tr>
<td>Other Accepted Responses</td>
<td>eat soup, eat yogurt, mix, scoop,</td>
<td>play with it, vroom vroom, mommy’s car</td>
<td>draw, color</td>
<td>play on the rug</td>
<td>close it, look at it</td>
</tr>
</tbody>
</table>

**Results**

**Relationship Between Individual Cusps and Intraverbals**

An independent-samples t-test was conducted to compare participants’ intraverbal responding scores with those who demonstrated and did not demonstrate the presence of Full Naming. There was not a significant difference in the scores for those with Full Naming (M= 73, SD= 33, range, 0-100) and those without (M= 61, SD=37, range, 0-100); t(33)= .983, p= .333.

An independent-samples t-test was conducted to assess the relationship between the presence/absence of the listener component of Naming and intraverbal responding for object/function relations. There was not a significant difference in the scores for participants with (M= 70, SD= 34, range, 0-100) and without (M= 63, SD= 41, range, 0-100) the listener component of Naming; t(33)= -.421, p= .676.

An independent-samples t-test was conducted to assess the relationship between the presence/absence of Say-Do and intraverbal responding for object/function relations and found there was a significant difference between the presence (M= 85, SD= 20,
range, 0-100) and absence (M=21, SD=16, range, 0-40) of Say-Do Correspondence; 
t(33)= -8.5, p<.001.

An independent-samples t-test was conducted to examine the relationship
between the presence/absence of Self-Talk and intraverbal responding for object/function
relations and found there was a significant difference between the presence (M=87, SD=
15.5, range, 40-100) and absence (M=44, SD= 37, range, 0-100) of the Self-Talk cusp in
relation to intraverbal responding; t(33)= -4.23, p< .001.

The presence or absence of conversational units emitted by participants was also
compared to scores on the intraverbal probe and another significant finding was
discovered. Participants who emitted conversational units across non-instructional
settings (M=81, SD= 23, range, 30-100) performed approximately 30% better in
answering intraverbal questions than their peers who did not emit conversational units
(M= 56, SD= 40, range, 0-100); t(33)= -2.25, p=.033.

**Relationships Between Combinations of Cusps and Intraverbals**

A two-way analysis of variance (ANOVA) was conducted to compare the main
effects of Naming and Say-Do and the interaction effect between Naming and Say-Do on
intraverbal responding. Although the main effects for Say-Do remained significant, the
main effects for Full Naming and the Listener component of Naming and interaction
effects between Full Naming and Say-Do and the Listener component of Naming and
Say-Do were not statistically significant at the .05 level.

A two-way ANOVA was conducted to compare the main effects of Naming and
Self-Talk and the interaction effect between Naming and Self-Talk on intraverbal
responding. The interaction effects between Full Naming and Self-Talk and the Listener
component of Naming and Self-Talk were not statistically significant at the .05 level. However, the main effects for Self-Talk remained significant.

A two-way ANOVA was conducted to compare the main effects of Say-Do and Self-Talk and the interaction between Say-Do and Self-Talk on intraverbal responding. The main effect for Say-Do was statistically significant; F(1, 31)= 601.72, p=.026. The main effect for Self-Talk was marginally significant; F(1, 31)= 81.48, p=.070. The interaction effect between Say-Do and Self-Talk was not significant, F(1, 31)= .039, p=.845.

**Analysis and Discussion**

According to the findings from Experiment I, the SOL repertoire is necessary for individuals to respond to bidirectional or reverse intraverbals. Out of the 23 participants who met criterion on the intraverbal probe, all of them had at least 1 component of the SOL repertoire, whether it was Naming, Say-Do, or Self-Talk. Similar to the preliminary results from the correlational pilot study, the presence of Naming did not have a significant effect on participants’ accurate responses to reverse intraverbals. However, the presence of Say-Do and Self-Talk were significantly correlated to accurate intraverbal responses.

The results suggest that individuals with Say-Do score more than 60% better on intraverbal probes, than those who do not. According to findings from Experiment I, individuals with Self-Talk in repertoire score about 40% better on intraverbal probes for object/function relations, than those who do not. See Figure 5 and Figure 6. Results and analysis also revealed that individuals who emit conversational units with peers across
non-instructional settings are more likely to be able to respond correctly to intraverbal probes for object/function relations.

When measuring the effect of combinations of SOL cusps on intraverbal responding, Say-Do and Self-Talk remained significant, even when controlling for other cusps. In fact, results from the 2x2 ANNOVA for Say-Do and Self-Talk revealed that the main effect for Say-Do remained statistically significant; $F(1, 31)= 601.72$, $p= .026$ even when controlling for Self-Talk while the main effect for Self-Talk was marginally significant; $F(1, 31)= 81.48$, $p= .070$ when controlling for Say-Do.

**Mean Scores and Standard Deviations for the Presence and Absence of Say-Do**

![Figure 4](chart.png)

*Figure 4.* The mean scores and standard deviations for the presence and absence of Say-Do Correspondence.
Mean Scores and Standard Deviations for the Presence and Absence of Self-Talk

![Bar chart showing mean scores and standard deviations for the presence and absence of Self-Talk.]

Figure 5. The mean scores and standard deviations for the presence and absence of Self-Talk.

Rationale for Experiment II

In continuing my investigation into the relation between the speaker-as-own-listener repertoire and intraverbal responding, Experiment II was a systematic replication of the pilot experiment. The pilot experiment only had two participants and thus a functional relation between SOL cusps and intraverbal responding could not be determined (refer to Tables 1 and 2). However, Experiment I demonstrated that an emerging SOL repertoire is necessary in order to respond to intraverbals for object/function relations for individuals with similar levels of verbal behavior.

In Experiment II, the same dependent variables are measured: the presence or absence of Naming, Say-Do, and Self-Talk, verbal operants emitted across non-instructional settings (specifically, conversational units), and participants’ correct responses to object/function intraverbals. Furthermore, two additional reverse intraverbal...
probes, commonly tested in other intraverbal studies, were conducted: animal sounds/sounds of animal and body part/function relations.

In Experiment II I sought to answer the following questions: 1) Is there a functional relation between the presence of Say-Do and intraverbal responding for reverse relations? 2) Is there a functional relation between the presence of Self-Talk and intraverbal responding for reverse relations? And, 3) if participants were able to respond to one type of bidirectional or reverse intraverbals (i.e. object/function relations), could they generalize that responding to other types of reverse intraverbals (i.e. body part/function intraverbals)? 4) Could a Self-Talk Immersion procedure induce components of Naming?
Chapter III

EXPERIMENT II: SINGLE-CASE DESIGN

Method

Participants

Four participants with similar verbal repertoires were selected from a CABAS® model E.I. integrated classroom. Participants ranged in age from 24-36 months old. Participants B, C, and D had Individual Family Service Plans (IFSPs) and Participant A was neuro-typical. Participants B, C, and D received EI specialized and group instruction services through the county and each had an IFSP addressing individualized goals discussed by their caregivers and therapists that would meet the child’s needs specific to several evaluations conducted by the county, or organizations hired by the county, and their resulting International Classification of Diseases Code, or ICD-10 code.

Participant A attended the AM and PM sessions at the EI center, for a total of five hours of individual and group instruction. Participants B and C attended the AM session for a total of two-and-a-half hours of individual and group instruction as well as other special services. Participant D attended the PM session for two-and-a-half hours of individual and group instruction as well as other special services.

Participant A was a 30-month-old female who was typically functioning. She functioned at listener, speaker levels of verbal behavior. Prior to the intervention, Participant B demonstrated Generalized Imitation, the listener component of Naming, and Say-Do Correspondence. She did not demonstrate self-talk fantasy play and emitted few
verbal operants across non-instructional settings. Examples of other programed instruction Participant A was being taught at the time of the study included SRA Connecting Math Concepts (Engelmann et al., 2003), SRA Reading Mastery (Engelmann et al., 2014), SRA Language for Learning (Engelmann et al., 2008), textually responding to phonemes, and basic transcription marks.

Participant B was a 36-month-old female with an IFSP and an ICD-10 code indicating specific development disorder of motor function. She functioned at listener, speaker levels of verbal behavior. In addition to specialized and group instruction, Participant B received services for speech and occupational therapy on site. At the time of the study she demonstrated Generalized Imitation, the listener component of Naming, and the emergence of a Self-Talk repertoire. She did not demonstrate Say-Do Correspondence. Examples of other programed instruction Participant A was being taught at the time of the study included SRA Connecting Math Concepts (Engelmann et al., 2003), SRA Reading Mastery (Engelmann et al., 2014), SRA Language for Learning (Engelmann et al., 2008), and textually responding to phonemes, and basic transcription marks.

Participant C was a 36-month-old male student with an IFSP and an ICD-10 code indicating specific development disorder of motor function. He functioned at listener and speaker levels of verbal behavior. In addition to specialized and group instruction, Participant C received speech and occupational therapy services on site and additional Applied Behavior Analysis (ABA) services at home five hours per week. Prior to the intervention Participant C demonstrated Generalized Imitation and the listener component of Naming. Participant C did not demonstrate Say-Do Correspondence or
Self-Talk and emitted few conversational units across non-instructional settings.

Examples of other programed instruction Participant D was being taught at the time of the study included 1:1 correspondence, identifying letters, SRA Reading Mastery (Engelmann et al., 2014), and SRA Language for Learning (Engelmann et al., 2008).

Participant D was a 24-month-old male student with and IFSP and ICD-10 code indicating specific development disorder of motor function. He functioned at listener and speaker levels of verbal behavior. In addition to specialized and group instruction, Participant D received speech, occupational therapy, and physical therapy services on site. At the time of the study Participant D demonstrated Generalized Imitation and the listener component of Naming. However, he did not demonstrate Say-Do Correspondence or Self-Talk Fantasy Play. Examples of other programed instruction Participant D was being taught at the time of the study included 1:1 correspondence, identifying colors and shapes, matching and pointing to letters and numbers, and choral responding to instruction in a group. Prior to the intervention, Participant D was using the Auditory Matching Protocol presented on an I-Pad to increase the intelligibility of his speech from 37% full echoic responding to the prerequisite 70% full echoic responding. Once he met criterion for his echoic repertoire additional pre-intervention probes were conducted and he then entered the intervention phase. See Tables 5 and 6 for participant descriptions and standardized language assessments and scores (Zimmerman et al., 2012).
**Table 5**

*Participant's Relevant Cusps/Capabilities*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age (months)</th>
<th>Sex</th>
<th>Development</th>
<th>Naming</th>
<th>Say-Do</th>
<th>Self-Talk</th>
<th>Verbal Operants CU emitted?</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>30</td>
<td>F</td>
<td>typical</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>B</td>
<td>36</td>
<td>F</td>
<td>IFSP; specific development disorder of motor function</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>C</td>
<td>36</td>
<td>M</td>
<td>IFSP; specific development disorder of motor function</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>D</td>
<td>24</td>
<td>M</td>
<td>IFSP; specific development disorder of motor function</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>

**Table 6**

*Participant's Standardized Language Scores*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Dated Assessed (Month/Year)</th>
<th>Language Assessment Used</th>
<th>Standard Score</th>
<th>SD from Mean</th>
<th>Percentile Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>X X</td>
<td>X</td>
<td>X X X</td>
<td>X X X</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>8/15</td>
<td>Preschool Language Scales-5</td>
<td>Receptive 73</td>
<td>-1.8</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Expressive 75</td>
<td>-1.7</td>
<td>5</td>
</tr>
<tr>
<td>C</td>
<td>10/16</td>
<td>Preschool Language Scales-5</td>
<td>Receptive 67</td>
<td>-2.2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Expressive 80</td>
<td>-1.3</td>
<td>9</td>
</tr>
<tr>
<td>D</td>
<td>7/16</td>
<td>Preschool Language Scales-5</td>
<td>Receptive 73</td>
<td>-2.0</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Expressive 69</td>
<td>-2.0</td>
<td>2</td>
</tr>
</tbody>
</table>

**Inclusion Criteria.** In order to be selected for the study participants were required to have the following in repertoire: point-to topography, listener literacy, a strong echoic repertoire (70% or better full echoic responding), and independent mands and tacts. Participants selected were also required to have a history of tact instruction and have basic intraverbals in repertoire, such as personal information and yes/no questions. In addition, participants needed to be able to tact at least 20 different actions and tact
their own behavior in the present, such as eating, sitting, standing, playing, etc. It was necessary for participants to be able to respond using 2-3 word utterances.

**Experimental Setting and Materials**

The experimental setting and materials used were exactly as described in Experiment 1. See Appendix A and Appendix B for pictures of the experimental setting and toys utilized.

**Dependent Measures**

The following dependent measures including, raw scores on the object/function intraverbal probe, the presence of Say-Do, Self-Talk, and Naming, and functional speech emitted during verbal operant probes, were as described in Experiment I. However, the procedures and measurement for Say-Do Correspondence and Self-Talk were much more stringent in the current study and additional reverse intraverbal probes were added.

The criterion for the reverse intraverbal probes were identical to Experiment I, 80% accuracy. Criteria for the presence of Say-Do, Self-Talk, and Naming were also exactly the same as in Experiment I, specifically 80% or better for Say-Do, one instance of a self-talk conversational unit for Self-Talk, and 75% or better for Naming. No corrections or feedback were delivered during probe sessions. See the Procedure section for more details.

**Reverse Intraverbals.** Animal sounds and sounds of animals and body part/function relations were included as additional reverse intraverbal probes in this experiment. Animal sounds were defined as emitting the sound a specified animal makes, for example, answering the question, “What sound does a dog make?” Sounds of animals were defined as emitting the name of the animal that makes a particular sound, for
example, answering the question, “What animal says, ‘roof roof’?” Body part/function reverse intraverbals included the following relations: eyes/see, ears/hear, hands/touch, nose/smell, and mouth/taste. Participants were asked body part-to-function questions, such as “What do you do with your nose?” and function-to-body part questions, such as “What body part do you smell with?”

**Say-Do Correspondence.** When assessing Say-Do Correspondence, the participant was given 10 opportunities to respond and in order to respond correctly the participant was required to engage with the toy for at least 10-seconds. In addition, independent Say-Do responses during which a participant told an experimenter or teacher what he/she was about to do or play with, and then did so, were recorded.

**Self-Talk Fantasy Play.** Another alteration in Experiment II was how data were recorded during Self-Talk probes in solitary play. In Experiment I, experimenters only recorded instances of self-talk conversational units, during which the participant emitted at least two listener and two reciprocal speaker vocal verbalizations in a verbal episode within-one’s-own-skin. In Experiment II, all vocal verbal components of a sequelic were recorded in addition to self-talk conversational units.

Self-Talk sequelics were defined as one half of a conversational unit or verbal episode, during which the individual acted as both a listener and a speaker within-the-skin. For example, during one of the participant’s Self-Talk probes, she had a fly in one hand and a horse in the other and she pretended to have the fly bite the horse. In this example, the participant had the fly say, “I got you!” and the horse replied with crying and shouting, “No, leave me alone! Ouch!” Sequelics are intraverbals in which one
verbal response is controlled by a prior verbal stimulus and the two verbal stimuli do not have point-to-point correspondence (Greer & Ross, 2008).

In Experiment II the vocal self-talk sequelic was broken into two components, a *vocal initiation* and a *vocal reaction*. In the example above, the fly’s initial statement was the vocal initiation of the sequelic and the horse’s vocal response was the vocal reaction. However, a vocal initiation could be followed by a non-vocal response just as a non-vocal behavior could be followed by a vocal reaction. During the Self-Talk probes in solitary, experimenters often saw a participant take on one role or character and have an anthropomorphic toy take on a different role. Typically, the participant would give several instructions to the other character, and although she would have the character respond, the responses would be primarily non-vocal. Therefore, there were several verbal episodes going on, however, most of the vocalizations were emitted by only one character or role. In order to account for all vocal verbal behavior and perhaps track the emergence of self-talk sequelics to self-talk conversational units, all vocal initiations and vocal reactions were recorded.

A self-talk conversational unit was defined as emitting at least two vocal responses as a listener and a speaker in a verbal episode. For example, in the current study, one participant emitted the following self-talk conversational unit with a Baby and a Daddy: the participant pretends to have the Daddy walk up the stairs, “Baby, where you?” the baby is placed upstairs in the bed, the Daddy asks, again, “Where are you?” the participant has the baby say, “Here!” and the Daddy goes into different rooms asking, “Are you here?” “You here?” The Baby says, “No”, and then when the Daddy goes into
the room with the Baby, the participant had the baby pop out of bed and say, “peek-a-boo!” See Figure 6.

![Baby and Child](image)

**Figure 6.** Self-talk sequels versus self-talk conversational units.

**Naming.** All participants were age 3 or under at the time of the study, therefore the pairing procedure (Carnerero & Pérez-González, 2014; Carnerero & Pérez-González, 2015; Longano & Greer, 2014) was used as the Naming experience. During the pairing procedure Naming experience, participants emitted observing responses, as the experimenter pointed to and tacted four novel stimuli in a storybook format. Participants were required to emit observing responses for each target stimulus six times, for a total of 24 observing responses per Naming experience. Probes to measure the components of Naming were conducted two hours following the Naming experience.

**Independent Variable**
Experimenters conducted an adaptation of the Self-Talk Immersion intervention used in the pilot experiment. During the intervention, participants were presented with four self-talk/say-do sequelics to imitate/echo across five different fantasy play scenes. A self-talk/say-do sequelic model contained a vocal initiation and reciprocal vocal reaction. One self-talk immersion session consisted of four sequelic models presented across five play scenes, totaling 20 self-talk/say-do sequelic opportunities.

The self-talk immersion procedure (STIP) was conducted for at least two sessions (only one session conducted per school session) or until an independent sequelic episode, including an initiation and reaction, was emitted by the participant. Following two or more consecutive STIP sessions, post-intervention probes were conducted.

During the intervention, data were collected on participants’ *echoic responses to initiations and reactions* to the experimenter’s model, *physical imitations* of how the experimenter moved the anthropomorphic toys during the sequelic episode, and any *independent initiations or reciprocal reactions*. Vocal imitation initiations were defined as the participant echoing the initial phrase the experimenter modeled with partial correspondence. The vocal imitation initiation did not need to have point-to-point correspondence with the experimenter’s model; imitated initiations containing the essential components of the model were accepted. For example, if the model was “Help me! Help me, Mommy. I’m falling. Ahh!” the following vocal imitations would be accepted: “Help, Mommy. Ahh!” “Mommy, I’m falling”, or “Falling. Ahh!”

Vocal imitation reactions were defined as reciprocal or corresponding vocal responses to the initiation emitted from a different character or role. During each fantasy play scene there were several roles for the experimenter and participant to choose from.
For example, roles for the dollhouse scene included the Mommy, Daddy, Baby, and even
the experimenter/participant could act out a role. In example, the experimenter could
model being the Mommy and telling the girl to go upstairs and brush her teeth and in
doing so the experimenter is setting up a sequelic episode in which she is serving as the
role of the Mommy and the anthropomorphic doll is serving as the role of the little girl.

Much like the initiations, vocal imitation reactions did not have to have point-to-
point correspondence with the experimenter’s model. For example if the modeled
reaction to the “Help me! Help me, Mommy. I’m falling. Ahh!” example used above was
a mother duck responding, “Oh no baby. I’m coming! Are you ok?” acceptable imitation
responses would include essential portions of the model, such as “Baby! You ok?” “I’m
coming baby” or “Oh no”

Physical imitation responses were defined as the physical manipulations of the
anthropomorphic toys or roles, distinguishing between the initiation and the reaction or
the two characters in the intraverbal episode.

Independent vocal initiations were defined as the participant taking on the role of
the initiator or first character, prior to the experimenter’s model. For example, if the farm
fantasy play scene was just set up and the participant immediately selected a baby duck,
put it on the top of the barn and said, “Help me Mommy! Falling!” an independent vocal
initiation would be recorded. If the participant reciprocally responded right away with
another character or role, such as grabbing a larger duck and pretending to have it say,
“Oh no. You okay, baby?” an independent reaction would be recorded.

If the participant did not emit an independent reaction, the experimenter would
model a reaction that corresponded with the participant’s initiation and then have them
switch roles so that the participant would have the opportunity to act as both the initiator and the reactor in one intraverbal episode. It is important to note that the participant’s independent reaction needed to correspond with the initiation to complete one sequelic episode.

Criterion for the STIP intervention was two consecutive sessions or until the participant emitted an independent sequelic episode during an intervention session. Again, a sequelic episode consisted of both, a vocal initiation and a vocal reaction that corresponded or was reciprocal to the initiation. See Figure 7 for the intervention graphs for each participant.
Figure 7. The self-talk immersion intervention graphs across all participants. Criterion was two consecutive days or until the participant emitted an independent initiation or reaction.
Sequence of Procedures

Pre-Experimental Screenings and Prerequisites. Participant prerequisites are exactly as described in the Inclusion Criteria section above. Potential participants were also pre-screened for the set of common object/function relations used in Experiment I (refer to Figure 1). If the potential participant emitted 70% accuracy or better on the pre-screening, he or she was excluded from the study.

Conditional Discriminations for Reverse Intraverbals. Prior to the three reverse intraverbal probes, experimenters ensured participants were able to discriminate the relations as a listener (selection responses) and tact the object or body part. In order to partake in the reverse intraverbal probe, participants were required to be able to tact the objects, select the functions, demonstrate the functions, and select the object that corresponded with the function for 10 different object/function relations. Participants were required to emit 10 different animal sounds, in order to measure the reverse intraverbal, responding to the type of animal that makes a particular sound. Participants were also required to tact five body parts (ears, eyes, mouth, nose, hands), select the functions for each body part (i.e. “Point to the picture of someone smelling”), and select the body part that correlated to the function (i.e. “Point to the body part you smell with). If participants did not emit correct responses during the conditional discrimination training, learn units were delivered in order to teach at least 10 object/function and animal sounds/sounds of animal relations and five body part/function relations.

Criteria for all conditional discriminations were 100% correct responding. Please refer to Figure 3 for a diagram of known and probed relations. See Figure 8 below, for
the data collection sheet used for the conditional discriminations and bidirectional or reverse intraverbal probes.

<table>
<thead>
<tr>
<th>Object/Function Data Sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>tact object</td>
</tr>
<tr>
<td>--------------</td>
</tr>
<tr>
<td>point to the girl digging</td>
</tr>
</tbody>
</table>

| 1 | dig/shovel      |
| 2 | wash/soap       |
| 3 | swim/pool       |
| 4 | blow nose/tissue|
| 5 | write with/pencil|
| 6 | wear on your hands/mittens |
| 7 | kick and throw/ball |
| 8 | wear on your head/hat |
| 9 | dry off with/towel |
| 10 | wear on foot/shoe |
| 11 | drink from/cup  |
| 12 | read/book       |
| 13 | eat with/spoon  |
| 14 | sit on/chair.   |
| 15 | drive/car       |
| 16 | talk on/phone   |
| 17 | sleep in/bed    |
| 18 | scissors/cut with |

*Figure 8.* The object/function data collection sheet used for the conditional discrimination training and object/function probes.

**Pre-Intervention Probes.** Pre-intervention probes were conducted to assess the participants’ speaker-as-own-listener repertoire and reverse intraverbal repertoire.
**Verbal Operant Probes.** Participants’ functional speech was observed and measured across two consecutive days. Each verbal operant probe consisted of two consecutive, 15-minute observations of interactions with peers across 3 non-instructional settings. Experimenters focused on the presence of sequelics and conversational units with peers as well as self-talk conversational units, as defined previously.

**Naming.** The presence or absence of the listener and speaker components of Naming were also assessed prior to the intervention. Naming for the four participants was assessed following three Naming experiences in a storybook format using the pairing procedure (Carnerero & Pérez-González, 2014; Carnerero & Pérez-González, 2015; Longano & Greer, 2014). The participants were exposed to four novel plants or creatures (depending on the storybook chosen) six times each during a Naming experience, for a total of 24 exposures. During the Naming experience with the storybook, the experimenter would read a short story about the 4 target stimuli, pointing to each stimulus as she read and ensuring that the participant observed each tact. Following two hours, participants were asked to select and then tact the four stimuli. Criterion for the listener half of Naming was 75% accuracy, as was the criterion for the speaker half.

**Say-Do Correspondence.** Say-Do was measured by providing 10 opportunities for the participant to say they were going to engage in a certain activity or play with a specific toy, and then doing so. Experimenters contrived situations and also used natural opportunities to test SDC. During contrived situations, the experimenter would place several toys, such as puzzles, crayons and paper, a shape sorter, and books, on a table or an the rug, call the participant over so he or she could view the items presented, and ask the participant, “What are you going to play with?” or “What are you going to do?”
Occasionally the experimenter would tact the items or activities if there was any doubt the participant did not know the tact for each item. During the non-contrived situations the participant may have been entering the toy area or going to recess where several free-play options would be available for him or her, and again the experimenter would ask the participant, “What are you going to play with?” or “What are you going to do?” Criterion was 80% accuracy or correspondence between saying and doing.

**Self-Talk Conversational Units.** The presence of self-talk conversational units were measured during verbal operant probes and in addition, the 15-minute self-talk probes in isolation. During the 15-minute self-talk isolation probes, participants were presented with 5 different fantasy play scenes and instructed to “have fun playing” Participants were isolated from their peers during this probe in order to measure any overt speaker-as-own-listener behavior between the participant and/or the anthropomorphic toys. A self-talk conversational unit consisted of two intraverbal episodes or two vocal initiations and two reciprocal vocal reactions. Criterion for STCU was the emission of one complete STCU during either a verbal operant probe or in the 15-minute self-talk probe.

**Reverse Intraverbal Probes.** Following the Conditional Discrimination Training procedures, at least 10 object/function relations were identified for each participant’s probe set. For each participant’s object/function probe set, see Table 7. Once the probe set was established, participants were first asked the object-to-function intraverbals, such as, “What do you do with a car?” followed by the 10 corresponding function-to-object intraverbals, such as, “What do you drive?”
Following the object/function probes, re-intervention probes were conducted for 10 animal sounds/sounds-of-animals relations and 5 body part/function relations. All 10 animal sound intraverbals (e.g. “What sound does a lion make?”) were asked prior to the sound-of animals intraverbals, such as “What animal says, ‘roar’?” The five body part-to-function intraverbals (i.e. “What do you do with your nose?”) were asked prior to the five function-to-body part intraverbals, such as “What body part do you smell with?”

Table 7

Participants’ probe stimuli sets

<table>
<thead>
<tr>
<th></th>
<th>Object/Function</th>
<th></th>
<th>Animal/Sound</th>
<th></th>
<th>Body Part/Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>wash/soap</td>
<td>1</td>
<td>dog/roof</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>swim/pool</td>
<td>2</td>
<td>cat/meow</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>wear on hands/mittens</td>
<td>3</td>
<td>bird/tweet</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>wear on head/hat</td>
<td>4</td>
<td>sheep/baa</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>kick and throw/ball</td>
<td>5</td>
<td>owl/who who</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>wear of foot/shoe</td>
<td>6</td>
<td>pig/oink oink</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>drink from/cup</td>
<td>7</td>
<td>frog/ribbit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>eat with/spoon</td>
<td>8</td>
<td>horse/niegh</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>read/book</td>
<td>9</td>
<td>cow/moo</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>sit on/chair</td>
<td>10</td>
<td>duck/quack</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>wash/soap</td>
<td>6</td>
<td>dog/roof</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>blow nose/tissue</td>
<td>7</td>
<td>cat/meow</td>
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<tr>
<td></td>
<td>3</td>
<td>write with/pencil</td>
<td>8</td>
<td>sheep/baa</td>
<td>3</td>
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<td>4</td>
<td>wear on hands/mittens</td>
<td>9</td>
<td>owl/who who</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>wear on head/hat</td>
<td>10</td>
<td>pig/oink oink</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>dry off with/towel</td>
<td>6</td>
<td>frog/ribbit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>wear of foot/shoe</td>
<td>7</td>
<td>horse/niegh</td>
<td></td>
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<tr>
<td></td>
<td>8</td>
<td>eat with/spoon</td>
<td>8</td>
<td>cow/moo</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>drive/car</td>
<td>9</td>
<td>duck/quack</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>talk or call on/phone</td>
<td>10</td>
<td>lion/roar</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>1</td>
<td>dig/shovel</td>
<td>1</td>
<td>dog/roof</td>
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</tr>
<tr>
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<td>2</td>
<td>swim/pool</td>
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<td>cat/meow</td>
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<td>blow nose/tissue</td>
<td>3</td>
<td>sheep/baa</td>
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<tr>
<td></td>
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<td>write with/pencil</td>
<td>4</td>
<td>owl/who who</td>
<td>4</td>
</tr>
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<td>wear on hands/mittens</td>
<td>5</td>
<td>pig/oink oink</td>
<td>5</td>
<td>mouth/taste</td>
</tr>
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<tr>
<td>6</td>
<td>wear on head/hat</td>
<td>6</td>
<td>frog/ribbit</td>
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<td>7</td>
<td>dry off with/towel</td>
<td>7</td>
<td>horse/niegh</td>
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<td>wear of foot/shoe</td>
<td>8</td>
<td>cow/moo</td>
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<td>drink from/cup</td>
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<td>duck/quack</td>
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<tr>
<td>10</td>
<td>eat with/spoon</td>
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<td>lion/roar</td>
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<table>
<thead>
<tr>
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<th>dig/shovel</th>
<th>1</th>
<th>dog/roof</th>
<th>1</th>
<th>eyes/see</th>
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<td>wear on head/hat</td>
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<td>cat/meow</td>
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<td>ears/hear</td>
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<td>kick and throw/ball</td>
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<td>sheep/baa</td>
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<td>nose/smell</td>
</tr>
<tr>
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<td>4</td>
<td>owl/who who</td>
<td>4</td>
<td>hands/touch</td>
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<td>pig/oink oink</td>
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<td>mouth/taste</td>
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<td>eat with/spoon</td>
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<td>frog/ribbit</td>
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<td>sit on/chair</td>
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<td>horse/niegh</td>
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<td>8</td>
<td>drive/car</td>
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<td>cow/moo</td>
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<tr>
<td>9</td>
<td>talk or call on/phone</td>
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<td>duck/quack</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>sleep in/bed</td>
<td>10</td>
<td>lion/roar</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Pre-Experimental Intraverbal Stimulus Equivalence Training.** Prior to undergoing the Self-Talk Immersion Procedure all participants underwent a stimulus equivalence training using a non-target object/function relations. During which, the participant was required to select an exemplar of the object (such as, shovel) in an array of three (one target exemplar and two non-exemplars), following the antecedent, “point to the object you dig with” and then tact multiple exemplars of the corresponding object (i.e., shovel). Each session contained 10 selection and 10 tact responses, which were rotated, for a total of 20 trials. Experimenters delivered learn units for during the stimulus equivalence training procedure, thus reinforcing correct responses and implementing a correction procedure following incorrect responses. Criterion was set at 90% accuracy of responding across two consecutive sessions. See Figure 9 for participants’ results during the stimulus equivalence trainings.
Stimulus equivalence training was conducted to assess if reverse intraverbals would emerge for the participant, following more exposure to the object/function relation. The stimulus equivalence trainings were conducted in order to strengthen the internal validity of the study. In other words, by conducting the stimulus equivalence training, the experimenter could eliminate lack of exposure or limited exemplars as the function of a limited bidirectional intraverbal repertoire. If correct responses to bidirectional intraverbals did not increase, participants entered the intervention. However, if correct responses increased following the stimulus equivalence training, as with Participant C, another stimulus equivalence training was conducted to establish steady-state responding. If correct responses increased following each stimulus equivalence training, sufficient enough to build a relational frame for responding to object/function intraverbals, the student was not included in the study.
Figure 9. Participants’ stimulus equivalence training sets as part of their pre-experimental training.
**Self-Talk Immersion.** The intervention consisted of a Self-Talk Immersion Procedure (STIP) during which participants were presented with four self-talk/say-do sequelics (in other words, half of a conversational unit) to imitate across five different fantasy play scenes. During the intervention, the experimenter would tell the participant to “Say what I say and do what I do” and then use the anthropomorphic toys, puppets, or cars to model a self-talk/say-do sequelic, such as picking up a pig and saying to the horse “I’m going to eat, want to come” and having the horse reply “Sure” and pretend the animals were eating. Following the model, the participants were given an opportunity to imitate and echo what had been modeled for them.

The five fantasy play scenes consisted of puppets, vehicles and car tracks, people and dollhouse, farm animals and barn and silo, and dinosaurs. One self-talk immersion session consisted of four models presented across all five scenes, totaling 20 self-talk/say-do opportunities. Criterion was set at two sessions or until the participant emitted an independent self-talk sequelics. Data were collected on participants’ full and partial echoic responses, whether they emitted the initiation or response/reaction part of the sequelic or both, as well as the imitation of the toys. See Figure 10 below for the sequence of procedures for Experiment II.
Figure 10. The sequence of procedures for Experiment II.
Data Collection

A second experimenter collected data during more than 60% of intervention sessions and 70% of probe sessions for Interobserver-agreement (IOA). Data were collected on data sheets using blue or black pens. Correct responses were recorded as a plus (+) and incorrect responses were recorded as a minus (-).

Intervention data were collected and graphed with stacked bar graphs representing echoic and independent vocal initiations, independent and vocal reactions, and independent self-talk sequelics emitted.

Data on VO probes were collected and graphed on bar graphs with a solid black bar representing the number of sequelics emitted, a white bar representing the number of conversational units emitted, and a grey bar representing the number of STCUs emitted.

Correct responses on the Say-Do Correspondence probes were displayed on a bar graph represented with a black bar. Correct responses on the Self-Talk probes were displayed on graphs with independent initiations represented with a white bar and independent reactions represented by a grey bar. Self-Talk conversational units were represented in a line graph, as a closed circle.

Correct responses to untaught object/function intraverbals for each participant were displayed on bar graphs with a black bar representing the object-to-function responses and a white bar representing the function-to-object responses. Correct responses for all the reverse intraverbal probes were collected and collapsed on bar graphs for each participant are depicted with a black bar representing object-to-function, animal-to-sound, and body part-to-function relations, and a white bar representing function-to-object, sound-to-animal, and function-to-body part relations.
Experimental Design

Delayed multiple probe across participants designs (Horner & Baer, 1978) were conducted for all dependent measures. Following the pre-screening procedures, the multiple probe design began with initial pre-intervention probes conducted for Participant A. Secondary pre-intervention probes were conducted for most dependent measures, especially if the participant was on the verge of demonstrating the developmental cusp or meeting the established criterion. Following pre-intervention probes, Participant A entered the STIP intervention. Once Participant A met criterion on the STIP, post-intervention probes were conducted for Participant A and pre-intervention probes were conducted for Participant B. See Figure 11 for the Experiment Design. For the procedural sequence, refer to Figure 10.
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-IV Probes (5)</td>
<td>SE Training</td>
<td>Post-SE Intra. Probes</td>
<td>Pre-IV Probes (5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>STIP Intervention</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post-IV Probes (5)</td>
<td>SE Training</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post-SE Intra. Probes</td>
<td>Post-SE Probes</td>
</tr>
<tr>
<td></td>
<td>Follow-up Probes</td>
<td>STIP Intervention</td>
<td>Post-IV Probes (5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SE Training</td>
</tr>
<tr>
<td></td>
<td></td>
<td>STIP Intervention</td>
<td>Post-SE Intra. Probes</td>
</tr>
<tr>
<td></td>
<td>Follow-up Probes</td>
<td>Post-IV Probes (5)</td>
<td>STIP Intervention</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Post-IV Probes (5)</td>
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<td></td>
<td>STIP Intervention</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Post-IV Probes (5)</td>
</tr>
</tbody>
</table>

*Figure 11.* The experimental design sequence across participants.
**Interobserver Agreement**

Interobserver agreement (IOA) was collected across all probe and intervention sessions. IOA was calculated by counting the number of agreements and disagreements, and dividing the number of agreements by the total trials and then multiplying by 100. Overall, IOA was collected for 63% of intervention sessions with a mean agreement of 96% (range, 86%-100%) and 76% of probe sessions with a mean agreement of 95% (range, 85%-100%).

**Intervention Sessions.** For Participant A, IOA was collected for 75% of intervention sessions with 91% agreement (range, 86%-100%). IOA was collected for 50% of Participant B’s intervention sessions with 100% agreement and 50% of Participant C’s intervention sessions with 94% agreement (range, 87%-100%). IOA was conducted for 75% of Participant D’s intervention sessions with 100% agreement.

**Reverse Intraverbal Probes.** IOA was conducted 100% of Participant A’s reverse intraverbal probes with 100% agreement. For Participant B, IOA was conducted 90% of the time with 100% agreement and for 67% of Participant C’s probes with 99% agreement (range, 94%-100%) and 83% of Participant D’s probes with 100% agreement.

**Say-Do Probes.** IOA was conducted for 50% of Participant A’s probes with 100% agreement; 66% of Participant B’s probes with 100% agreement; 75% of Participant C’s probes with 97% agreement (range, 90%-100%); and 60% of Participant D’s probes with 100% agreement.

**Self-Talk Probes.** IOA was conducted for 100% of Participant A’s probes with 97% agreement (range, 90%-100%); 100% of Participant B’s probes with 85% agreement
(range, 82%-86%); 67% of Participant C’s probes with 90% agreement (range, 82%-100%); and 60% of Participant D’s probes with 89% agreement (range, 85%-92%).

**Naming Probes.** IOA was conducted for 75% of Participant A and B’s probes with 100% agreement; 100% of Participant C’s probes with 100% agreement; and 67% of Participant D’s probes with 100% agreement.

**Verbal Operant Probes.** IOA was conducted for 97% of Participant A’s probes with 95% agreement (range, 91%-100%); 70% of Participant B’s probes with 88% agreement (range, 83%-94%); 60% of Participant C’s probes with 89% agreement (range, 83%-100%); and 57% of Participant D’s probes with 89% agreement (range, 79%-100%).

**Results**

Participants A, B, C, and D’s results across dependent measures are reported herein, and are graphically depicted below.

**Reverse Intraverbals**

As Figure 12 depicts, prior to the STIP intervention, Participant A emitted 2/10 correct object-to-function responses and 2/10 correct function-to-object responses in the first pre-intervention probe, then 4/10 correct object-to-function responses and 1/10 correct function-to-object responses in the subsequent pre-intervention probe. Following the SE training, she emitted 0/10 object-to-function responses and 4/10 correct function-to-object responses. Following STIP, Participant A emitted 9/10 object-to-function responses and 7/10 correct function-to-object responses and during the post 3-week follow up probe she emitted 10/10 object-to-function responses and 8/10 correct function-to-object responses. Prior to STIP, Participant A emitted 12/25 correct
object/body part to function and animal-to-sound responses and 5/25 correct function to object/body part and sound-to-animal responses in her first pre-intervention probe and 14/25 correct object/body part to function and animal-to-sound responses and 5/25 correct function to object/body part and sound-to-animal responses in her second pre-intervention probe. Following the intervention, Participant A emitted 21/25 25 correct object/body part to function and animal-to-sound responses and 19/25 correct function to object/body part and sound-to-animal responses. In her post 3-week follow up probe, Participant A’s correct object/body part to function and animal-to-sound responses remained the same at 21/25 and her correct function to object/body part and sound-to-animal responses increased to 21/25. See Figure 13 for the graphs of overall emerged reverse intraverbals.

Participant B emitted 5/10 correct object-to-function responses and 0/10 correct function-to-object responses in the first pre-intervention probe, then 5/10 correct object-to-function responses and 1/10 correct function-to-object responses in the subsequent pre-intervention probe. Following the SE training, her correct responses for object-to-function remained the same while the correct function-to-object responses increased to 3/10. Another SE training was conducted, following which; Participant B emitted 4/10 correct object-to-function responses and 3/10 correct function-to-object responses. Following STIP, Participant B emitted 9/10 correct object-to-function responses and 7/10 correct function-to-object responses. She emitted 7/10 correct object-to-function responses and 9/10 correct function-to-object responses during her 3-week follow up probe. Her overall emerged reverse intraverbals increased from 16/25 and 2/25, object/body part to function and animal to sound and function to object/body part and
sound to animal, respectively, to 21/25 and 19/25 following the STIP intervention. During 3-week follow up probes, Participant B emitted 20/25 and 20/25 reverse intraverbals.

Participant C emitted 1/10 correct object-to-function responses and 5/10 correct function-to-object responses in the first pre-intervention probe, then 0/10 correct object-to-function responses and 6/10 correct function-to-object responses in the subsequent pre-intervention probe. Following the SE training, he emitted 1/10 correct responses for object-to-function and 5/10 correct function-to-object responses. Following STIP, Participant C emitted 7/10 correct object-to-function responses and 4/10 correct function-to-object responses. After another STIP intervention his correct responses increase to 9/10 and 8/10. He emitted 9/10 correct object-to-function responses and 7/10 correct function-to-object responses during his 3-week follow up probe. His overall emerged reverse intraverbals increased from 11/25 and 6/25, object/body part to function and animal to sound and function to object/body part and sound to animal, respectively, to 17/25 and 15/25 following the first STIP intervention and 20/25 and 19/25 following the second STIP intervention. During 3-week follow up probes, Participant C emitted 20/25 and 19/25 reverse intraverbals.

Participant D emitted 3/10 correct object-to-function responses and 2/10 correct function-to-object responses in the first pre-intervention probe, then 1/10 correct object-to-function responses and 2/10 correct function-to-object responses in the subsequent pre-intervention probe. Following the SE training, he emitted 2/10 correct responses for object-to-function and 4/10 correct function-to-object responses. Another SE training was conducted, following which; Participant D emitted 3/10 correct object-to-function
responses and 3/10 correct function-to-object responses. Following STIP, Participant D emitted 5/10 correct object-to-function responses and 4/10 correct function-to-object responses. After another STIP intervention his correct responses increase to 7/10 and 8/10. He emitted 8/10 correct object-to-function responses and 8/10 correct function-to-object responses during his 3-week follow up probe. His overall emerged reverse intraverbals increased from 13/25 and 12/25, object/body part to function and animal to sound and function to object/body part and sound to animal, respectively, to 16/25 and 15/25 following the first STIP intervention and 18/25 and 19/25 following the second STIP intervention. During 3-week follow up probes, Participant D emitted 19/25 and 19/25 reverse intraverbals.
Participant A, B, C and D’s correct responses to reverse intraverbal probes for object/function relations pre- and post-stimulus equivalence training(s) and pre- and post-self-talk immersion intervention(s).

Figure 12. Participant A, B, C and D’s correct responses to reverse intraverbal probes for object/function relations pre- and post-stimulus equivalence training(s) and pre- and post-self-talk immersion intervention(s).
Figure 13. Participant A, B, C, and D’s correct responses across all reverse intraverbal probes conducted in pre- and post-self-talk immersion intervention(s).
Say-Do Correspondence

Participant A demonstrated SDC during her pre-intervention probes with 7/10 and 8/10 correct responses. However, following the STIP intervention, Participant A’s correct responses increased to 10/10 and she emitted 10/10 correct SDC responses during her post-3 week follow up as well.

Participant B emitted 5/10 correct SDC responses during her pre-intervention probe. Following STIP, she demonstrated the SDC cusp by emitting 9/10 correct responses. During the post-3 week follow up probe she emitted 10/10 correct SDC responses.

Participant C emitted 6/10 correct SDC responses in his pre-intervention probe. Following the first STIP intervention his correct responses increased to 10/10, demonstrating the SDC cusp. Following another STIP intervention, he emitted 9/10 correct SDC responses. He emitted 9/10 correct SDC responses during his post-3 week follow up probe as well.

Participant D emitted 6/10 and 5/10 correct SDC responses during pre-intervention probes. Following his first STIP intervention, he demonstrated the SDC cusp by emitting 10/10 correct responses. Following the second STIP intervention, he emitted 9/10 correct SDC responses. Following 3-weeks he emitted 9/10 during follow up probes. See Figure 14 below.
Figure 14. Number of correct responses during Say-Do Correspondence probes for Participants A, B, C, and D.
Self-Talk Conversational Units

During pre-intervention probes, Participant A emitted 0 vocal initiations, 1 vocal reaction, and 0 STCUs. Following the STIP intervention, Participant A emitted 33 vocal initiations and 19 vocal reactions; Participant A demonstrated the self-talk cusp by emitting 6 STCUs. During her post-3 week follow up probe she emitted 17 vocal initiations, 7 vocal reaction, and 2 STCUs.

Participant B demonstrated the self-talk cusp during pre-intervention probes as she emitted 3 STCUs. More specifically, she emitted 15 vocal initiations and 14 vocal reactions. However, following the STIP intervention her STCUs tripled as she emitted 9 STCUs (50 vocal initiations and 33 vocal reactions) and then 10 STCUs (43 vocal initiations and 24 vocal reactions) during her post-3 week follow up probe.

Participant C did not emit any STCUs during his pre-intervention probe. He emitted 6 vocal initiations and 3 vocal reactions. Following the STIP intervention, three post-intervention probes were conducted to assess the effects of the intervention on STCUs. He emitted 1, 2, and 1 STCUs, respectively. Following a second STIP intervention, his emission of STCUs increased to 4 (with 23 vocal initiations and 11 vocal reactions) and during his post-3 weeks follow up probe he emitted 2 STCUs (with 20 vocal initiations and 13 vocal reactions).

Participant D emitted 0 STCUs during his pre-intervention probes. He emitted 22 vocal initiations and 7 vocal reactions during his first pre-intervention probe followed by 22 vocal initiations and 6 vocal reactions. Following STIP, he emitted 6 STCUs (with 30 vocal initiations and 18 vocal reactions) and following another STIP intervention phase, he emitted 10 STCUs, comprised of 56 vocal initiations and 27 vocal reactions. During
his 3-week follow up probe; Participant D emitted 48 vocal initiations, 21 vocal reactions, and 8 STCUs. See Figure 15.
Figure 15. The number of independent vocal initiations, vocal reactions, and self-talk conversational units emitted for Participants A, B, C, and D during pre- and post-self-talk immersion intervention probes.
Naming

At the onset of the experiment, all participants had the listener component of Naming in repertoire. Participant A emitted 50% and 25% correct responding for the speaker component of Naming during pre-intervention probes. Following STIP, Participant A demonstrated the full Naming capability as she emitted 75% correct speaker responses. Her correct responses to Naming probes increased to 100% following 3-weeks.

Participant B emitted 75% correct responding for the listener half of Naming and 35% correct responding to the speaker half of Naming during her first pre-intervention probe and 100% and 35% correct responding during her second pre-intervention probe. Following STIP, Participant B demonstrated Full Naming as she emitted 75% correct speaker responses. She emitted 100% correct listener and speaker responses to Naming probes during her post-3 week follow up probe.

Participant C emitted 75% correct listener and 63% correct speaker responses during his pre-intervention probe. Following STIP his correct responses increased to 100% for listener and 75% for speaker, demonstrating the Naming capability. Following another STIP intervention phase his correct responses to Naming probes remained the same. However, post-3 weeks, Participant C emitted 100% correct listener and speaker responses during follow up probes.

Participant D emitted the listener component of Naming, but not the speaker component of Naming during pre-intervention probes, Following STIP interventions, Full Naming did not emerge. See Figure 16.
Figure 16. Participant A, B, C and D’s pre- and post-self-talk immersion intervention responses to Naming probes.
Verbal Operants

Participant A did not emit any sequelics, conversational units, or STCUs during pre-intervention probes. Following STIP she emitted 3, 1, 2 and 1, 2, 2 sequelics, CUs, and STCUs, respectively. During her post-3 week follow up probes she emitted 4 sequelics, CUs, and STCUs.

Participant B emitted 2 sequelics and 4 CUs during his pre-intervention probes. Following STIP, she emitted 1, 5, and 1 sequelics, CUs, and STCUs, respectively, then 3, 5, and 3 in another post-intervention probe. In her post-3 week follow up probe, she emitted 6, 14, and 9 sequelics, CUs, and STCUs, respectively.

Participant C only emitted 1 sequelic during his pre-intervention probes. Following the first STIP he emitted 0, 0, and 2 sequelics, CUs, and STCUs, respectively. His vocal verbal operants increased to 1, 4, and 7 sequelics, CUs, and STCUs, respectively, following his second STIP intervention. During his follow up probe, he emitted 0, 7, and 4 sequelics, CUs, and STCUs, respectively.

Participant D only emitted 2 sequelics during his pre-intervention probes. Following STIP he emitted 4, 2, and 8 sequelics, CUs, and STCUs, respectively, then 6, 6, and 4 sequelics, CUs, and STCUs. During his follow up probe, he emitted 8, 10, and 3 sequelics, CUs, and STCUs, respectively. See Figure 17.
Figure 17. The number of sequels, conversational units and self-talk conversational units emitted by Participant’s A, B, C, and D during 30 minute verbal operant probes across non-instructional settings.
Discussion

In the current single-case experiment, a functional relation between Say-Do Correspondence and correct responding to reverse intraverbals, was demonstrated. A functional relation between the induction of Self-Talk Fantasy Play and correct responding to reverse intraverbals was also demonstrated.

Full Naming emerged in three out of the four participants, following the STIP intervention, highlighting the close connection between cusps in the speaker-as-own-listener repertoire. In addition, conversational units emerged and STCU's were emitted across non-instructional settings, following STIP. See Table 8 below, for the cusps and cusps that are also capabilities that were acquired by participants following the STIP intervention.

Table 8

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age (months)</th>
<th>Sex</th>
<th>Naming</th>
<th>Say-Do</th>
<th>Self-Talk</th>
<th>Verbal Operants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Listener</td>
<td>Speaker</td>
<td>CU emitted?</td>
</tr>
<tr>
<td>A</td>
<td>30</td>
<td>F</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
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</tr>
<tr>
<td>B</td>
<td>36</td>
<td>F</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>C</td>
<td>36</td>
<td>M</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
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</tr>
<tr>
<td>D</td>
<td>24</td>
<td>M</td>
<td>yes</td>
<td>no</td>
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</tr>
</tbody>
</table>
Chapter V

GENERAL DISCUSSION

Primary Findings

Two experiments were conducted in this study to test relations between the verbal behavior developmental cusps in the speaker-as-own-listener repertoire and responding to reverse or bidirectional intraverbals. Results from Experiment I, a group design, demonstrated significant correlations between the presence of Say-Do Correspondence and correct responses to reverse intraverbals for object/function relations and the presence of Self-Talk and correct responses to reverse intraverbals for object/function relations. Data from Experiment I demonstrated that Say-Do Correspondence was the SOL cusp most vital for reverse intraverbal responding.

Several studies have used conditional discrimination training (Kisamore et al., 2016; Ma et al., 2016; Miguel et al., 2005; Pérez-González & Asenjo, 2016; Petursdottir et al., 2008) or transfer of stimulus control procedures (Diaz & Pérez-González, 2015; Luciano, 1986; Mellor et al., 2015; Partington & Bailey, 1993; Pérez-González et al., 2008; Vedora & Conant, 2015) to teach intraverbals. The present experiments are the first to connect the emergence of the speaker-as-own-listener repertoire to intraverbal behavior, demonstrating that the joining of the listener and speaker repertoires is crucial for intraverbal responding.

The literature on intraverbal responding focuses on the emergence of intraverbal relations for complex and entirely novel combinatorial relations, such as language
translations (Coon & Miguel, 2012; Petursdottir, Olafsdottir, & Aradottir, 2008) and state
types of birds and flowers. During these studies, participants undergo procedures to learn
reflexive and symmetrical relations and are tested for the emergence of combinatorial
relations. In Experiments I and II, participants had the reflexive and symmetrical relations
in repertoire for the object/function relations. Participants were able to identify the
objects and functions as a listener and speaker and demonstrate the use or the function of
each of the items. In Experiments I and II we built on relations that existed in the
participant’s environment to build upon previous learning.

Findings from Experiment I indicated that a speaker-as-own-listener repertoire
was necessary for individuals to respond to intraverbals, specifically Say-Do
Correspondence and Self-Talk. The presence of Say-Do Correspondence had the
strongest correlation with correct responses to reverse intraverbals.

Experiment II tested for functional relations between the verbal behavior
developmental cusps of Naming, Say-Do, and Self-Talk, and correct responses to reverse
intraverbals in a single-case design. Findings were consistent with Experiment I, in that
the emergence of Say-Do and Self-Talk functioned to increase correct responses to
reverse intraverbals.

Secondary Findings

Results from Experiment I and Experiment II were consistent with the results
from the pilot study (refer to Tables 1 and 2), indicating the presence of Naming was not
strongly correlated to intraverbal responding. However, the measurements used in testing
for the presence or absence of SOL cusps is discussed as a potential limitation in the
section below.
Results from Experiment II demonstrated emergence of three types of reverse intraverbals: object/function relations, animal sounds and sounds of animals, and body part/function relations. Following the Self-Talk Immersion Procedure, correct responses to all reverse intraverbal probes increased. The most significant increases were in the responses to object-to-function and function-to-object relations and the sounds of animals. Furthermore, the STIP and joining of listener and speaker repertoires, led to the emergence of Naming in two out of the four participants.

**Educational Implications**

The implications of these findings have considerable educational significance with regards to language development. Rather than focusing on lengthy and complex interventions to teach intraverbals, such as, instructive feedback (Carroll & Kodak, 2015), auditory tact and auditory imaging instruction (Mellor, Barnes & Rehfeldt, 2015), or problem-solving procedures (Kisamore, Carr, & LeBlanc, 2011; Sautter, LeBlanc, Jay, Goldsmith, & Carr, 2011), test for the presence of a complete SOL repertoire. Findings from Experiments I and II indicated that a deficient intraverbal repertoire might be attributed to the absence of verbal behavior developmental cusps. Results from the current study support the need for a complete verbal behavior analysis when attempting to locate the source of a problem in an individual’s learning.

Findings from Experiment I and Experiment II reveal the significance of a complete speaker-as-own-listener repertoire in order to be truly verbal. There is a great body of literature on the significance of the Naming capability and the educational implications of having Naming in repertoire, however, the results from the pilot study (refer to Tables 1 and 2) and current study indicate Say-Do and Self-Talk are critical to
educational and social development as well. The overt Say-Do and Self-Talk behaviors observed in the current study, during which children were listening-behaving, behaving-speaking, and listening-speaking about their own behavior, coincided with the emergence of untaught reverse intraverbals.

An intraverbal repertoire is critical to academic success and socialization. Intraverbal responses are often associated with common academic responses (for example, answering questions) and perhaps more importantly, within conversation, further validating the importance of emitting this form of verbal behavior. Intraverbals take on many forms, from the alphabet and fill-in’s to complex, multiply-controlled questions. Responding to an intraverbal requires comprehension of the question or antecedent stimulus.

The current study adds to the body of research on verbal development as it bridges the speaker-as-own-listener research with research conducted on intraverbal responding. Much research and examination has focused on the significance of the Naming capability as the source for incidental language acquisition. Findings from Experiments I and II add to the literature on verbal development as they highlight the impact of Say-Do Correspondence and Self-Talk on complex verbal behavior, such as derived relational responding.

**Limitations**

This investigation between the speaker-as-own-listener repertoire and responding to reverse intraverbals is not without limitations. In Experiment I, the presence of Naming, Say-Do, and Self-Talk were analyzed as categorical variables. More accurate correlations could have been demonstrated had the experimenters analyzed the SOL
cusps as continuous variables, by using participants’ percentage of correct responding to Naming, Say-Do, and Self-Talk probes.

In Experiment II, Participants’ speech and language scores are included in Table 6. Please note the dates during which the standardized assessments were conducted. The current study was conducted approximately 17 months following Participant B’s assessment, 4 months following Participant C’s assessment, and 8 months following Participant D’s assessment. Therefore, the scores were not reflective of the participants’ speech and language skills and repertoires at the time of the study.

Another possible limitation is the fact that common object/function relations were tested. One could argue using completely novel stimuli would demonstrate more experimental control. However, this investigation arose from the two students in the pilot study who could not answer simple reverse intraverbals for object/function relations even though they had all the conditional discriminations for those relations in repertoire.

Experiment I only had 6 typical functioning participants in the sample. The majority of participants received special instruction services pertaining to behavioral, developmental, and educational goals listed on their Individual Family Service Plans (IFSPs) or Individual Education Plans (IEPs). Although all participants functioned at the same levels of verbal behavior and had the same prerequisites in place at the onset of the study, a better mixed group with equal number of participants with and without disabilities or delays would be more reflective of the general population.

According to Greer and Ross (2008), three instances of self-talk conversational units in a 10-minute solitary play condition is criterion for the presence of self-talk. In the current study, the criterion for self-talk was the emission of only one self-talk
conversational unit. One could argue that criterion was set too low and that multiple probes would be necessary to demonstrate if the cusp is present or not.

Several prerequisites were required for Experiment II, and therefore some participants were working on establishing those prerequisites, such as answering personal identification questions, and identifying present behavior, up till their entry into the study. Due to the short time frame between the establishment of prerequisites and his entry into the study, Participant C only had one pre-intervention probe for Naming. Although Participant C demonstrated criterion for the Full Naming capability following the STIP intervention, it cannot be directly attributed to the intervention as only one pre-intervention probe was conducted.

Out of the three reverse or bidirectional intraverbals used, participants in Experiment II demonstrated the smallest increase for body part/function relations. Body part/function relations also required the most pre-experimental conditional discrimination training. Participants had essentially just learned the relations surrounding the five body parts and their corresponding functions, therefore they lacked a thorough history of experiences with body part/function relations and perhaps even more importantly, they lacked a history of reinforcement for responding to body part/function relations.

Although experimenters did not look at age as a function of intraverbal responding, including the age of participants in the group design study would enhance the study and findings could be compared to results from Sundberg and Sundberg (2011) and Poon and Butler (1972) studies.

Future Research

Based on limitations stated above, future research should consider using all
continuous variables when relating SOL cusps to correct intraverbal responses. Having a percentage score for the presence of Naming may have demonstrated a significant correlation between the presence of Naming and intraverbal responding. Future researchers should also consider identifying participants’ skills and repertoires, specifically for speech and language, using standardized or norm-referenced assessments and/or language questionnaires in order to add other variables to the analysis.

Future experimenters should consider using Sundberg and Sundberg’s (2011) 80-item intraverbal assessment to examine the effects of the intervention on a wide range of intraverbals. In the current study, only simple reverse intraverbal responses were targeted. However, Sundberg and Sundberg’s assessment includes intraverbal responding of increasing complexity. Using the 80-item intraverbal assessment could provide greater insight into the development of an individual’s intraverbal repertoire.

Hart and Risley notably conducted a longitudinal study with over 40 families, and the researchers were able to form a trajectory of verbal development. It would be interesting to measure the emergence of SOL cusps as they develop and are observable in their overt form and compare to the development of participants’ more advanced repertoires, such as perspective-taking and problem solving, to see if and how these SOL cusps play a role in complex verbal behavior.

Data from the 3-week follow up probes seem to suggest that as the SOL repertoire develops and cusps emerge or are induced, the once separate listener and speaker repertoires fuse together, promoting continued learning in the absence of intervention. Participant A and D’s correct responses to untaught reverse intraverbals increased during the follow up probes, as did Participant B’s correct Say-Do responses and STCU’s
emitted in the solitary Self-Talk probes. Although Participant A, B, and C demonstrated Full Naming following STIP, their correct responses increased to 100% during the follow up probes. All participants conversational units increased during follow up verbal operant probes. These results further support evidence that inducing verbal behavior developmental cusps and capabilities allows the individual to contact new contingencies in his or her environment. Future researchers should consider conducting SOL and intraverbals probes with typical functioning children in the absence of any training or intervention to demonstrate any pattern in acquisition of cusps and intraverbals.

This was the first study exploring the relation of SOL cusps and intraverbal responding. More research and replications are necessary for better analysis of the speaker-as-own-listener repertoire as it relates to intraverbal responding and other complex verbal behavior.

**Conclusion**

Results of the present study demonstrated the significance of a complete speaker-as-own-listener repertoire on intraverbal responding. Experiments I and II indicated that the presence of Say-Do and Self-Talk are necessary for intraverbal responding. The first experiment, a group design with over 30 participants, showed significant correlations between the presence of Say-Do and Self-Talk and intraverbal responding. The presence of Say-Do Correspondence was the most significant factor. Experiment II was conducted as a single-case design to test for a functional relation between the presence of SOL cusps and correct responses to reverse intraverbals. Following the induction of Say-Do and Self-Talk, correct responses to reverse intraverbals emerge for all four participants. Furthermore, follow up probes conducted 3 weeks following the intervention
demonstrated to continued fusion of the listener and speaker repertoires as correct responses to intraverbals continued to increase for three out of the four participants.

To the best of my knowledge, this is the first investigation of the connection between the SOL repertoire and intraverbal responding. Furthermore, the current study focuses on Say-Do and Self-Talk as critical cusps for verbal development, cusps that have not attracted much attention from a research standpoint. Self-Talk is primarily discussed in developmental psychology literature, where vocal behavior is the focus rather than verbal or communicative behavior. Moreover, the current study is the only in existence that included all cusps and capabilities in the SOL repertoire as dependent measures.

More experimental research is needed, as there remain more questions to be answered. Do speaker-as-own-listener cusps develop in a specific order? If so, what is the particular order? Does the order depend on the individual’s instructional history? How do Say-Do and Self-Talk relate to one another? Can the induction of one SOL cusp lead to the emergence of another? In the present study, a serendipitous finding was that the full Naming capability emerged in two of the four participants. Future experimenters should look into the induction of particular cusps on the development of the remaining cusps.

The present study highlights the importance of a speaker-as-own-listener repertoire in order to a truly social being. When children can mediate their own behavior and rotate between acting as his or her own listener and speaker, developments into more advanced repertoires are possible. As Skinner wrote, “Once a speaker also becomes a listener, the stage is set for a drama in which one man plays several roles” (Skinner, 1957, p.433).
References


Childers, J. B., & Tomasello, M. (2002). Two-year-olds learn novel nouns, verbs, and
conventional actions from massed or distributed exposures. Developmental Psychology, 38, 967–978.

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. Unpublished Ph.D Dissertation, Columbia University Graduate School of Arts and Sciences and Teachers College, New York, NY.


Boston: Allyn & Bacon


https://www.youtube.com/watch?v=PZQiwyNZmHU


Longano, J. M. (2008). *The effects of echoic behavior and a second order classical


technology: Which is better, “self” or “other” as a model? *Behavior Modification*, 25, 140–158.


or other developmental disabilities. Pleasant Hill, CA: Behavior Analysts, Inc.


Appendix A

Picture of the Experimental Settings for probe and intervention settings.
Appendix B

Pictures of the toys utilized during Experiments I and II.