Basic Relational Concept and Verbal Behavior Development in Preschool Children With and Without Autism Spectrum Disorder

Alexis Branca Bancroft

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ABSTRACT

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The current study investigates basic, relational concept development, as measured by the Boehm Test of Basic Concepts 3rd Edition – Preschool Version (BTBC3-P), in 51 preschool aged children (M_{age} = 49.26 months; *SD* = 8.53 months) with and without Autism Spectrum Disorder (ASD) attending the same Comprehensive Application of Behavior Analysis to Schooling (CABAS©) preschool. Relational concepts represent spatial, dimensional, temporal, quantitative, and class relationships between objects or people (i.e., *above* and *behind*). They predict academic achievement in grades two and three and are essential for following directions, making comparisons, sequencing, and classifying—the foundational skills for more complex problem solving (Boehm, 2013; Steinbauer & Heller, 1978). Relational concepts are difficult to learn, represent less tangible and stable relationships, and are often acquired incidentally (Boehm, 2001). Research in Applied Behavior Analysis (ABA) has found that incidental learning generally does not occur until a child masters the *naming* capability (Greer & Longano, 2010). Naming is a phenomenon that involves a circular understanding whereby a child can see a nonverbal term (i.e., a picture or a word), name that term, hear themselves naming the term, and then select the appropriate representation of that term without direct instruction (Horne & Lowe 1996). Naming is the mechanism through which success in traditional classroom settings is possible, such that once a child has attained the naming capability, that child can learn through observation or by asking questions if he/she sees or hears something novel (i.e., "What is pesto?" Greer & Longano, 2010; Greer & Speckman, 2009).

Considering the widespread use of ABA to help children with ASD develop language, this study investigated relational concept acquisition using an ABA (i.e., Verbal Behavior Development Theory [VBDT]) framework. Overall, preschool children with ASD knew significantly fewer total concepts, quantitative concepts, and spatial concepts than their typically developing (TD) counterparts. In addition, the more VBD cusps and capabilities a child attained, the more concepts he/she correctly identified (R^2 VBD= .054 with diagnosis held constant). Further, *regardless* of diagnosis and student progression of VBD, naming was a significant predictor of total concepts known (R^2 naming = .114), as well as of concepts known not covered in the C-PIRK© curriculum (R^2 naming = .099) used at the preschool. The latter finding supports previous studies that identify naming as a prerequisite to incidental learning.

A secondary aim of this dissertation investigated the actions of the examiner required to keep children motivated and on task by creating an Assessor's Tactic Checklist that lists a number of behavioral techniques to build motivation and increase assessment validity. Overall, diagnosis and naming were related to the number of assessor's tactics used, with those children with ASD and children without naming requiring significantly more types of tactics than those without (approximately two more types for ASD and two and a half more types for those without naming).

Implications for future studies include exploring the rate of concept learning pre and post naming acquisition as well as working to uncover the mechanisms through which naming affects concept acquisition. There is also an identified need for continued exploration into the usefulness of an Assessor's Tactic Checklist. Strengths and weaknesses of the study are also addressed.

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Chapter I

INTRODUCTION AND REVIEW OF THE LITERATURE

Introduction

Autism Spectrum Disorder (ASD) is a behaviorally defined neurodevelopmental disorder comprised of a constellation of symptoms including deficits in social communication and the presence of restricted interests and repetitive behaviors. Individuals with ASD are heterogeneous in many respects, yet all evidence qualitative impairments in nonverbal and verbal communication. As such, receptive and expressive language impairments are frequently present in children with ASD (American Psychiatric Association, 2013).

Typical speech and language development involves the process by which a child begins orienting to sounds around seven months of age, the emergence of spoken word understanding between seven to 12 months of age (i.e., “Want more?”), and single words spoken at 12 months of age (American Speech Language Hearing Association [ASHA], 2016). At this early developmental milestone, children can understand many more words and context specific phrases (i.e., “Baby up?”) than they can speak. Shortly thereafter, the understanding of nonverbal communicative signs such as eye-gaze and gesture emerge. In the following months (18-24 months), there is an explosion of expressive and receptive vocabulary development (Tager-Flusberg & Caronna, 2007). In children with ASD, the aforementioned trajectory of language development is largely disrupted, resulting in delayed language comprehension and production. When compared to their same-age peers, children with ASD generally have greater receptive language delays than expressive, in that typically developing (TD) children understand *many* more words than children with ASD (Hurdy et al., 2005; Luyster, Kadlec, Carter & Tager-Flusberg, 2008).

The present study investigates a specific component of receptive language: basic relational concepts. Basic concepts are abstract words indicating spatial, dimensional, temporal, quantitative, and class relationships between objects or people. They are relational in nature and enable children to function academically and socially. Relational concept development is important to a child's academic growth: it significantly predicts academic achievement in grades two and three in the areas of paragraph meaning, spelling, word study skills, language, arithmetic computation, and arithmetic concepts (Steinbauer & Heller, 1978). Basic concepts are also essential for making comparisons, sequencing, and classifying, which are the foundational skills for more complex problem solving later in life (Boehm, 2013). Therefore, it is critical to assess for basic concept acquisition in early childhood, as they are frequently overlooked as a prerequisite for schooling—adults often expect children to know words such as *alike*, *before*, and *after* when they enter a mainstream classroom (Boehm, 1967; Boehm, 2009a).

Relational concepts are difficult for any child to learn to learn because they represent less tangible and stable relationships between an object and its referent (Boehm, 2000). They can be especially difficult for children with disabilities because they represent abstract concepts and unfixed relationships. For example, studies suggest the development of basic concepts in children with learning disabilities is delayed and subject to greater individual differences on concepts dealing with quantity and space (Herschkorn, 2015; Kavale, 1982). Similarly, concept development is significantly delayed in children with intellectual disabilities (Nelson & Cummings, 1984). A more recent study investigated the difficulty of each individual concept included in the BTBC for both an intellectually disabled and a matched (based on raw BTBC scores) typically developing child and found no discernable difference in concept difficulty for children with an intellectual impairment as compared to their TD counterpart, when matched based on total concepts known. Overall, concepts were learned later but generally in the same order as TD children (Facon, Magis, & Courbios, 2012). While basic concept development has been investigated in the learning disabled and intellectually disabled populations, few studies to date have investigated basic concept development in preschool children with and without ASD. Since basic concepts are essential prerequisites to learning and can often require incidental learning it is necessary to understand their development in this growing group of individuals.

As identified in the Applied Behavior Analysis (ABA) community, incidental learning generally does not occur until a child masters the *naming* capability. Naming involves circular understanding whereby a child is able to understand an object across modalities (i.e., a child sees a non-spoken term (i.e., a picture of a dog), name that term (i.e., "dog"), hear themselves naming the term, and then select the appropriate representation of that term (i.e., point to the word *dog*) without direct instruction of each component (Horne & Lowe 1996). Greer and Speckman (2009) and Greer and Longano (2010) have suggested naming to be the mechanism by which success in traditional classroom settings is possible. Once a child achieves naming, that child can learn through observation or by asking questions if he/she sees or hears something novel (i.e., "What is cream cheese?").

Considering the widespread use of ABA to help children with ASD develop spoken and non-spoken language, this study investigates relational concept acquisition using an ABA (i.e., Verbal Behavior Development Theory [VBDT]) framework. More specifically, this dissertation investigates relational concept development in preschool aged children with ASD attending a specialized, ABA school in the suburbs of New York City. These particular schools use the Comprehensive Application of Behavior Analysis to Schooling (CABAS©) model, where instructional curricula are tailored to each student's needs and are comprised of individual learning goals. The CABAS© system uses the Preschool Inventory of Repertoires for Kindergarten (C-PIRK©; Greer, 2014) curriculum, which is designed to include learning goals necessary for success in a mainstream classroom and follows VBDT.

Another aim of this study is to explore a wide array of assessor's tactics that can be used to keep children with ASD engaged and motivated throughout the task (see Appendix C). Spector (1979) identified multiple areas where children with intellectual disabilities could potentially struggle with the BTBC: difficulty focusing on key words, complexity of directions, deficits in spatial perception, lack of understanding of the concept, confusion in terminology, poor memory, difficulty of abstraction, negative concepts, etc. Furthermore, Kogel, Kogel, and Smith (1997) state that testing children with ASD is particularly difficult because of deficits in social interaction and commonly exhibited disruptive behaviors. They tested six children across two conditions: standardized testing and augmented standardization to increase attention and motivation based on prior knowledge of the child. Kogel, Kogel, and Smith (1997) discovered that the standardized administration without augmentation resulted in a significant underestimation of the child's abilities. Therefore, the present study will use an examiner created "Assessor's Tactics Checklist" to identify the requirements of the assessor to keep a child motivated and on task (i.e., by identifying the number of different types of tactics required to keep the child motivated).

Literature Review

Autism Spectrum Disorder (ASD): Definitional Framework

ASD is a behaviorally defined neurodevelopmental disorder of individuals with deficits in socialization, impairments in communication, and the presence of restricted interests and/or repetitive behaviors (American Psychiatric Association [DSM-IV-TR], 2000; American

Psychiatric Association [DSM-5], 2013). Individuals with ASD are a unique group who present with a wide range of behaviors and symptom severity. According to the Center for Disease Control and Prevention (CDC, 2016), children with ASD are a growing group, affecting approximately one in 68 children within the United States.

For the purposes of this dissertation, the term ASD encompasses both children diagnosed under the newly revised criteria in the *Diagnostic and Statistical Manual of Mental Disorders* (i.e., DSM-5) for ASD in addition to the following DSM-IV-TR disorders: autism, Asperger's Disorder, Pervasive Developmental Disorder—Not Otherwise Specified (PDD-NOS). Since many of the children included in this study received diagnoses prior to the release of the DSM-5, both DSM-IV-TR and DSM-5 criteria were used by outside psychologists, psychiatrists, and primary care physicians to identify children with ASD (See Appendix A for a full list of criteria). It is important to note that all children included in this study received outside, verified diagnoses of ASD by a psychologist, psychiatrist, or primary care physician that was confirmed by a student file review. This study does not include children with known genetic disorders associated with pervasive developmental disorders such as Rett's Syndrome or Childhood Disintegrative Disorder.

According to the DSM-IV-TR (2000), the diagnostic criteria for autism included qualitative impairments in social interaction and communication in addition to the presence of restricted and/or repetitive interests and/or behaviors. Both positive and negative symptoms must have been present prior to the child's third birthday. The diagnostic criteria for Asperger's Disorder stated children and adults must have impairments in all three domains (i.e., social, communication, and restricted interests and/or repetitive behaviors) without language delay or cognitive impairment. The diagnostic label, PDD-NOS, was reserved for children who evidenced impairments in the aforementioned domains but who did not meet full criteria for either Asperger's Disorder or autism (See Appendix A for full list of criteria).

In the fairly recent (2013) DSM-5, all Pervasive Developmental Disorder diagnostic labels (i.e., PDD-NOS, Asperger's Syndrome, and autism) have been combined into one diagnostic category entitled Autism Spectrum Disorder (ASD). As part of the new classification system, specifiers distinguish whether ASD is accompanied by an intellectual impairment or language impairment. In addition, the three core features of autism described previously (i.e., social, communication, and restricted interests and/or repetitive behaviors) have been collapsed to two domains (i.e., social communication and restrictive interests and/or repetitive behaviors) due to the challenges associated with parsing out impaired social behaviors from impaired communicative behaviors (See Appendix A for full list DSM-5 of criteria).

The aforementioned criteria can present in a number of ways. For example, a child with ASD may have impairments in his or her play skills (i.e., make-believe and functional play), social imitation, social relatedness, social interactions, eye contact, theory of mind, displays of empathy, and pragmatic language. Some children with ASD engage in echolalia (i.e., repeating language heard either immediately after or after a delay period) and/or use scripted speech (i.e., repeating longer prose heard from television shows or movies). In terms of restricted interests, children with ASD often have interests that are abnormal in content or intensity (i.e., trains, dinosaurs, cotton balls, etc.). Many children with ASD engage in repetitive non-functional play behaviors (i.e., spinning wheels and lining up objects) and exhibit complex motor and hand movements (i.e., hand flapping, finger flicking, and hopping). Other characteristics include rigid adherence to schedules and sensory seeking or avoidance behaviors.

Beyond the core features that define ASD, there are many associated characteristics referenced in academic literature and in popular media. For example, some studies suggest up to 79 percent of children and adults diagnosed with "classic autism" have comorbid intellectual impairments (Edelson, 2006; Volkmar & Klin, 2005) and up to 74 percent have comorbid psychiatric disorders (Mattila et al., 2010). Some of the most prevalent comorbid disorders include behavioral disorders (44%), anxiety disorders (42%), and tic disorders (26%; Mattila et al., 2010). It is important to note that to date, there is no "cure" for ASD, and 75 to 85 percent of individuals maintain their diagnosis throughout adulthood, indicating persistent impairment across the lifespan (Howlin, Goode, Hutton, & Rutter, 2004). Studies examining maintenance of diagnosis suggest expressive language and language comprehension significantly affect outcomes (i.e., needing to live with support, employment, etc.; Lord & Bailey, 2002).

Verbal Behavior Development Theory (VBDT)

ABA has contributed greatly to our understanding of how to first build and then advance skills repertoires in individuals with ASD. As a result, ABA is very successful in promoting the development and improving the prognosis of children with ASD by applying elementary principles of behavior (i.e., classical conditioning, operant conditioning, and stimulus-stimulus pairing) in treatment. ABA therapy is endorsed by The American Academy of Pediatrics, The U.S. Surgeon General, and 32 of 50 states have laws mandating health insurance companies to cover the cost of ABA therapy for children with ASD (U.S. Department of Health and Human Services, 1999).

The Comprehensive Application of Behavior Analysis to Schooling (CABAS©) schools, from which participants were selected, uses a scientific approach to teaching focused on skill development and concurrent Verbal Behavior Development (VBD, as described in Greer &

Keohane, 2006). It is important to note that verbal behavior includes both non-spoken behaviors such as body language, hand gestures, and non-word sounds (i.e., social behavioral exchanges) as well as a language lexicon. Considering the interrelated deficits of language and social reciprocity in children with ASD, the VBD cusps and capabilities identified through the research produced by the CABAS© program allow for systematic instruction on how to use and respond to verbal behavior "within and between" individuals (Choi & Greer, 2013). Unlike other disciplines, who are searching for brain-based, biological, and heritable causes for ASD, behavior analysis remains focused on the ontogenetic factors (i.e., experiences and events) that play a role in a child's development and work towards creating learning experiences to build skill repertories in children with ASD (Petursdottir & Carr, 2011).

The VBDT used in this dissertation is based on the understanding that when children obtain certain developmental cusps and capabilities, they can learn faster and in new ways than before (i.e., students who are reinforced by sounds [phonemic awareness], have conditioned reinforcement for faces and voices, attain the capacity for sameness, naming, etc. can access other learning opportunities). Therefore, VBD begins at the most foundational component of verbal behavior, systematically building a child's ability to engage socially with the world (See Appendix D for VBD Pyramid of Cusps and Capabilities).

The present study aims to discover how basic concept acquisition of preschoolers with ASD resembles that of TD children, and to understand the relation between VBD and basic concept acquisition. More specifically, it will investigate whether certain VBD cusps (i.e., naming) are prerequisites for basic relational concept acquisition, particularly for acquisition of untaught concepts. The following is a description of the VBDT framework used at the CABAS© schools and other schools:

(1) Pre-Listener is the first stage of VBDT in which interdependency and participation in the social community is not possible. Children in this stage of VBD are dependent on others to provide for their needs. Further, they may not respond to other's requests (i.e., have not achieved conditioned reinforcement for faces or voices). In a classroom, a pre-listener is a child who does not respond consistently to a teacher and appears more interested in self-stimulation than engaging with others. The Listener Preverbal Foundational Cusps that may need to be conditioned during this stage of VBD include building conditioned reinforcement of others (i.e., becoming interested in others), increasing visual tracking, mastering a capacity for sameness (i.e., such as matching 2-dimensional and 3-dimensional identical objects, colors, shapes, and common pets), and evidencing basic compliance based on visual contexts (i.e., behavioral control in the presence of teachers or parents without parent or teacher using verbal means of control) and with the teacher or parent as a source of reinforcement (Decasper & Spence, 1987; Deohane, Greer, & Ackerman, 2005b; Keohane, Greer, & Ackerman, 2005a).

(2) Listener Status is the second stage of VBD. During this stage, one can expect an individual to perform a command or instruction expressed verbally. While Listeners still depend on others, many of the physical redirections and prompting required during the Pre-Listener stage can be replaced by simple verbal commands. As part of this stage, children learn to discriminate between words and other sounds that are not words and are able to match words that are presented orally (Chavez-Brown, 2004). The ability to match words and non-words without error (i.e., auditory matching) is considered an important prerequisite for movement to Speaker status.

While typically developing children have an innate capacity to learn language without direct instruction, many children with ASD require systematic instruction to bring them first into the social world and then to distinguish sounds and internalize language. At the CABAS© schools, students are brought to a listener status by working towards achieving the Basic Listener Literacy cusp, which is required for children to understand and learn from spoken instructions (Greer, Chavez-Brown, Nirgudkar, Stolfi, & Rivera-Valdes, 2005). This is accomplished through engaging in a *listener emersion* procedure where intensive instructions in acoustic properties of speech are conducted until the child is able to discriminate sounds (i.e., inducing phonemic awareness). In other words, children continue with listener emersion until they are able to respond to words such as "point to ___," "match ____," "do this," "stand up," "turn around," and *not* respond to non-words such as "blah, blah, blah." Once the components of the listener emersion are attained, children are able to learn four to ten times faster from spoken teacher instruction (Greer & Du, 2015). In the present study, acquisition of listener status was a prerequisite of participation. Only children able to use their listener skills by responding to the direction "point to ____" were selected as participants.

(3) Speaker Status is the third stage of VBD. Children at this stage can request items or actions of another listener and/or speaker (i.e., by stating, "eat now" or "help"). Speakers are, in general, much better at engaging with their community and with other individuals. CABAS© instruction during this stage focuses on the following cusp repertories: parroting (i.e., a child repeating exactly what the teacher says), echoic-to-mand (i.e., if a child wants juice and the teacher first says, "juice" and the child echoes "juice" to request), and echoic-to-tact (i.e., in the presence of a nonverbal stimuli such as a book, the teacher says, "book" and the child repeats, "book"). Comparatives (also known as basic relational concepts) are also taught during this time (i.e., smaller/larger, shorter/longer, fist/last, same/different; big/little; tall/short; full/empty; heavy/light; soft/hard; rough/smooth etc.; Speckman, 2005).

During the speaker stage, children are taught to mand (i.e., a request) and tact (i.e., seeing a book and stating, "book"); however, children are not expected to have obtained the capability of generalizing a mand to a tact. For example, at this stage it is expected a child will be able to mand for 'milk' when he is hungry, but not be able to use the word *milk* as a tact in a separate context. For most children, the two will eventually integrate, allowing a child to generalize a mand to a tact and vice versa (Greer & Keohane, 2006; Lamarre & Hollarn, 1985; Twyman, 1996). Some believe the transformation of establishing operations across mand and tact functions is evidence of a universality of grammar in the human brain. Regardless, this development is considered a verbal cusp, which is defined by Rosales-Ruiz and Baer, as cited in Greer and Keohane (2006) as:

> " a change *[in the capability of the child]* that (1) is often difficult tedious or otherwise problematic to accomplish, yet (2) if not made means little or no further development is possible in its realm (and perhaps in several realms); but (3) once it is made, a significant set of subsequent developments suddenly becomes easy or otherwise highly probable which (4) brings the developing organism into contact with other cusps crucial to further, more complex, or more refined development in a thereby steadily expanding, steadily more interactive realm" (p. 113).

Once this cusp has been achieved, the CABAS© schools engage children in *speaker immersion*, to increase the frequency of spoken emissions.

(4) Speaker-Listener Exchanges with Others is the fourth stage of VBD and involves two components: sequelics and conversational units. Sequelics involves a child responding to questions as a listener-speaker. For example, a child can both listen (i.e., listener component) and respond (i.e., speaker component) to "What?" questions. Conversational units, on the other hand, include a repertoire in which individuals are reinforced as both a speaker and as a listener during a conversational (back and forth) exchange (i.e., a social exchange between people). As noted in Greer and Keohane (2006), while children with ASD can be taught to use conversational units, they are often uninterested in what the speaker has to say, and thus there is no reinforcement for acting as the listener in a conversational exchange. Conversation remains a fundamental component of engaging in society as a social being. As such, the CABAS© schools are successfully teaching children how to engage in social verbal behavior.

(5) Speaker as Own Listener is the fifth stage of VBD. At this stage, an individual has considerable independence, which is largely contingent on the particular individual's sophistication of language. Children at this stage engage in the following behaviors: say-and-do, self-talk, and naming. Being able to say-and-do indicates that individuals have the capability to act in such a way that they are a listener to their own verbal behavior (i.e., "First I should do this, then I'll do that."). Self-Talk is a separate component of the speaker-as-own-listener phenomenon wherein an individual is able to both listen and speak *within* one's self. For example, Lohdi and Greer (1989) observed this phenomenon in TD children while they engaged in self-talk during solitary play. The final component of listener-as-own-speaker is the ability to engage in *naming*. As described by Horne and Lowe (1996), naming is a phenomenon that is often mistaken as a tact (i.e., a verbal utterance in the presence of a non-verbal stimulus). For example, if a child were to see the printed word *car* or a printed picture of a car and then say "car," it would be considered a tact. Naming, on the other hand,

> "Involves the speaker responding as a listener to his or her own speaking. Naming…is a circular relation that includes, for example *seeing* an object (i.e., seeing a picture of a car),

> *saying* (‘car’), *hearing* her own utterance (/car/) and *seeing* or otherwise attending to the object again” (Horne & Lowe, 1996, p.190; see also Greer, & Longano, 2010).

In other words, a child can see a non-spoken term (i.e., a picture or a word), name that term, hear themselves naming the term, and then select the appropriate representation of that term without direct instruction. Greer and Keohane (2006) describe this stage as a prerequisite cusp for incidental learning. Incidental learning, in terms of language acquisition, involves the learning of new words without direct instruction. Incidental learning is akin to accidental learning of language in TD children as they are exposed to language in their homes and in their community (Hart & Risley, 1996). In other words, children without the naming capability require systematic instruction for each part of the cycle of naming (i.e., *car* sounds like /car/; when you see a picture of a car it looks like a *car,* when you see a picture of a car it sounds like /car/) for each new word acquired. Greer and Speckman (2009) and Greer and Longano (2010) identify naming as a primary component of not just incidental learning, but also to success in traditional classroom settings. For example, the lack of direct learning present in most traditional classrooms creates an environment in which children without the naming capability are unable to learn effectively.

Decades of research have been devoted to documenting the importance of attaining the naming capability for children with and without language vulnerabilities (i.e., how to develop naming, the benefits of attaining naming, and the continued vulnerabilities to not attaining naming; See Greer and Longano, 2010 for a more detailed description). For example, different types of naming cusps have been identified. Once such type, naming by exclusion, uses the concept of mutual exclusivity and suggests children with this capability use the assumption that terms within a sentence are mutually exclusive to learn new words as quickly (Greer & Du, 2015b). This type of naming is similar to the cognitive psychology concept of fast mapping. This phenomenon is an associative word learning process whereby children rapidly learn new words with minimal exposure (Carey, 1978). This was first observed in 3 year old preschool students who learned new words by making hypotheses about the meanings of new words. In fast mapping, similar to naming by exclusion, children learn words by contrasting an unknown word with a known word. For example, if a child heard, “Bring me the pomegranate, not the apple,” he/she would be able to obtain information about the novel term “pomegranate” by contrasting it to the more well-known term, “apple” (Carey & Bartlett, 1978). Following the use of fast mapping to establish an initial understanding of a word, slow mapping, is used to elaborate and deepen understanding of a word meaning before it is fully incorporated into a language lexicon (Swingley, 2010).

(**6) Reader Status** is the sixth stage of VBD and is considered to be an advanced speaker-as-own-listener repertoire. For example, a reader must able to both textually respond to a printed stimulus (i.e., read, which is the speaker component) and listen to (or hear) what they are reading (i.e., the listener component) in order to facilitate comprehension. This stage of VBD first involves conditioned reinforcement for looking at books (i.e., children choosing to look at books over toys during free time). Once conditioned reinforcement for books is achieved, children aged two and three can acquire textual responses (i.e., learn to read) more quickly.

(7) Writer Status is the seventh stage of VBD and represents an expansion of the speaker repertoire (i.e., a listener does not need to be present). The purpose of writing, according to VBDT, is to affect the behavior of the reader. To induce writer status, the *writer immersion* procedure is completed. Throughout this procedure, communication is done exclusively in written form for specified periods of the day, and each communication (initiated by the writer) is revised until the reader responds with the desired behavior. In doing so, this procedure evokes writer-as-own-reader self-editing abilities (see below), which allows a person to edit written work to better affect the behavior of the intended recipient. The procedure also results in functionally effective writing (i.e., writing for a desired outcome) and improves the structural components of writing (i.e., grammar, syntax, and spelling).

(8) Writer as Own Reader is the eighth stage of VBD and indicates an increased ability to use perspective taking to read one's own writing from the perspective of the audience and to engage in self-editing to seek desired outcomes. Attainment of the writer-as-own-reader capability leads to increased independence and ability to effectively affect audience behavior.

(9) Verbal Mediation for Solving Problems is the ninth stage of VBD. At this stage, individuals have a more sophisticated ability to solve complex problems under written or spoken verbal stimuli. For example, problems can be solved with precise verbal descriptions, which lead to more verbal behavior (i.e. thinking) that then direct the person to solve the problem. To illustrate, CABAS© teachers who were provided clear descriptions of tactics or who observed teachers receiving accurate descriptions of tactics were better at incorporating tactics in their own instruction (Nuzzolo-Gomez, 2002).

For the purposes of the present study, VBD is described in terms of the aforementioned VBDT stages and was assessed using the VBD Assessment used at all CABAS© schools, which is completed by teachers as each new cusp/capability is achieved by a student (See the Method for a more detailed description of this assessment).

Language Development and ASD

Regardless of a child's level of functioning, *every* child with ASD evidences deficits in aspects of communication and language. These difficulties can be seen early in development and persist throughout the lifespan. TD infants are competent communicators well before they are able to produce language. Typical language development begins with nonverbal understanding of communication. For example, the emergence of joint attention and sharing experiences occurs within the first year of life. Between nine months and 12 months, infants are able to monitor gazes, use social-references, and shift their gaze to observe changes in affect. Word comprehension (receptive language) begins at nine months, which is followed by single words spoken at 12 months of age (expressive language). Around this developmental milestone, children typically understand many more words and context specific phrases than they can speak. From 18-24 months, there is an explosion of expressive and receptive vocabulary development (Bloom & Lahey, 1978; Tager-Flusberg & Caronna, 2007).

Children with ASD, however, often deviate from the expected trajectory of language development (Kjelgaard & Tager-Flusberg 2001). Spoken language deficits are often the first identified behavioral characteristic of ASD, and have been acknowledged as an indicator of prognosis (Rutter, 1970; Venter, Lord, & Schopler, 1992). Using retrospective analysis, studies suggest children with ASD demonstrate early deficits in communication. For example, children with ASD aged nine to 19 months of age showed reduced use of gestures [pointing], early babbling, response to name, and at age 24 months understood fewer phrases than their TD counterparts (Mars, Mauk & Dowrick, 1998; Osterling & Dawson, 1994; Zakian, Malvy, Desombre, Rous & Lenoir, 2000). Similar to retrospective findings, a prospective study of 97 infant siblings of children with ASD showed those children later diagnosed with ASD ($N = 15$) understood fewer phrases (i.e., “Don’t touch,” “Give it to mommy.”), produced fewer gestures (i.e., holding arms up to signify “up,” shaking/nodding head), and engaged less in social routines (i.e., peek-a-boo) than TD siblings. Further, at 18 months, siblings later diagnosed with ASD understood and produced fewer words than those siblings not diagnosed with ASD (Mitchell, et al., 2006).

Receptive and Expressive Language Development in ASD

In terms of receptive and expressive language abilities in children with ASD, studies have primarily focused on identifying differences between the development of these two capacities relative to each other and in comparison with TD children. While a recent meta analysis of over 74 studies investigating the receptive and expressive language profiles of children and youth with ASD suggested no differences between children with ASD's expressive and receptive language skills (other than that they are both 1.5 standard deviations, on average, lower than their same-age TD peers), the literature is unsettled (Kwok, Brown, & Smyth, 2015). Many studies suggest that as compared to their TD same-age peers, children with ASD have greater receptive language delays than expressive language delays, which, "is the converse of that expected in typical development, in which a child's ability to understand vocabulary and syntax is generally far in advance of the ability to formulate spoken utterances reflecting the same competence" (Kover, McDuffie, Hagerman & Abbeduto, 2013, p. 2697).

The discrepancy in receptive and expressive language (i.e., expressive-better-than-receptive) is evident when children with ASD are very young. For example, children at the youngest developmental level (i.e., newly diagnosed two year olds) have syntax profiles suggesting higher expressive communication than auditory comprehension (Volden et al., 2011). In general, typically developing children understand *many* more words than children with ASD (Hurdy et al., 2005; Luyster, Kadlec, Carter & Tager-Flusberg, 2008). While the average toddler can understand 200 or more words and can produce around 45 words, children with ASD display reduced understanding of words until they can produce many more words (57-126 words; see

Charman et al., 2003; Hurdy et al., 2010; Luyster et al., 2008). This also suggests that young children with ASD understand proportionately fewer words than would be expected given their expressive language output (Hurdy et al., 2010).

Kjelgaard and Tager-Flusberg (2001) investigated language profiles in 89 children with ASD between the ages of four and 14. The children were administered the *Goldman-Fristoe Test of Articulation* (Goldman & Fristoe, 1986), *Peabody Picture Vocabulary Test-III* (PPVT; Dunn & Dunn, 1997), *Expressive Vocabulary Test* (EVT; Williams, 1997), the *Clinical Evaluation of Language Fundamentals* (CELF; Wiig, Secord, & Semel, 1992), and the Repetition of Nonsense Words subtest from the *NEPSY* (Korkman, Kirk, & Kemp, 1998). In terms of receptive and expressive language, 80% of children had a receptive or expressive vocabulary difference less than one standard deviation. However, when a smaller subgroup of children was considered (i.e., those who were able to complete the longer measure of receptive and expressive language [CELF]), the language profile was consistent with previous studies suggesting expressive abilities as higher than receptive abilities. Among receptive subtests in the CELF (with subtest $M = 10$ and $SD = 3$), Basic Concepts had a mean of 5.60 ($SD = 3.21$), Linguistic Concepts had a mean of 4.08 ($SD = 2.58$) and Sentence Structure had a mean of 4.56 (SD = 2.40). Overall, preschoolers with ASD in this sample had language scores approximately 1.5 standard deviations below the mean.

Interestingly, this trajectory of language development appears to be unique to children with ASD. When compared to children with specific language impairment, who evidence less impairment in receptive language as compared to expressive language, children with ASD evidence more impairment in receptive language as compared to expressive language (Loucas, et al., 2008).

Basic Relational Concepts

Definitional Framework

Early on, Dr. Ann Boehm recognized the importance of a specific type of receptive language, basic relational concepts, used frequently in classroom directions and in early childhood curricula. To assess children's knowledge of these concepts, she created the Boehm Test of Basic Concepts (BTBC; Boehm, 1971) for use with children in kindergarten through second grade. This dissertation continues her work by investigating basic relational concept development in preschool children with ASD.

Basic concepts are abstract words indicating spatial, dimensional, temporal, quantitative, and class relationships between objects or people (see Appendix B). They are relational in nature and enable children to function academically and socially. When individuals are in their early childhood years, knowledge of basic concepts becomes an important foundation for reasoning, problem solving, and critical thinking skills (Flavell, 1970). For example, according to Boehm (2001b), basic concepts are components of more complex thinking tasks such as classification, conservation, and perspective taking. Knowledge of relational concepts also predicts academic performance, intelligence, and influences a child's ability to follow directions and relate to his/her peers (see sections that follow for detailed study descriptions). As such, basic concepts are considered the "building blocks" for thinking, and young children use them to explain events, organize experiences, and to describe objects across contexts.

In a study of middle class children in the United States and China, basic concepts were generally learned by age five or six (Zhou & Boehm, 2001; Zhou & Boehm, 2004). However, many children, especially those from lower socioeconomic levels and those who had lower intelligence, struggled to pick up on and understand relational concepts (Boehm, 1971).

Relational words are more complex and difficult to acquire than other types of words (i.e., nouns; Halberda, 2003) because they are not often explicitly taught and require the cognitive ability to understand unfixed relationships (Johnston & Slobin, 1979). For example, the use of these concepts can shift depending on the situation (i.e., there is no constant referent). If one considers a group of five ducks among three other groups of ducks, the group could be both the group of ducks with the *most* ducks (i.e., if both of the other groups had fewer than five ducks) or be the group with the *fewest* ducks (i.e., if the other groups had more than five ducks). In addition, some concepts require the combination of concepts in order to compare or classify (Boehm, 2009a). For example, the concept *some but not all* is difficult because a child first needs to understand the concepts *some* and *all* and then use those concepts comparatively to determine which picture had *some but not all* items. Basic concepts can also be difficult to acquire because they are applied across time, space, and quantity. Therefore, a child's understanding in one context may not translate to a different context. Further, basic concepts are used across sensory modalities. For example, both a position in space as well as a sound could be characterized as being *high* or *low*. Basic concepts also represent positions that are reversible. Consider a ball that is placed on *top* of a box of toys. This ball can also be at the *bottom* of a different pile—the ball is separate from its position in space. For all of these reasons, basic concepts are challenging for children to learn and use, yet represent concepts imperative for later academic and social success. See Appendix B for Table B1 describing difficulty level of concepts by age.

The Importance of Basic Concept Development: Academic Achievement

Preschool is a critical and sensitive time in a child's life. Scores of studies have demonstrated the effectiveness of high quality preschool education on outcomes later in life. For example, Dearing, McCartney, and Taylor (2009) found that higher quality childcare during early childhood moderates the relation between family economic status and children's achievement during middle childhood. Put more simply, the higher the quality of childcare, the more ready the child is to learn when they enter school (i.e., better school readiness skills), which leads to better achievement through middle childhood and beyond. The benefits of early childhood education underscore the importance of high quality instruction of basic relational concepts during preschool. Research has shown that when preschool and young elementary aged children receive instruction in basic relational concepts, they demonstrate gains not only in their understanding of basic concepts, but also on standardized achievement tests (Armour-Thomas, 1984).

The importance of basic concepts in predicting school achievement was first investigated by Estes, Harris and Moers (1976). In this study, 278 first graders were administered the BTBC to determine their understanding of basic concepts at the onset of first grade. Then, in May of that year, the same students were administered the Primary I Battery of the *Stanford Achievement Test*, a standardized measure of academic achievement (Madden, Gardner, Rudman, Karlson, & Merwin, 1973). The authors found a significant, positive relation between knowledge of basic concepts in September and academic achievement in May. Steinbauer and Heller (1978) extended these results by investigating BTBC as a predictor of academic achievement in grades two and three. Steinbauer and Heller tested 43 second and 51 third graders who had previously taken the BTBC in kindergarten. Their achievement was also assessed using the *Stanford Achievement Test*. Knowledge of basic concepts in kindergarten predicted later academic success. Specifically, the BTBC predicted achievement in paragraph meaning, spelling, word study skills, language, arithmetic computation, and arithmetic concepts in both second and third grade.

Piersel and McAndrews (1982) also investigated the relation between relational concept knowledge and achievement, namely knowledge of colors, shapes, numbers, letter recognition, and counting skills. One hundred twenty three students about to enter kindergarten were administered the BTBC as part of a school district's screening process. In terms of concurrent validity, the BTBC was positively related to knowledge of basic shapes, knowledge of colors, counting skills, number recognition, and letter recognition. In terms of predictive validity, the BTBC predicted achievement outcomes at the end of first grade, as measured by a standardized achievement test.

Not only does knowledge of basic concepts predict later achievement, they are embedded within the learning goals of the new Common Core State Standards initiative. Bracken and Crawford (2010) systematically reviewed basic concept inclusion in state educational standards for all 50 states in pre-kindergarten, kindergarten, and first grade. This review searched for concepts aligning with the Bracken Concept Development Program, which was created using the work of Dr. Boehm, and contains an expanded concept list (Bracken, 1987). Overall, Bracken and Crawford (2010) identified over 300 concepts among the curricula reviewed. The extent to which the concepts were included in core state standards is described below:

Colors are included as part of a necessary knowledge set and include student knowledge of primary, secondary, and tertiary colors. Recognition of letters and naming ability are included, starting with uppercase letters and ending with lowercase letters, respectively. In terms of numbers and counting, state standards included concepts of quantity (i.e., more/less, whole/part, full/empty, some/many, pair, etc.). Learning goals related to knowledge of sizes and comparisons included graduated knowledge of concepts related to gross, three-dimensional size (i.e., big/small) then concepts related to two-dimensional size (i.e., tall/long).

Overall, according to Bracken and Crawford (2010), the state standards focus broadly on a student's ability to discern differences in their environment related to relative size (i.e., *same*, *equal*, *different*). In terms of understanding directions and positions, Bracken and Crawford (2010) state the normal progression within the state standards generally involves understanding positions first from one's own perspective and then later from another's perspective (i.e., my right is Sally's left). State standards also reportedly include relational concepts such as: *top/bottom*, *near/far*, *above/below*, *next to*, *under/over*, *inside/outside*, *between*, *together*, and many others. Knowledge of shapes, texture, self and social awareness, are also included.

The Importance of Basic Concept Development: Following Directions

Beyond basic concepts' importance in school achievement, basic relational concepts are a prerequisite for understanding directions (Kaplan & White, 1980). At home, parents often use relational concepts to a) tell a child the task that needs to be completed and b) how it should be executed (i.e., "Clean up your toys, please. Put your shoes *in* the bin and your books *on* the shelf."). Likewise, teachers use basic concepts in their directions within the classroom, making them essential for student learning—without understanding the directions, the child cannot follow along with the class. According to Boehm (1990) as cited in Zhou and Boehm (2004),

> "Children's ability to follow directions represented in different problem types depends on the development of thinking skills, such as making intermediate-position comparisons (e.g., "Find the ball that is *bigger* than one but not the *biggest*"), making comparisons to a standard (e.g., "Find the basket with *more* apples than *the first* basket"), ordering, and following multistep directions."

In addition to classroom directions, intelligence test directions include many "difficult" basic concepts (Boehm, 1991). For example, when a psychologist follows standardized administration, the assessor is acting under the assumption that the child being assessed understands all of the words in the directions, including the basic concepts embedded within them. When this assumption is violated, the results of the intelligence test are no longer valid and the assessment becomes a test of basic relational concept knowledge, rather than a test of intelligence.

Kaufman (1975) investigated the degree to which four popular individually administered standardized measures use basic concepts in their directions (i.e., *Illinois Test of Psycholinguistic Abilities* [ITPA; Eshbaugh, 1971], *McCarthy Scales of Children's Abilities* [McCarthy; McCarthy, 1972], *Stanford-Binet Intelligence Scale* [Stanford Binet; Terman & Merrill, 1960], and the *Wechsler Preschool and Primary Scale of Intelligence* [WPPSI; Wechsler, 1967]). Overall, the WPPSI assumed the most basic concept knowledge (14 concepts: *after*, *alike*, *different*, *farther*, *half*, *in order*, *inside*, *middle*, *next*, *other*, *row*, *side*, *skipping*, and *top*) followed by the McCarthy (7 concepts: *after*, *alike*, *away*, *different*, *other*, *over* and *whole*), the Stanford-Binet (5 concepts: *alike*, *around*, *difference*, *other*, *whole*), and lastly, the ITPA, which assumed no concept knowledge.

While standardized measures of academic achievement and intelligence change with each new edition, over 25 years after Kaufman's article, popular standardized measures *still* contain a large number of basic concepts. For example, a study conducted by Flanagan, Alfonso, Kaminer, and Rader (1995) investigated standardized intelligence tests for preschoolers (aged 3-5), specifically looking at not only the amount of basic concepts contained within the measures, but also the frequency with which each basic concept was used. Overall, the *Wechsler Preschool and Primary Scale of Intelligence – Revised* (WPPSI-R; Wechsler, 1989) contained ten concepts (i.e., *another*, *up*, *missing*, *finished*, *all*, *middle*, *both*, *after*, *together*, *before*), the *Bayley Scales of*

Infant Development—Second Edition (BSID-II; Bayley, 1993) contained nine concepts (i.e., *another*, *up*, *across*, *down*, *many*, *all*, *both*, *after*, *together*), the *Differential Ability Scales* (DAS; Elliot, 1990) contained seven concepts (i.e., *another*, *down*, *finished*, *all*, *both*, *under*, *together*), *The Stanford Binet: Fourth Edition* (SB:FE; Thorndike et al., 1986) contained five concepts (i.e., *another*, *up*, *finished*, *all*, *together*), and the *Woodcock Johnson Psycho-Educational Battery—Revised: Tests of Cognitive Ability* (WJ-R COG; Woodcock & Johnson, 1989) contained two concepts (i.e., *another* and *after*). Flanagan and colleagues also suggested that the number of times each concept, especially the more difficult concepts (as identified by norming samples), contributed to the complexity of directions and reduced the validity of assessment results. These studies highlight the importance of assessing knowledge of basic concepts *before* administering individually administered norm-referenced tests of cognitive and academic functioning. Without first knowing what concepts a child understands, it is nearly impossible to distinguish concept misunderstanding from true cognitive or academic impairment. Further, when the normative procedures are followed, it may result in an unreliable estimate of that particular child's functioning (Kaufman, 1975).

Basic Concept Development in Non-Typical Samples: Learning Disabilities

Kavale (1982) investigated basic concept development in learning disabled children as compared to their TD peers using the BTBC. Participants included 25 first graders (19 boys, 6 girls) who were identified as having a learning disability and 25 (15 boys, 10 girls) first graders without a learning disability. After comparing the two groups, the learning disabled group evidenced lower total mean scores and larger standard deviations. More specifically, on the total score, the comparison group was in the 85^{th} percentile and the learning disabled group was in the 5^{th} percentile in overall concept knowledge, indicating that children with learning disabilities knew fewer concepts. Not only was there a significant difference between groups on overall concepts learned, there were significant differences across concept categories of quantitative, space, and miscellaneous. Interestingly, there were no differences noted for time concepts, likely due to the limited number of concepts included within this category (i.e., there were only four concepts total). Wider standard deviations were also evident within the learning disabled group, reaching an average of 2.8 times the variability in the comparison group. Overall, the results of this study showed that first graders labeled as having a learning disability have deficits in their understanding of basic concepts, as measured by the BTBC, which may hinder their ability to succeed within a classroom, above and beyond having a learning disability. Kavale (1982) also observed learning disabled students to have more attentional difficulties than their peers, especially toward the end of the test. The authors suggested considering attentional levels when interpreting the BTBC. Further, when compared to their non-learning disabled peers, learning disabled first graders evidenced difficulty in their ability to change their response set. For example, when asked to mark to two objects that are *alike* and when they were asked to mark two objects that have *equal* numbers, 80% of the first graders with a learning disability failed to mark both correct pictures whereas only 40% of the comparison peers failed to mark both.

Basic Concept Development in Non-Typical Samples: Intellectual Impairments

Spector (1979) generated possible underlying reasons why children with cognitive deficits perform more poorly than their non-impaired counterparts on the BTBC. Her list included an inability to focus on key words within the directions, deficits in spatial perception, complexity of directions, lack of knowledge of the concept label, confusion in terminology, level of abstraction, poor auditory memory for sentences, and social considerations.

Nelson and Cummings (1981) empirically explored basic concept development in educable mentally handicapped (EMH) children. In this particular study, 45 EMH children (i.e., IQ scores ranging from 49 to 71), with mean ages ranging from ages 7 years 0 months (7:0) to 10:7. All children were administered the school aged version of the BTBC in groups of seven. The results break down the acquisition of basic concepts by identifying which concepts were missed most frequently by this group of children. For example, the concepts *in order*, *least*, *pair*, and *third* were missed by 75 to 100 percent of the EMH subjects whereas *equal, forward, left,* and *medium sized* were missed by 50 to 74 percent, and *above, almost, always, as many, beginning, between, center, corner, different, matches, middle, not first or last, other, right, now, separated,* and *whole* were only missed by 35 to 49 percent. The authors noted a developmental trend in concept acquisition, such that the younger participants missed significantly more concepts than the older participants. There was no discussion regarding the difficulty level of concepts attained by EMH children as compared to the typically developing students. Nelson and Cummings (1981) suggest that while children with intellectual disabilities learn basic concepts at a slower rate, the fact that they can be taught these concepts, as evidenced by the trajectory of concepts missed by age, is promising.

Nelson and Cummings (1984) replicated their findings with students from a different geographic region of the United States. Their sample consisted of 52 students who were considered EMH and had a mean IQ of 68. Of the 50 BTBC Concepts administered, 21 of the concepts were missed by at least one participant. Specifically, the concepts *equal, least, medium-sized, pair, second,* and *third* were missed by over 50 percent of the sample whereas *after, always, beginning, center, forward, half, in order, left, not first or last, other, right, separated, skip, some not many,* and *whole* were missed by more than 25 percent of the sample. As compared to Nelson and Cummings (1981), 81 percent of the concepts missed by the EMH children overlapped, replicating the pattern of acquisition difficulty among EMH children.

A more recent study conducted by Facon, Magis and Courbois (2012) investigated the difficulty of relational concept acquisition among participants with Down syndrome, a genetic disorder commonly co-occurring with intellectual impairment, as compared to children with intellectual disabilities (ID) without Down syndrome, and as compared to their typically developing peers. In this study, both the Preschool and School Aged French-language versions of the Boehm Test of Basic Concepts Third Edition (BTBC3; Boehm, 2009) were administered. The three groups of children, comprised of 47 participants each, were individually administered a 72-item test that included all items from the preschool and school age versions of the BTBC3. The three groups were matched on their BTBC3 raw score and were comprised of individuals from regular education kindergarten classrooms (TD students mean age approximately 5 years old), individuals with ID of undifferentiated etiology (mean age approximately 15 years old), and individuals with Down syndrome recruited from special education schools for children with ID (mean age approximately 16 years old). While the ages across groups were significantly different, the difference in intellectual ability across groups was non-significant (i.e., defined by raw scores on the *Raven's Matrices Test*; Raven & Court, 1998), indicating language development (as they were matched groups based on BTBC3 raw scores) was commensurate with intellectual ability. The authors found that the difficulty level of almost all items were similar across groups, regardless of their intellectual disability status. It is important to note that this finding suggests that when BTBC3 raw score is held constant, the difficulty level and degree of mastery of basic concepts remains consistent, regardless of intelligence.

While this study uses rigorous methods to investigate basic concept acquisition, the authors used a merged version of the BTBC-3 and BTBC-P and did not discuss issues of fatigue or attention related to administering a 72 item test to an individual with an intellectual disability (i.e., the authors did not state whether they administered the preschool version with the easel or paper and pencil).

Basic Concept Development in Non-Typical Samples: ASD

Few studies have investigated the acquisition of basic relational concepts within the ASD population. A recent study by Ayfer Yıldırım (2015) explored the relation between mean length utterances (MLU; i.e., mean length of natural utterances over a 30 minute observational period) in Turkish children (aged 36-72 months) with ASD and basic concept knowledge. In this study, as MLU increased, knowledge of relational concepts, as measured by the BTBC3-P increased. The most challenging concepts for children with ASD to learn were *some but not all*, *between*, *before*, and *around*. Yıldırım (2015) also discussed possible explanatory factors for reduced relational concept knowledge in preschool children with ASD to be reduced cognitive flexibility, greater expressive than receptive language, and greater attention to parts of objects rather than their coherent whole; however, he only tested expressive language empirically.

In addition to the aforementioned study, a recent dissertation compared basic relational concept development in first and second grade students with ASD to their TD counterparts (Herschkorn, 2015). Herschkorn recruited 57 first (M_{age} = 6 years 8 months, *SD* = 3.94 months) and second (M_{age} = 7 years 7 months, *SD* = 2.96) grade children (ASD *n* = 23 and TD *n* = 34) from seven schools in the New York City (NYC) area. TD students were recruited from two NYC public schools and one public school in Westchester County (a suburb of NYC). The ASD group was comprised of high-functioning students with ASD (defined as having an IQ > 70 according to Department of Education psycho-educational assessments) recruited from two private schools in Manhattan, a public school in Westchester County, and four NYC public schools with an "ASD Nest" Program (i.e., a specialized NYC Department of Education program based on the integrated co-teaching model of instruction in which students with ASD are immersed in a general education classroom with supports from a special education teacher).

Herschkorn (2015) modified the standardized administration of the BTBC3 after observing that children with ASD had difficulty attending to items appropriately. In doing so, she re-formatted the response booklet so that only one item was displayed on a page at a time. Herschkorn also instructed each student *point to* rather than *circle* their responses. Herschkorn (2015) found that the ASD and TD group differed in the number of items answered correctly on the BTBC3, with the TD performing significantly better than the ASD group. A larger standard deviation for the ASD group indicated more variation in responding, which is consistent with previous studies of basic concept acquisition in non-typical samples.

There were ten concepts (20%) mastered by all ASD children (i.e., *top*, *whole*, *always*, *end*, *through*, *above*, *first*, *next*, *below*, and *bottom*), and 31 concepts mastered by all TD children (62%). Interestingly, all but one concept mastered by the children in the ASD group were also mastered by all TD children (i.e., *bottom*). In regard to specific relational concept clusters (i.e., spatial, quantitative, and temporal concepts), children with ASD answered significantly less spatial and quantitative concepts than TD children, but did not differ in their answering of temporal concepts. It is of note that Herschkorn (2015) did not control for overall knowledge of concepts in her analysis of specific concept clusters. Analysis of error patterns suggested the majority of incorrect responses were random errors. The NT tended to engage in more antonym errors (i.e., pointing to *top* when the concept is *bottom*), whereas the ASD group tended to choose more than one answer for the target item.

A separate dissertation by Parish-Morris (2011), studied the mechanisms underlying children with ASD's difficulty acquiring relational words. Parish-Morris (2011) tested the Central Coherence Theory, in which children with ASD are thought to have a stronger ability to focus on details and parts of objects rather than their coherent whole (Frith, 1989; Frith & Happe, 1994). Studied empirically by Parish-Morris (2001), children with ASD, as compared to TD peers, focused more on *manners* of movement when presented on a screen (i.e., a starfish twisting or flapping) rather than the *path* of movement of an object (i.e., an object's movement in relation to another object), which may impact a child's ability to understand relational terms. Parish-Morris recruited 17 children with ASD, aged three to six years, and 17 mental age matched controls (matched on nonverbal cognitive ability). Participants were shown videos of a starfish performing a *path* (i.e., an object moving in relation to another object [*over* or *under*]) and a *manner* movement (i.e., *twist*) to determine preference. Parish-Morrish (2011) found that those children who were able to discriminate *path* movements had significantly higher relational word knowledge (i.e., as measured by the *Test of Relational Concepts*; Edmonston & Litchfield Thane, 1988).

In addition, Parish-Morris (2011) found that social skills aided the mapping of words to concepts. Children who were better at reading social cues (as measured by social intention) had more relational words in their lexicon, than children who struggled to read social cues. Understanding of social intensions was also related to reciprocal social interaction and communications scores on the *Autism Diagnostic Observation Schedule* (Lord, Rutter, DiLavore & Risi, 2002), suggesting interrelatedness between reciprocal social interaction, perspective taking/theory of mind, understanding of relational concepts, and verbal/nonverbal communication, which is why the present study seeks to understand relational concept development within a VBDT framework (i.e., VBDT teaches social verbal behavior and brings children with ASD into the social world). The current study will also use the understanding of the Central Coherence Theory (i.e., a child's tendency to attend to parts of objects versus its coherent whole) as a potential factor impacting specific cluster (i.e., temporal and quantitative) concept acquisition in preschoolers.

Assessor's Tactics and Child Motivation

Children with developmental disabilities are generally difficult to motivate, especially when they are participating in assessment activities (Park, Pereira, Delgado, Choi & Greer, 2008). Kjelgaard and Tager-Flusberg (2001) discuss the challenge of testing children with ASD, specifically citing behavioral problems (i.e., echoing the examiner, perseverating across stimulus items) and attention problems as vulnerability factors. A separate study by Tager-Flusberg and Coronna (2007) suggested their results were impacted by the co-occurring deficits in social responsiveness (i.e., responding to the examiner's requests). Since children with ASD have a complex presentation, it is difficult to determine whether their abilities, as measured by a standardized test, are fully captured when test items are presented in a standardized manner. Despite the questioned validity of standardized assessment in this population, assessment is recommended for all children with suspected disabilities, and is used as a way to identify disabilities, create a plan of instruction/intervention, and document treatment progress. Throughout the literature, there has been acknowledgement of potential misinterpretation of data obtained through standardized assessment of children with ASD, but little has been done to formally adapt standardized assessment procedures. The Applied Behavior Analysis (ABA) literature, however, has been studying motivation since its infancy (Keller & Schoenfeld, 1950; Skinner, 1938). Within this field, Establishing Operations (EO) are a common consideration when engaging in assessment or instruction. EOs are:

> "an environmental event, operation, or stimulus condition that affects an organism by momentarily altering (a) the reinforcing effectiveness of other events and (b) the frequency of occurrence of that part of the organism's repertoire relevant to those events as consequences" (p. 192 Michael, 1993).

An EO momentarily increases the effectiveness of a reinforcer (i.e., something obtained/provided that increases the probability of a behavior occurring again) *and* momentarily increases the frequency of behavior emitted for the reinforcer. For example, if a child is deprived of their favorite food for a short period of time, when they encounter the food, it will increase both its effectiveness as a reinforcer (i.e., the food) and the behaviors the child will emit to get that food. In another example, Park and colleagues (2008) found that pre-instructional play influenced the number of questions answered correctly during instruction. Play was an EO that increased motivation to engage in instruction and resulted in more questions answered correctly than when play was not introduced as an EO.

Other tactics commonly used by members of the ABA community to motivate children with ASD during assessment include schedules of reinforcement (i.e., giving access to a desired activity after a specific number of items or an unfixed number of items), visual schedules (i.e., answer 5 items then break visually represented), contingent reinforcement (i.e., first ______ then ______), forced choice (i.e., *this* or *that*), spoken labeled praise (i.e., nice job sitting in your chair, nice looking, thanks for answering in a loud voice), non-spoken social reinforcement (i.e., smile, head nod), token economy, and access to preferred edibles/ activities after completing a specific number of items.

Kogel, Kogel, and Smith (1997) investigated the impact of motivation increasing modifications in standardized procedures for six school-aged children with ASD. The first condition (i.e., the standardized condition) involved administering tests as indicated in the manuals by professionals familiar with testing procedures. For example, testing materials were placed on a small table and two chairs were placed on either side. Children were asked to sit at the table and were prompted to respond to the examiner's instructions. The authors note that verbal praise and some treats were given for appropriate sitting and test-taking behavior. In the second condition (i.e., the motivation/attention condition), each child's parents were interviewed to identify behaviors likely to interfere with testing prior to testing, and the testing sessions were modified accordingly for each child's potentially test interfering behavior (i.e., as identified during parent interviews). For example, some of the identified problem behaviors included: incessant talking in cartoon character voice, failure to orient to stimuli, screaming when asked to sit at a table, perseverative stereotypic self-talking, etc. After identifying each of the potential problem behaviors, the authors used behavioral techniques such as providing predictable breaks for "cartoon character talking" contingent upon on-task responding to test stimuli, administering the test in the presence of child's parent, etc. The results indicated higher scores in the attention/ motivation condition as compared to the standardized condition, showing reduced validity of results when assessing children with ASD in a standardized manner.

Interestingly, a recent dissertation examined the effects of token reinforcement and verbal praise as compared to a control condition on TD six and seven year-olds' performance on a task of nonverbal intelligence (Cimini, 2015). Generally inconsistent with a large literature stating positive effects of praise and token reinforcement on task performance, Cimini (2015) found no difference in nonverbal intelligence test scores across conditions.

Herschkorn (2015) assessed frequencies of behavior during task performance in the assessment of basic concepts among school-aged children with and without ASD. The most common behaviors observed in the ASD group were hyperactivity and fixation on objects in the immediate environment unrelated to the task. Other behaviors reportedly observed included distractibility, repetitive speech, motor movements, and vocalizations (defined as echoing the examiner or delayed instances of echolalia). Herschkorn (2015) reported that the number of off task behaviors exhibited was negatively correlated with BTBC3 total scores. Yıldırım (2015) also acknowledged participant behaviors that made the assessment of concept knowledge difficult such as: test refusal, engagement in off-task behavior, and resisting communication. As such, the present study investigates the number and type of appropriate modifications to the standardized administration of the BTBC3-P needed to engage participants in taking the BTBC-P. Assessors were required to use an author generated Assessor's Tactic Checklist that includes numerous behavioral techniques to help motivate, redirect, and refocus students and to record the different tactics used to keep a child on task and focused with the larger goal of improving assessment validity in this population.

Summary and Study Rationale

Language impairment is a core feature of ASD. All children with ASD evidence impaired communicative ability, and many children present with a concurrent behavioral presentation that benefits from systematic instruction and structured learning experiences to build skill repertoires from a very basic level (i.e., orienting to sounds) to a more complex level (i.e., conversation; Petursdottir & Carr, 2011). Given this population's explicit impairment in language functioning, the current study investigates a specific component of language understanding called basic relational concepts. Basic concepts are abstract words that indicate spatial, dimensional, temporal, and quantitative relationships between objects or people. In general, basic relational concepts are difficult for children to acquire because they are often not explicitly taught and they require the cognitive underpinnings to understand unfixed relationships. Basic relational concepts are considered the "building blocks" for thinking, as young children use these concepts to explain events, organize experiences, and to describe objects (Boehm, 1990 as cited in Zhou & Boehm, 2001; Boehm, 2009a). Knowledge of these concepts is a prerequisite for understanding directions across contexts and is a strong predictor of later academic performance (Estes, Harris, & Moers, 1976; Piersel &McAndrews, 1982).

It is likely that preschool children with ASD, like their school-aged disabled (i.e., EMH [educable mentally handicapped] and learning disabled) counterparts, will have reduced understanding of relational concepts, as compared to same age TD children (Kavale, 1982; Nelson & Cummings, 1981; Nelson & Cummings, 1984). Children with ASD have difficulty thinking abstractly and flexibly, and according to the Central Coherence Theory, are more apt to attend to parts of images as opposed to their coherent whole. These factors may further compound a child with ASD's ability to understand and identify an object in quantitative, spatial, and temporal relation to another object. While the literature has demonstrated basic concepts' importance in the academic and social success of young typically developing children, few studies have investigated acquisition of basic concepts in preschoolers with ASD, a growing group of children with developmental disabilities. One study (a recent dissertation) investigated basic relational concept acquisition in high functioning (i.e., IQs > 70) school-aged students with

ASD and their TD same-aged peers (Herschkorn, 2015). This dissertation will extend Herschkorn (2015)'s study by creating a downward extension in both age and functioning level.

The present study will compare concept acquisition of preschool children with ASD to that acquired by their TD peers attending the same ABA school. This will be done first by comparing overall concept development. Then, the present study will investigate whether, as informed by the Central Coherence Theory, there will be differences in ASD and TD children in the acquisition of different types of concepts (i.e., spatial and quantitative), after controlling for total concept knowledge.

The current study will also investigate concept acquisition though the lens of VBDT by identifying the prerequisite verbal behavior necessary for basic concept acquisition (i.e., verbal behavior cusps and capabilities). This dissertation will investigate whether a child's progression on the VBD Assessment (i.e., the proportion of cusps/capabilities learned) predicts relational concept knowledge. In addition to discerning whether progression of VBD predicts overall concept knowledge, this dissertation will add to the literature on the importance of the naming capability by testing the hypothesis that that children with naming, *regardless* of their diagnostic status, will know more relational concepts than those without the naming capability, and will know more concepts that are not in the curriculum taught in the ABA school that they attend (i.e., they will have learned concepts independently of the formal curriculum, possibly through observation/incidental learning). Since naming is required for a child to understand that, for example, a spoken word "ball" is the same as the written word "ball" which is also the same thing as the physical "ball" as well as the picture of a "ball," it would make sense that a child must first obtain the understanding of the noun "ball" across contexts before the child is able to identify the ball *on* the table. Without naming, preschool students require multiple exemplar instruction to learn relational concepts. In addition, based on the findings Parish-Morris (2011), where understanding of social intensions and reciprocal communication were found to be related to relational word understanding, it is likely that preschoolers who have attained speaker-as-own-listener status (i.e., naming) will understand more relational concepts. VBDT teaches individuals to join the social world and to be reinforced by social exchanges, which aids in relational concept understanding.

In addition to child acquisition, the literature indicates a need to understand what is required of the assessor to ensure valid assessment of knowledge within the ASD population. As such, an additional aim of this study is to investigate the usefulness of a possible addendum to the administration BTBC3-P: an author generated Assessor's Tactic Checklist that includes numerous behavioral techniques to keep children on task without compromising the standardized administration, as outlined in the Administration Manual (Boehm, 2001b). Unlike Herschkorn's (2015) focus on the recording of disruptive behavior a child engages in, the current study focuses on what the examiner can do to maintain participant focus. It is expected that children with ASD and lower functioning children in terms of their VBD, regardless of diagnostic status, will require more types of Assessor's Tactics to keep them focused and on task. In addition, it is expected that children with the naming capability will require less tactic types, regardless of VBD and diagnostic status.

Hypotheses

Based on a review of the literature the following hypotheses are proposed:

H1. a) Preschool children with ASD will correctly identify significantly fewer basic relational concepts than TD children attending the same ABA preschool, holding demographic variables (i.e., age and SES) constant and b) the standard deviation of the ASD group will be greater than that of TD peers attending the same ABA preschool

There is a robust literature suggesting children with ASD have significant impairments in receptive language development as well as a tendency to focus on parts of images rather than their coherent whole (i.e., Central Coherence Theory) that may affect their ability to acquire basic relational concepts. For example, school-age children with disabilities (i.e., intellectual disabilities and learning disabilities), as well as school-age children with ASD, evidence reduced acquisition of basic relational concepts and greater variability in terms of the amount of basic relational concepts known. While few studies have explored basic concept acquisition in a preschool sample, it is expected that preschoolers with ASD will also have reduced mastery of relational concepts. Demographic variables identified in the literature as influencing typically developing children's concept acquisition, SES and age, will be considered. First, correlations between BTBC total score and demographic variables will be assessed. Any significantly related demographic variables will be added to the regression model as controls. Subsequently, Hypothesis 1a will be analyzed using a regression analysis with any correlated demographic variables and diagnosis (TD/ASD) as predictors of overall concepts known. Hypothesis 1b will be analyzed by using the Levine's Test of Homogeneity and qualitatively by reviewing histogram plots depicting score distribution within each diagnostic group (TD/ASD).

H2. Proportion of VBD cusps and capabilities attained will predict proportion of basic concepts known, controlling for diagnosis and any demographic variables that are significantly related to concept knowledge, in that the more advanced a child is in terms of his/her VBD, the more concepts that child will know.

After learning whether preschool children with ASD exhibit more difficulty mastering basic relational concepts than their TD counterparts, the current study will determine whether this difficulty is related specifically to a child's VBD as measured by the VBD Assessment (i.e., the more cusps and capabilities attained the greater knowledge of relational concepts). Hypothesis 2 will be analyzed by regression analysis where by proportion of VBD cusps and capabilities attained (see Method section for detailed description of VBD variable) will be added to any significant variables remaining in the regression model used in Hypothesis 1 (i.e., diagnosis and demographic variables as predictors of proportion of overall concepts known). It is anticipated that children who have attained more VBD cusps and capabilities, will know more overall concepts, regardless of diagnosis.

H3. Naming is a VBD capability that is prerequisite to incidental learning. Therefore, students who have achieved naming will a) Know more concepts overall (i.e., proportion of Total Concepts known) as measured by the BTBC3-P controlling for any significant demographic variables (i.e., diagnosis and/or SES) and will b) Know more concepts assessed on the BTBC3-P not directly taught on the C-PIRK© (i.e., proportion of concepts not directly taught), than those who have not attained this cusp.

Based on previous research suggesting the naming capability as a prerequisite skill for incidental learning and success within a classroom, it is hypothesized that attainment of the naming cusp will significantly predict knowledge of basic concepts, even when controlling for proportion of VBD cusps and capabilities attained, diagnosis, and any other demographic variable found to be related to overall concepts known.

Hypothesis 3a and b will be analyzed using stepwise regression analysis whereby the variable of achievement of naming (dummy coded Yes = 1/No = 0) will be added to any significant variables remaining in the regression model used in Hypothesis 1 and 2. In addition, the presence of interaction variables will be explored. Finally, to assess specifically for the relation of naming to incidental learning of basic relational concepts, a list of BTBC3-P concepts not covered by the C-PIRK© curriculum will be created. Regression analyses will be run to assess for naming as a predictor of relational concepts known not directly taught on the C-PIRK© curriculum, controlling for diagnosis, VBD, and any other demographic variable found to be related to overall concepts known.

H4. a) Preschool children with ASD will correctly identify fewer spatial concepts than their TD counterparts attending the same ABA preschool b) Preschool children with ASD will correctly identify fewer quantitative concepts than their TD counterparts attending the same ABA preschool after controlling for total number of concepts known.

Herschkorn's (2015) analysis of school aged children with and without ASD revealed reduced mastery of spatial concepts and quantitative concepts, but no difference in temporal concepts in children with ASD. This dissertation will also test the differences in the specific type of concept acquisition between groups, informed by Central Coherence Theory, to determine if this younger sample exhibits similar difficulties. According to the Central Coherence Theory, it is expected that children with ASD will have more difficulty with spatial and quantitative concepts because they require the child to focus on the whole picture, rather than the parts of the picture. When considering quantitative concepts such as full/empty and shortest/longest, the child must first scan across choices, then analyze individual choices for relationships within (i.e., is the jar *full* or *empty*). It is likely that the younger group of children with ASD included in this study will also have more difficulty mastering both quantitative and spatial concepts than their TD peers, consistent with Herschkorn's findings. It is of note that this dissertation does not fully replicate Herschkorn (2015) because the BTBC3-P only has one temporal concept (*finished)* whereas the BTBC3 School Aged Version contains five. A limitation of Herschkorn's (2015) study is that she did not control for overall number concepts known. The present study will use two separate regression analyses to test for differences between ASD and TD children in number of concepts learned in each category (i.e., spatial/quantitative), holding any significant demographic variables and overall concepts known constant.

H5. a) Diagnosis will predict the number of Assessor's Tactics types required to keep the participant motivated and on task, in that children with ASD will require significantly more types of tactics than TD children; b) VBD will also predict the number of different Assessor's Tactics used when controlling for diagnosis, in that the more sophisticated a child is in terms of his/her VBD, the fewer types of tactics will be used; c) Naming will predict the number of different Assessor's Tactics used regardless of diagnostic status or VBD in that children who have attained naming will require significantly less tactic types than those who have not, controlling for VBD and diagnosis.

In reviewing the literature, it was observed that Herschkorn (2015) and other studies focused primarily on the behaviors children with ASD exhibit when placed in standardized testing situations rather than what modifications were required of the examiner to keep a child on task. Herschkorn (2015) observed student hyperactivity, fixation on objects in the immediate environment, distractibility, repetitive speech, motor movements, and vocalizations (defined as echoing the examiner or delayed instances of echolalia) during the BTBC3 and used that information to modify the modality of presentation of materials (i.e., presenting one item per page rather than three in the School Aged version of the BTBC3). This dissertation takes Herschkorn's (2015) observations one step farther by providing assessor's a checklist of behavioral techniques (i.e., the Assessor's Tactic Checklist) that can be used without interfering with general standardized test instruction to increase children's motivation and on task behaviors. The number of different type of Assessor's Tactics used by the examiner will be analyzed using regression analysis in relation to the child's diagnostic status, level of VBD, and naming status. It is expected that preschool children with ASD will require many more types of tactics than TD preschool children and that children who are less sophisticated in terms of their VBD will also require more tactic types maintain on task behavior. Furthermore, it is expected that naming will predict the number of tactics required above and beyond diagnosis and VBD.

Chapter II

METHOD

Participants

Participants were recruited as part of larger study aimed at establishing concurrent validity between the BTBC3-P and the Preschool Inventory of Repertoires for Kindergarten (C-PIRK©; Greer, 2014), the individualized curriculum used at all Comprehensive Application of Behavior Analysis to Schooling (CABAS©) schools. Inclusion criteria for each child included prerequisite skills (as determined by classroom teachers and supervising staff) of: maintaining attention for at least five minutes during a one-on-one task (i.e., attainment of instructional control), being able to be re-directed back to task when prompted, following basic one step vocal directions, and being able to point when asked. Each child recruited for this study had an Individualized Education Plan (IEP) and was classified as a Preschool Student with a Disability, received early intervention (EI) services, or did not have an IEP and was considered TD. Participants in the ASD group had outside, verified diagnoses of PDD-NOS, autism, Asperger's or ASD given by a primary care physician or psychologist. Diagnoses were verified in this study through a review of school materials (i.e., outside diagnostic evaluations, medical records, etc.) and IEPs.

There were a total of 66 students considered for inclusion in this study. Of the 66, three withdrew consent and were removed from the sample. An additional three students were unable to complete the sample items in the BTBC3-P. Administration of the BTBC3-P was immediately discontinued and those participants were removed from further data analysis. The three students unable to complete the BTBC3-P sample items were IEP students with a mean age of 45 months from School District 16 (n = 1; 21.8% poverty by school district) and School District 25 (n = 2;

21.5% poverty by school district). They attained an average of 28.4% VBD pre-reader cusps and capabilities, as compared to 73.4% attainment in the total sample.

The sample of students who were able to complete the BTBC3-P consisted of 60 preschool (n = 57) and EI students (n = 3) ranging in age from 36 months to 64 months (M_{age} = 49.28 months *SD* = 8.33 months). Of the 60 participants, 41 had IEPs or received EI services (IEPs; M_{age} = 49.95 months *SD* = 8.0; n_{males} = 37; $n_{females}$ = 4). 19 participants did not have an IEP, and for the purposes of this study were considered TD (M_{age} = 47.84 months *SD* = 8.3; n_{males} = 12; $n_{females}$ = 7). It is of note that many of the TD students were children of school staff members. Within the IEP group, 32 participants had outside, verified diagnoses of PDD-NOS (n = 9) or ASD (n = 23). The remaining diagnoses for students with IEPs included Mixed Expressive/Receptive Disorder (n = 2), Developmental Coordination Disorder (n = 1), Mixed Developmental Disorder (n = 3), and no formal diagnosis (n = 3). For the purposes of this study, only children with outside verified diagnoses of ASD were included in the final sample.

The final sample consisted of 51 students ranging in age from 36 to 64 months (M_{age} = 49.26 months *SD* = 8.53 months). Descriptive statistics were completed after splitting the sample based on diagnosis (TD = 19; ASD = 32). See Table E1 for descriptive statistics and for the demographic correlation matrix.

Procedure

Institutional Review Board (IRB) approval was obtained from the ABA School's IRB from which this dissertation obtained its sample on January 9, 2015 and on March 23, 2015 from Teachers College Columbia University IRB. Data collection began in May 2015 and continued through March 2016. Participants were recruited from two CABAS© schools that use the C-PIRK© curriculum, which is designed to include learning goals necessary for success in a mainstream classroom. The population of students enrolled at the CABAS© schools from which this sample is drawn includes students who are primarily classified as a Preschool Child with a Disability (approximately 75%) and approximate a developmentally delayed population in need of individualized learning goals and plans. Many of the children have diagnoses of ASD.

More specifically, recruitment involved the following steps: 1. Recruitment flyers and consent forms were sent home to parents of all students to review (see Appendices H-L). 2. Once the research team determined which parents consented to participate, teachers were interviewed to determine inclusion eligibility (i.e., to determine if the child had the required prerequisite skills). A file review of each student was then completed to obtain information on the child's formal diagnosis, special education classification, date of birth, progress on the individualized curriculum (i.e., C-PIRK©), and assessments of VBD (i.e., VBD Assessment).

Once a child was deemed eligible to participate, the experimenter discussed an appropriate time to assess the child with the teacher (See Appendix G for Research Protocol for Research Assistants). Then, the experimenter entered the classroom to allow for the participant to habituate to her presence. After approximately 10-15 minutes, the experimenter approached the student and said, "My name is ________________. How are you? [Wait for response]. I was hoping you could help me answer some questions about some pictures. Some of the questions may seem really easy, while others will be harder. If you don't know, it is ok. Just try your best." If the child declined participation, then the child resumed his/her normal, individualized classroom activities and was given a second opportunity on another day to participate in the study. There was no punishment for declining participation and no children chose to decline. Experimenters worked closely with classroom teachers to ensure that the test took place during a non-instructional period of the day. Data collection occurred in an office location outside of the classroom. The offices used were well lit, well ventilated and were free of distractions. Testing occurred at a child-sized table or on the floor, depending on the child's individual need. If a child appeared to be in distress, a break or access to a desired object (i.e., computer) was offered. Lastly, if the child was unable to complete the practice items, testing was discontinued.

Graduate students in school psychology with extensive training in individual administration of standardized and unstandardized tests were the assessors in this study. Each of the students had completed a graduate course in Behavioral Interventions, and many assessors had experience working with children with ASD and in ABA schools. The graduate student assessors also underwent a three-hour training in the administration and scoring of the Preschool Version of the Boehm Test of Basic Concepts (BTBC3-P) in addition to training and practice in using the tactics listed on the Assessor's Tactics Checklist.

Assigning identification numbers to all participants ensured subjects' confidentiality. Identifiable consent forms that link the subjects with their identification numbers were kept in a locked filing cabinet in the principal investigator's office, separate from the de-identified data.

Measures

Boehm Test of Basic Concepts 3rd Edition – Preschool Version (BTBC3-P; Boehm, 2001b)

The BTBC3-P is an individually administered standardized assessment of preschool children's knowledge of basic relational concepts (See Appendix B). The BTBC Preschool Version is in its second revision, as it was first published with the BTBC – Revised (Boehm, 1986). The BTBC3-P is typically administered over a period of 20-30 minutes and consists of 26 basic concepts commonly used in preschool curricula. In the BTBC3-P, each relational concept is tested twice to determine whether a concept is absent, emerging, or mastered. Scores on the BTBC3-P are reported in multiple ways: percent correct, performance range, and percentile.

Performance range is a measure ranging from one to three with a performance range of one indicating a child knows most of the concepts, as compared to age-level peers. A performance of two indicates the child knows many of the concepts, but lacks understanding of some key concepts, and a performance range of three suggests the child's relational concept knowledge is extremely low when compared to age level peers.

The standardization sample for the BTBC3-P included over 1,600 children from across the United States. For the English version of the BTBC3-P, used in the current study, the standardization sample consisted of 660 children aged 3:0 to 5:11. Internal Consistency Reliability Coefficients for the total score (Coefficient Alphas) ranged from .85 to .92. The Standard Error of Measurement (SEM) ranged from 1.98 to 2.88, indicating low variability. In terms of validity, the content of the BTBC3-P is based off of extensive review of preschool curricula. The concurrent validity of the BTBC3-P with the original BTBC-P is .84 and concurrent validity of the BTBC3-P with the *Bracken Basic Concept Scale-Revised* (Bracken, 1998) is .80 for three-year-olds and .73 for five-year-olds.

Assessor's Tactic Checklist

The Assessor's Tactic Checklist (see Appendix C) used in this study is examiner created. After reviewing the literature on children with ASD and standardized assessments, it became clear that while examiner tactics have been identified as an important consideration when testing young children with ASD, little has been done to augment standardized assessment to increase validity of assessment results. As such, a preliminary Assessor's Tactic Checklist was created by Alexis Branca Bancroft M.A., Ed.M., Ann E. Boehm, Ph.D., and Lin Du, Ph.D., given their collective and extensive experience assessing preschool students and students with ASD. The checklist contains commonly used behavioral tactics to increase student motivation: schedules of reinforcement (i.e., giving access to a desired activity after a specific number of items or an unfixed number of items), visual schedules (i.e., answer 5 items then break visually represented), contingent reinforcement (i.e., if______ then ______), forced choice (i.e., *this* or *that*), labeled praise (i.e., nice job sitting in your chair, nice looking, thanks for answering in a loud voice), social reinforcement (i.e., non-spoken reinforcement smile, head nod), token economy, and access to preferred edibles/ activities. The checklist contains the tactics listed above and asks the examiner to check whether the tactic was used or not used. There is also a space for comments that can be used for noting effectiveness, how the tactic was used, child response or preferences, etc. The checklist is intended for easy use before the administration of the BTBC3-P as a reference sheet for available tactics, during administration, or immediately following administration to document both use of different types of tactics and the perceived effectiveness. This measure will be used in the present study to obtain data on the use of different types of tactics (rather than the number of times each specific tactic was used) to maintain student attention and motivation in relation to a child's diagnosis, level of VBD, and attainment of the naming capability.

Verbal Behavior Development (VBD) Assessment

The VBD Assessment used in the present study is an unpublished tool used at all CABAS© schools and research development centers (See Appendix D). The VBD Assessment is based on VBDT and is a criterion referenced assessment that assists classroom teachers in the scientific monitoring of VBD associated with student progression through the CPIRK© curriculum. The VBD Assessment provides a detailed task analysis of sequenced learning objectives for assessing whether pre-reader and reader/writer cusps and capabilities are mastered, in progress, or are absent in children. The pre-reader cusps and capabilities (explained in detail in

Literature Review) span from Pre-Listener status through Verbal Mediation for Solving Problems. The VBD Assessment has been verified by thousands of single subject research design experiments. In addition, individual classroom teachers are trained in the VBD Assessment to criterion, resulting in strong interrater reliability among raters. This measure will be used as an indicator of VBD within the sample. Data was gathered concurrently with the administration of the BTBC-3 (i.e., within 1-2 weeks of completing the BTBC-3 assessment; See Appendix D).

Chapter III

RESULTS

Preliminary Data Analysis

Missing Data

There was no missing data.

Testing the Assumptions

The dataset was split based on diagnosis (TD/ASD) and checked for normal distribution and presence outliers for all dependent variables (Total Concepts Known, Quantitative Concepts Known, Spatial Concepts Known, Concepts known not also covered on the CPIRK© curriculum). Skew and kurtosis were evaluated using rule of thumb measurements (i.e., by dividing the skew statistic by the SEM to assess whether it was ≥ 1.96; Field, 2013). There was significant skew for the TD group in terms of VBD (Skew = -1.56, SEM= .524), indicating a tendency towards higher VBD. This skew is expected within this population. Therefore, no transformations were completed. No other significant skew values were identified. Outliers were tested using the rule of thumb three standard deviations. There was no significant kurtosis or outliers identified.

Descriptive Statistics

Age

The 51 students included in this study ranged in age from 36 to 64 months (M_{age} = 49.26 months *SD* = 8.53 months).

Socioeconomic Status (SES)

2015 U.S. Census Tract Data for school district catchment areas were used to approximate SES within the sample. The data obtained included percent of children (aged five to

18) living in poverty by school district (US Census, 2015). The students included in this dissertation were from 24 school districts in New York and one school district in Virginia. Based on the literature, it was expected that age and SES would correlate with proportion of total concepts known on the BTBC3-P.

A correlation matrix of demographic characteristics and BTBC3-P scores was created (See Table E2). It is of note that BTBC3-P concept scores, progression of VBD, and SES variables were transformed into proportion scores so that all variables could be analyzed using the same measurement scale (see below for descriptions of how proportion scores were created for each variable). Age approached significance as a positive correlate of total concepts known for both groups (TD: $r = .14$, $p > .05$; ASD: $r = .03$, $p > .05$). Since age approached significance, it will be not be included as a control variable in the following analyses. Proportion of children in poverty by school district was significantly, negatively related to proportion of total concepts known for the TD group (TD: $r = -.49$, $p < .05$), suggesting that as percent of children in poverty by school district increased, the total proportion of concepts of known decreased. Proportion of children in poverty by school district was not significantly related to proportion of concepts known for the ASD group (ASD: $r = -.10$, $p > .05$). Since proportion of children in poverty was significantly related to proportion of overall concepts known in the TD group, SES (proportion of children in poverty by school district) will be included as a control variable in analyses involving proportion of total concepts known.

Boehm Test of Basic Concepts 3rd Edition – Preschool Version

In the current study, the Cronbach's Alpha for the BTBC3-P proportion of total concepts known was high. For the total sample, the Cronbach's Alpha for students aged 3:0 to 3:11 was .93, and the Cronbach's Alpha for students aged 4:0 to 5:11 was .91. For the TD group, the

Cronbach's Alpha for students aged 3:0 to 3:11 and aged 4:0 to 5:11 was .88. For the ASD group, the Cronbach's Alpha for students aged 3:0 to 3:11 was .91, and for students aged 4:0 to 5:11, .89.

An analysis of errors was conducted using the BTBC3-P suggested guidelines for marking student errors. Each incorrect response was noted on the corresponding thumbnail picture printed in the protocol and was categorized into one of four categories: "A" for any antonym or opposite responses (ASD A Error $M = 6.06$, $SD = 3.52$; TD A Error $M = 2.16$, $SD = 2.63$; i.e., responding by pointing to *down* when the concept was *up*), "E" for any *every* error responses (ASD E Error $M = 1.38$, $SD = 2.60$; TD E Error $M = 0.47$, $SD = 2.06$; i.e., when a child points to *every* individual component of the pictured that comprised the item), "M" for any miscellaneous response (ASD M Error $M = 12.38$, $SD = 7.07$; TD M Error $M = 4.05$, $SD = 4.01$), and "NR" for No Response (ASD NR Error $M = 0.34$, $SD = 0.83$; TD NR Error $M = 0.00$, $SD = 0.00$). In the present study, the most common error observed was a Miscellaneous response; See Table E1).

BTBC3-P proportion score variables (i.e., proportion of total concepts known, proportion of spatial concepts known, and proportion of quantitative concepts known) were created using the following steps and considerations. First, a total score for each concept administered within a particular category (i.e., total, spatial, or quantitative concepts) was calculated. Then, the participant's total score was divided by the highest possible score for each category. Since each concept was tested twice, the score for each individual concept ranged from 0 to 2. It is of note that in the standardized administration of the BTBC3-P, different age groups (3:0 to 3:11 and 4:0 to 5:11) are administered different sets of concepts. As such, the proportion scores were created to take into consideration both the child's age and the corresponding items administered on the

BTBC3-P.

Proportion of Total Concepts Known ranged from .63 to 1.0 in the TD group (TD Proportion Total Concepts Known *M* = .87, *SD* = 0.13) and from .28 to 1.0 in the ASD group (ASD Proportion Total Concepts Known *M* = .61, *SD* = 0.20). It is of note that in the TD group, two children received perfect scores on the BTBC3-P with 11 children earning a 90 percent and above. In the ASD group, one child earned a perfect score on the BTBC3-P and five children earned a 90 percent and above (See Figures E1 and E2 for histogram of Total Scores). Proportion of Spatial Concepts Known ranged from .54 to 1.0 in the TD group (TD Proportion Spatial Concepts Known *M* = .84, *SD* = .15) and from 0.23 to 1.0 in the ASD group (ASD Proportion Spatial Concepts Known *M* = .56, *SD* = .22). Proportion of Quantitative Concepts Known ranged from .65 to 1.0 in the TD group (TD Proportion of Quantitative Concepts Known *M* = .88, *SD* = .13) and from .25 to 1.0 in the ASD group (ASD Proportion of Quantitative Concepts Known *M* = .64, *SD* = .21).

C-PIRK©

The proportion score for concepts known on the BTBC3-P that are also present as learning objectives on the C-PIRK© was created by adding the total score of each overlapping concepts between the C-PIRK© curriculum and the BTBC3-P in each age group (3:0 to 3:11 and 4:0 to 4:11). Then, that number was divided by the total possible score for each age group. The overlapping concepts for ages 3:0 to 3:11 were: *under*, *next, outside*, *in front of*, *empty*, *full*, *all*, *smallest*, *longest*, *tallest*, *different*, and *same*. The overlapping concepts for ages 4:0 to 5:11 were: *in front of*, *last*, *first*, *smallest*, *longest*, *tallest*, *shortest*, *different*, and *same*. The TD group ranged in proportion of concepts known also on the C-PIRK© curriculum from 0.54 to 1.00 (TD Proportion of Concepts Known Also on C-PIRK *M* = 0.88, *SD* = 0.17). The ASD group ranged in proportion of concepts known also on the C-PIRK© from 0.17 to 1.00 (ASD Proportion of Concepts Known Also on C-PIRK© *M* = 0.61, *SD* = 0.24; See Table E1). It is of note that in the TD group, 10 children knew all concepts covered in the curriculum with 12 students demonstrating knowledge of 90 percent or more of the concepts. For the ASD group, four knew all concepts covered in the curriculum, with five demonstrating knowledge of 90 percent or more of the concepts.

The proportion score for concepts known not taught directly on the C-PIRK© was created by adding the total score for each concept on the BTBC3-P not overlapping with the C-PIRK© by age group and dividing that number by the total possible score for each age group. Non-overlapping concepts for ages 3:0 to 3:11 were: *top, down, highest, up, nearest, across, around, both, many, most largest,* and *finished.* The non-overlapping concepts for ages 4:0 to 5:11 were: *nearest, across, around, before, farthest, lowest, bottom, together, middle, between, both, many, most, largest, some but not many,* and *finished*. The TD group ranged in proportion of concepts known not also covered on the C-PIRK© curriculum from 0.67 to 1.00 (TD Proportion of Concepts Known Not covered on C-PIRK© *M* = 0.86, *SD* = 0.12). Three students knew all concepts not covered in the curriculum, with 10 knowing above 90 percent of the concepts. The ASD group ranged in proportion of concepts known not also covered on the C-PIRK© curriculum from 0.31 to 1.00 (ASD Proportion of Concepts Known not covered on C-PIRK© *M* = 0.62, *SD* = .20). Of the ASD group, one demonstrated knowledge of all concepts not covered in the curriculum, with only two students demonstrating knowledge above 90 percent.

Verbal Behavior Development (VBD)

The proportion of student VBD acquisition variable was created by assigning a value of 0, 1 or 2 to each item on the VBD Assessment. A value of 0 was assigned if the cusp and/or capability was determined *not present* by the student's teacher, a value of 1 was assigned if the cusp and/or capability was *in process*, and a value of 2 was assigned if the cusp and/or capability was *mastered*. After assigning the appropriate values, a total VBD score was calculated. This value was then divided by the total possible value (i.e., if the child had earned a 2 on each cusp and/or capability) to create a proportion score. For the purposes of this dissertation, the proportion of VBD cusps and capabilities attained only included pre-reader cusps and capabilities listed on the VBD Cusps and Capabilities Pyramid. The proportion of pre-reader VBD acquisition in the TD group ranged from 0.50 to 1.00 (M = 0.88, SD = 0.16). The proportion of pre-reader VBD acquisition in the ASD group ranged from 0.06 to 1.00 (M = 0.69, SD = 0.23). VBD was also measured by acquisition of naming cusp (yes/no). This variable was dummy coded 0 = not attained and 1 = attained. For the purposes of this dissertation, if the naming cusp was labeled *in progress* or *mastered* it was considered attained and was assigned a value of 1[1]. Within the TD group, 17 (89%) students obtained the naming cusp and within the ASD group, 18 students obtained the naming cusp (56%; See Table E1).

Assessor's Tactics

Assessor's use of tactics was coded for the total number of different types of tactics used. It was not coded for the total number of times each specific tactic was used (i.e., if labeled praise was used 17 times, it was coded as using one tactic). Overall, the use of Assessor's Tactics ranged from two to 14 (M = 6.49, SD = 2.66). When broken down by individual assessors,

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[1] All analyses were also completed with a redefined naming cusp (yes = 1/no = 0) dummy variable (i.e., *mastered* = 1; *in progress* = 0; and *not present* = 0). It is of note that all analyses including the naming variable maintained their significance (i.e., Hypothesis 3). The only difference noted is that in Hypothesis 3 with Diagnosis, VBD, and naming as predictors of Proportion Concepts Known *not* Directly Taught, the effects of naming and VBD were washed out, in that neither were found to be significant. However, when VBD was removed from the regression, naming became a significant predictor of Proportion Concepts Known *not* Directly Taught, regardless of diagnosis.

assessor's average use of tactics per participant ranged from four to 10. When Assessor's Tactics were broken down by type, usage of Gaining Attention tactics ranged form zero to three (M = 1.67, SD = 1.01) and usage of Tactics to Increase Motivation ranged from one to 12 (M = 4.78, SD = 2.36). When the sample was split based on diagnosis, children with ASD received three to 14 different tactics (M = 7.21, SD = 2.72) where as TD students received two to nine different tactics (M=5.26, SD=2.10). When the sample was split based on attainment of the naming cusp, use of Assessor's Tactics with children with naming ranged from two to 11 (M = 5.66, SD = 2.30) whereas those who had not attained naming ranged from four to 14 (M = 8.31, SD = 2.55). Overall, 96.0% of children with ASD were called by name prior to reading a question, where as only 68.4% of TD children were called by name. ASD children required more physical inhibition (TD = 0%, ASD = 53.1%), more variable reinforcement (TD = 15.8%, ASD = 43.8%), and more non-spoken reinforcement (TD = 53%, ASD, 78.1%). It is of note that TD children received slightly more social reinforcement (TD = 94.7%, ASD = 87.5%), labeled praise (TD = 100%, ASD = 90.6%), short breaks (TD = 57%, ASD = 50%), and fixed reinforcement (TD = 26.3%, ASD = 21.9%) than children with ASD.

In terms of attainment of the naming capability, children without naming required more physical redirection (Naming = 40%, No Naming = 65.6%), flexible presentation of materials (Naming = 2.85%, No Naming = 18.75%), short breaks (Naming = 45.71%, No Naming = 68.75%), fixed reinforcement (Naming = 14.29%, No Naming = 43.75%), variable reinforcement (Naming = 28.57%, No Naming = 50%), contingent reinforcement (Naming = 37.14%, No Naming = 56.25%), social reinforcement (Naming = 85.71%, No Naming = 93.75%), non spoken reinforcement (Naming = 62.85%, No Naming = 81.25%), and preferred edibles (Naming = 5.71%, No Naming = 31.25%). Interestingly, unlike when broken down by diagnosis, no categories showed greater use for those who have attained naming verses those who have not. For a complete breakdown by tactic and diagnosis/naming status, respectively, see Table E9 and Table E10.

Time to Completion

For a small subsample of each group (ASD/TD), the time to completion (i.e., from the start of administration through the last item administered) was measured in minutes and seconds. The time to completion for the eight TD students ranged from 7 to 15.28 (*M* = 11.15, *SD* = 2.83). The time to completion for the seven ASD students ranged from 11 to 24 minutes (*M* = 15.25, *SD* = 5.53). Time to completion for the five students without naming ranged from 11.30 to 24 minutes (*M* = 15.44, *SD*= 4.97). Time to completion for the 10 students with naming ranged from 7 to 24 (*M*=12.27, *SD* = 4.62)

Analysis of Hypotheses

Hypothesis 1a Preschool children with ASD will correctly identify fewer total concepts than TD children attending the same ABA preschool, holding SES constant.

Hypothesis 1a (see Table E3) was supported. Preschool children with ASD, on average, knew .26 (or 26%) fewer total concepts than the TD group. Diagnosis accounted for 34% of the variance in the model (R^2 = .34, F (1,49) = 25.25, p = .00) with percent poverty accounting for 2.8% of the variance (R^2 change = 0.37, F Change (1,48)=13.81, p = .175). Percent of children in poverty was not a significant predictor of proportion of BTBC3-P concepts known and did not add significant variance to the regression model. Therefore, percent of children in poverty was removed from subsequent analyses. Diagnosis significantly predicted proportion of total concepts known, while holding proportion of students in poverty constant (B = -.26, p = .00).

Hypothesis 1b the standard deviation of the ASD group will be greater than that of typically developing peers attending the same ABA preschool.

Hypothesis 1b was also supported. The *SD* of the TD group for Total Score obtained on the BTBC3-P was 6.50 and the *SD* for the ASD group was 10.22. Using the Levene's Test of Homogeneity of Variance, the TD and ASD group differed in variance (F = 5.12, p = .028), with the ASD group exhibiting larger within group differences than the TD group. This difference was also seen qualitatively by creating a histogram of percent correct on the BTBC3-P by diagnostic group (See Figure E1 and E2).

Hypothesis 2 The proportion of VBD cusps and capabilities attained will predict proportion of relational concepts known, controlling for diagnosis and any other significant demographic variables, in that the more sophisticated a child's VBD, the more concepts that child will know.

Hypothesis 2 was supported (See Table E4). VBD was positively related to proportion of concepts known, holding diagnosis constant (B = .24, p = .045). VBD accounted for 5% of the variance of the model (R^2 change= 0.05, F(1,47)=4.24, p = .045). An interaction variable DiagnosisXVBD was added to the model to test for a potential interaction between diagnosis and proportion of VBD cusps and capabilities attained. The interaction variable was a non-significant predictor (B = .19, p = .53) and was not included in subsequent models.

Hypothesis 3 Naming is a VBD prerequisite to incidental learning of concepts. Therefore, students who have achieved the naming cusp will: 1. Know more concepts overall (i.e., proportion of total concepts known) as measured by the BTBC3-P controlling for diagnosis, significant demographic variables, and proportion of cusps and capabilities attained (i.e., VBD) and will 2. Know more concepts assessed on the BTBC3-P not directly taught on the C-PIRK©, than those who have not attained this cusp, controlling for diagnosis, demographic variables, and VBD.

Hypothesis 3 was supported. When naming was added to the model including diagnosis and progression of VBD as predictors of proportion of overall concepts known, naming added 12% of variance to the overall model (R^2 change = .12, F (1, 47) = 10.97, *p* = .002). Naming is a significant predictor of overall concepts known (B = .19, *p* = .002). It is of note that when naming was added to the model, diagnosis remained a significant predictor of proportion of overall concepts known (B = -.19, p = .000), whereas VBD lost its significance (B = .05, p = .679). Therefore, VBD was removed from the remaining analyses. An interaction variable DiagnosisXNaming was then added to the model to test for a potential interaction between diagnosis and naming as predictors of proportion of overall concepts known. The interaction variable was a non-significant predictor of proportion of overall concepts known (B = .19, *p* = .139). Therefore, the final regression model consisted of diagnosis and presence/absence of naming as predictors of proportion of overall concepts known (see Table E4).

The same progression of regression analyses was completed using proportion of concepts not directly taught on the C-PIRK© curriculum as a dependent variable. Diagnosis was significantly related to knowledge of concepts not directly taught by the C-PIRK© curriculum, accounting for 33.7% of the variance in the model (B = -.25, *p* = .000). When VBD was added to the model, it was determined to be a non-significant predictor of knowledge of concepts not directly taught by the C-PIRK© curriculum, and was dropped from subsequent models (B = .14, p = .248). When naming was added, it was determined to be a significant predictor of knowledge of concepts not directly taught on the C-PIRK© (B = .15, *p* = .006), controlling for diagnosis. Naming added 9.9% of variance to the model (R^2 change = .10, F (1, 48) = 8.41, p = .006). It is of note that ASD also remained a significant predictor of knowledge of concepts not directly taught (B = -.20, *p* = .00). An interaction variable DiagnosisXNaming was added to the model to test for any interaction between diagnosis and naming and was found to be a non significant predictor of knowledge of concepts not directly taught on the C-PIRK© (B = .19, *p* = .164). Therefore, the final regression model consisted of diagnosis and naming as predictors of concepts known not also covered on the C-PIRK© (See Table E5).

Hypothesis 4a Preschool children with ASD will correctly identify fewer spatial concepts than their TD counterparts attending the same ABA preschool, while holding overall knowledge of concepts and any significant demographic variables constant.

Hypothesis 4a (Table E6) was not supported. A regression model with diagnosis (TD/ASD) predicting proportion of spatial concepts known, while holding proportion of total concepts known was used to test this hypothesis. Results indicated that while on average, preschool children with ASD correctly identified 28% fewer spatial concepts than those in the TD group, when proportion of overall concepts known was added to the model as a control, preschool children with ASD do not differ from their TD counterparts in terms of the proportion of spatial concepts known (B = -.01, *p* = .628).

Hypothesis 4b Preschool children with ASD will correctly identify fewer quantitative concepts than their TD counterparts attending the same ABA preschool, while holding overall knowledge of concepts and any significant demographic variables constant.

Hypothesis 4b (Table E7) was also not supported. This hypothesis was analyzed by fitting a regression model with diagnosis (TD/ASD) predicting proportion of quantitative concepts known, while holding overall knowledge of concepts constant. The results indicate that while on average, preschool children with ASD correctly identified .27 (27%) fewer quantitative concepts than those in TD group, when overall concepts known was added to the model, preschool children with ASD did not differ from their TD counterparts in terms of the number of spatial concepts known (B = .01, p = .655).

Hypothesis 5a Diagnosis will predict number of different Assessor's Tactics required to keep the participant motivated and on task, in that children with ASD will require significantly more types of tactics than TD children. ***Hypothesis 5b*** VBD will also predict the number of different Assessor's Tactics used when controlling for diagnosis, in that the more sophisticated a child is in terms of his/her VBD, the fewer types of tactics will be used. ***Hypothesis 5c*** Naming will predict the number of different types of Assessor's Tactics used regardless of diagnostic status or VBD in that children who have attained naming will require significantly fewer tactics than those who have not, while controlling for VBD and diagnosis.

To assess Hypothesis 5 (Table E8), a regression model was first fitted with diagnosis as a predictor of the number of assessor's tactics used. Diagnosis accounted for 12.9% of the variance in the model (R^2= 0.13, F(1,49)=7.23 p = .010). Diagnosis significantly predicted the number of different assessor tactics used (B = 1.96, p = .010). On average, children with ASD required approximately two more tactic types than TD children. Then, proportion of VBD cusps and capabilities attained was added to the model. VBD was a marginally significant predictor of tactics used (B = -.10, p = .055) and added 6.5% of variance (R^2 change = .07, F (1,48)=3.87, p = .055). Due to VBD's non-significance, VBD was dropped from the model before naming was added. In a model with diagnosis and naming, naming accounted for 13.4% of the variance (R^2 change=.13, F(1,48)=8.70, p = .005). Naming was a significant predictor of number of different tactics used (B = -2.21, p = .005). Children without naming required approximately two more tactics than those with naming (two and a half more in a model with just naming). It is of note that when naming was included in the model, diagnosis was no longer a significant predictor of tactics used (B = 1.22, p = .097).

Post-hoc analysis was then completed to further assess use of assessor's tactics. More specifically the relation between use of assessor tactics and performance on the BTBC3-P was assessed. A model with total types of assessor's tactics as a predictor of performance of BTBC3-P showed a negative relation between assessor's tactics and performance on the BTBC3-P (i.e., as performance increased, use of assessor's tactic types decreased; B = -.04, p = .002). Use of tactics accounted for 18.6% of the variance in the model (R^2 = .19, F (1,49)=11.22, p = .002). Tactics were then broken down into their respective categories (i.e., gaining attention and increasing motivation) and used as separate predictors of BTBC3-P performance. Gaining attention tactics were significantly, negatively related with BTBC3-P performance (B = -.137, p = .000; R^2 = .39, F (1,49)=33.16, p = .000), whereas tactics aimed at increasing motivation tactics were not (B = -.02, p = .09; R^2 = .06, F (1,49)=3.07, p = .086).

Chapter IV

DISCUSSION

Summary of Findings

Despite basic concepts' demonstrated importance in the academic and social success of school-aged children, few studies have investigated the acquisition of basic relational concepts in preschoolers with ASD, a growing group of children with developmental disabilities. The current study included 51 preschool aged students with and without ASD ranging in age from 36 to 64 months (M_{age} = 49.26 months *SD* = 8.53 months; n_{TD} = 19; n_{ASD} = 32). Overall, findings suggest preschool children with ASD, similar to other children with disabilities, exhibit more difficulty mastering basic relational concepts, as assessed by the BTBC3-P than their TD counterparts (Facon, Magis & Courbois, 2012; Herschkorn, 2015; Kavale, 1982; Nelson & Cummings, 1981). Children with ASD knew fewer concepts and had larger within group variability (SD) than their TD peers. In addition to overall knowledge of relational concepts, this dissertation investigated concept knowledge in relation to a child's VBD, as measured by the VBD Assessment. Proportion of VBD cusps and capabilities attained was a significant predictor of proportion of total concepts known (R^2 VBD= .05 with diagnosis held constant), suggesting sophisticated verbal behavior to be an important component of a preschool child's capacity to learn and master basic concepts. This study was the first to consider naming as a precursor to basic concept acquisition, and findings support the continued importance of naming, in that *regardless* of ASD status and VBD, naming significantly predicted proportion of total concepts known (R^2 naming = .114). Interestingly, when naming was added as a predictor of overall concepts known, VBD was no longer a significant predictor, suggesting naming as a more robust predictor of relational concept knowledge. In addition, naming was an independent predictor of concepts known not also covered on the CPIRK© curriculum, even when holding diagnosis constant (R^2 naming = .099; Note: VBD was not included in this model because it was not a significant predictor above and beyond diagnosis). In terms of assessor's tactics investigated, diagnosis and naming were related to the amount of assessor's tactics types used, with those children with ASD and children without naming requiring significantly more different tactics than those without.

In terms of overall knowledge of concepts, preschool children with ASD, on average, knew 26% fewer total concepts than the average proportion of BTC3-P concepts known in the TD group. This finding supports previous literature of school-aged children with disabilities (i.e., learning and intellectual disabilities) knowing fewer concepts than their typically developing counterparts (Facon, Magis & Courbois, 2012; Herschkorn, 2015; Kavale, 1982; Nelson & Cummings, 1981). In addition, the variability of scores was greater in the ASD group than in the TD group. The ASD group's *SD* for total score on the BTBC3-P was 10.22 and the TD group's *SD* was 6.50, indicating a much greater range of scores within the ASD group. This finding adds to the literature regarding the heterogeneous language and functioning profiles of children with ASD population. It also supports Herschkorn (2015) by replicating the pattern of greater within group variability with a younger sample of children with ASD. On average, preschool children with ASD correctly identified 28% fewer spatial concepts and 23% fewer quantitative concepts than those in TD group. This finding supports Herschkorn (2015), where school aged children with ASD identified fewer spatial and quantitative concepts. However, Herschkorn (2015) did not control for overall concepts known. Therefore, the present study investigated whether or not the finding was an artifact of reduced total concepts known. After controlling for overall concepts known, preschool children with ASD did not differ from their TD counterparts in terms of number of spatial or quantitative concepts known suggesting the reduced spatial and quantitative concept knowledge is due to general difficulty with relational concepts rather than potential difficulty attending to the whole rather than parts of objects (i.e., due to Central Coherence Theory).

Since it was expected that children with ASD would have more difficulty acquiring basic concepts than their TD counterparts attending the same specialized ABA preschool, the present study also sought to determine whether the difficulty was related to a child's progression of VBD, as measured by proportion of cusps and capabilities attained on the VBD Assessment, attainment of the naming cusp, or to both. The first step in determining the prerequisite skills for achieving basic concept knowledge included testing proportion of VBD cusps and capabilities attained as a predictor. VBD was positively related to proportion of total concepts known, regardless of diagnostic status. Overall, the more sophisticated a child was in terms of their VBD, the more basic, relational concepts they understood. Further, since VBD was determined to be a significant predictor of overall concepts known, regardless of diagnostic status, this study also determined whether VBD would remain a significant predictor when attainment of the naming capability was added into the model. Numerous studies have identified naming as a prerequisite skill for incidental learning and success within a traditional classroom setting. As such, it was hypothesized that attainment of the naming capability would significantly predict knowledge of basic concepts, even while controlling for overall level of VBD and diagnosis. This hypothesis was supported. When naming was added to the regression model, both diagnostic status and naming were significant predictors of overall concepts known whereas proportion of VBD cusps and capabilities attained was no longer significant. Naming and diagnosis were also found to be a significant predictors of proportion of concepts known not directly taught by the C-PIRK© curriculum ($R^2 = .436$), whereas VBD was a non-significant predictor. On average children with naming knew 20% more concepts than those without naming.

These findings add to the literature supporting the importance of attaining the naming capability and the ability to learn incidentally once naming is mastered. It is particularly interesting that the proportion of VBD cusps and capabilities learned became a non-significant predictor of overall concepts known once naming was added to the model, whereas naming remained a significant predictor of concepts known even while holding diagnostic status constant. This indicates naming as a capability essential for learning basic concepts more quickly for *both* TD students and students with ASD.

VBD (i.e., naming) and BTBC3-P relational knowledge were measured concurrently in this study, which raises the question of whether naming predicts relational concept knowledge, knowledge of relational concept knowledge predicts naming, or if they occur simultaneously. While this cannot be tested empirically in this study (i.e., due to the concurrent measurement of variables), the findings of this dissertation support naming as preceding relational concept knowledge. Naming is a circular capability in which a child a child can see a non-spoken term (i.e., a picture or a word), name that term, hear themselves naming the term, and then select the appropriate representation of that term without direct instruction. This phenomenon is linked primarily to nouns, so it is intuitive that a child would need to have the capability to understand objects in multiple contexts and across modalities (i.e., picture, spoken, and written) before they can identify where an object is in *relation* to another object, a higher order skill. Naming has been identified as an important prerequisite to incidental learning, which is often how basic relational concepts are acquired and how traditional classrooms are taught. Without naming, preschool students require instruction from both the listener and speaker to be able to identify relational concepts, and would require multiple exemplar instruction (MEI) to facilitate joining of the listener and speaker repertoires (see below for a more detailed description of MEI).

In addition, this finding supports previous work identifying a relation between understanding of social intensions/ reciprocal communication and relational word understanding (Parish-Morris, 2011). Linking this to VBDT, preschoolers who have attained speaker-as-own-listener status and naming may also understand more relational concepts because they benefit from observing others, and thus learning incidentally, and their level of sophistication in the social use of language allows them to engage in social exchanges (i.e., conversational units, etc.), which aids in relational concept understanding.

Given that Herschkorn (2015) observed student hyperactivity, fixation on objects in the immediate environment, distractibility, repetitive speech, motor movements, and vocalizations (defined as echoing the examiner or delayed instances of echolalia) during administration of the BTBC3, the present study aimed to further this finding by identifying what was required by the examiner to keep the child focused and on task, regardless of the child's behavior. Assessor's tactics were used frequently for both groups at this age. On average, children with ASD required approximately two more different types of tactics than TD children. When VBD was added, VBD was a non-significant predictor of the amount of assessor's tactics types used. However, when both diagnosis and naming were included as predictors of the number of Assessor's Tactics used, naming was a significant predictor, whereas diagnosis no longer retained its significance, indicating naming as a driving force for on task behavior. Children with naming required approximately 2.5 less tactic types than children without naming.

Additional Findings

Correlations between primary study variables suggest the proportion of total concepts known was negatively related to the proportion of children in poverty (by school district) for the TD group and not the ASD group. Therefore, this variable was added as a control variable for initial regression analysis and was later dropped, as it was determined a non-significant predictor of overall concepts known. Surprisingly, age was not significantly related to total concepts known in either the TD or ASD group. This finding is contradictory to findings in individuals with other disabilities (i.e., Down Syndrome; Facon, Magis, & Courbois, 2012) and within the TD children used in the standardization sample. It is possible age was not found to be a predictor due to the reduced sample size and/or truncation of range due to prerequisite criteria. Another possibility could be the individualized curriculum offered to the students, where a child, regardless of age, can progress at his or her instructional speed. If that were the case, it would challenge the idea suggested by previous studies that with time, children eventually learn concepts. Instead, it would promote a proactive, systemic approach to teaching relational concepts prior to a child learning naming and exposure to concepts thereafter to allow for incidental learning. By taking a proactive approach, it can close the gap for children lagging in relational concepts due to poverty, disabilities, etc. and would allow for children to be better equipped to access material presented in mainstream classrooms.

Time to completion for the 15 timed subjects differed by approximately 4 minutes. While the time to completion differed between groups, they did not differ from the overall expected completion time 15-20 minutes listed in the Examiner's Manual. This is interesting given the assumption that increasing assessor interventions would also increase the time to completion. Instead, it allowed for children with ASD to be assessed well within the average time to completion for the standardization sample. However, it is of note that this sample was drawn from a pool of students attending a specialized ABA preschool where each student is conditioned to respond to queries within five seconds. In addition, the vast majority of students are familiar with standardized testing situations and behavioral interventions. It is unclear at this time whether using Assessor's Tactics would add to the standardized administration time in a different sample of students.

The most common BTBC3-P error for both the ASD group and TD group was miscellaneous responding. Children with ASD engaged in more Antonym errors than TD preschool students, possibly indicating the early stages of concept understanding.

In terms of naming influencing use of Assessor's Tactics, children without naming required more physical redirection, breaks, and spoken and non-spoken types of reinforcement. Interestingly, unlike when broken down by diagnosis, no categories showed greater use for those who have attained naming verses those who have not. This finding suggests that while assessors differed in their use of tactics between children with ASD and TD children, assessors were more consistent in their use of tactics across children with and without naming. This finding also suggests children with naming are better equipped to handle standardized testing situations, which would make sense given their assumed further progression on the differing VBD cusps and capabilities pyramid which is correlated with a child's ability to function in the social world.

There were a number of additional findings associated with the Assessor's Tactic Checklist. For example, assessors differed in their use of tactic types, with the average number of tactics by assessor ranging from four to 10. It is unclear at this time whether the difference is due to the differing presentation of each individual child (i.e., diagnosis, naming status, or overall behavioral difficulty), or if the difference is due to inherent differences in assessor's use of tactics, which would introduce threats to the internal validity of this study. In addition, the findings that BTBC3-P performance is negatively related with the use of assessor's tactics (i.e., as performance increased use of tactics decreased) and that the increased use of Gaining Attention tactics were associated with decreased BTBC3-P performance are interesting. It is clear that children who were lower functioning (i.e., with ASD and without naming) required more tactic types from the examiner. However, these findings raise the question of whether assessor's tactics are effective in improving test performance (i.e., Would children who required more tactic types perform significantly different if tactics weren't used?).

Strengths of the Study

At the time this study began, there were no research studies using the BTBC3-P, let alone using it with preschoolers with ASD. Since that time, one study conducted by Ayfer Yıldırım (2015) found a significant positive relation between mean length utterances in Turkish children with ASD (Aged 36-72 months) and basic concept knowledge, as measured by the BTBC3-P. There has only been one other study, a dissertation, studying the BTBC with school-aged children (Hersherkorn, 2015). Therefore, strength of this study is adding to the literature on basic relational concept development in special populations (i.e., preschoolers and preschoolers with ASD).

An additional strength of this study is the consideration of VBDT, specifically adding to the robust literature on the importance of the naming capability. Investigating relational concept knowledge from an ABA perspective allowed for a merging of literatures and sharing of information across disciplines. Recruiting all participants from two specialized ABA preschools that use the same curriculum also allowed for more control over threats to internal validity. For example, at the ABA preschools from which this dissertation drew its sample, there was an inherent control with regard to what each child had been exposed to within the classroom (i.e., the individualized curriculum and teacher training to criterion). In addition, each participant recruited attained instructional control based on prerequisite criteria (i.e., being able to be redirected back to task and being able to attend to a task for 5 minutes).

Limitations of the Study

Limitations of the present study include a lack of gold standard formal diagnosis of ASD, as this study relied on a file review system to verify ASD diagnosis, rather than inclusion of diagnosis as part of the study protocol. A gold standard diagnosis would have allowed for certainty in defining the ASD group. Another weakness of this study is the small sample size. A larger sample size would have provided a more accurate picture of both within group and between group differences in relation to the BTBC3-P, and may have elucidated relationships between variables.

This study also lacked sound measurement in demographic and control variables. For example, this study did not explicitly control for intellectual ability or adequately measure socioeconomic status, both of which are known factors that contributes to knowledge of basic relational concepts. In the current study, intellectual ability was indirectly measured by student progression on the VBD Assessment, which coincides with student progression on the individualized curriculum. For example, children with lower intellectual abilities move more slowly through the curriculum, in their progression of VBD, and those students knew fewer concepts. It is likely an additional assessment of intellectual ability wouldn't have added significant variance to the model; however, having an additional measure would have been helpful in testing this assumption. In the present study, Census Tract Data was used to approximate parent income in a given school district. Not only is this data an extrapolation, the

Census data only considered individuals of school age and did not include household incomes that had children of preschool age. In addition, while assessors completed a rigorous training in the administration of the BTBC3-P, there was no systematic way they were assessed for competency (i.e., they were not trained to criterion). While this is representative of training and how the measure is often administered (i.e., by professionals reviewing the manual, possibly attending a training, and then administering the measure), the lack of training assessors to criterion could have introduced variability with regard to the administration of the BTBC3-P across assessors. However, it is important to note that the assessors in this study were second year graduate students who had completed multiple practicum and theoretical assessment courses that train students to criterion for administration of standardized assessments. In addition, assessors had completed a course devoted to behavioral interventions, and many assessors had prior experience working in ABA preschools and with children with ASD. Further, many assessors were completing and/or had already completed an advanced preschool assessment course with Dr. Ann Boehm.

An additional limitation of this study is the way Central Coherence Theory was used to inform the hypotheses related to spatial and quantitative concept knowledge. The use of the Central Coherence Theory in this dissertation was an extrapolation based on the theory and it was not directly measured. Having a measure of Central Coherence Theory would have added to these results, in that one could better link Central Coherence Theory to student understanding of relational concepts (i.e., specifically spatial and quantitative concepts).

Further, it would have been beneficial to have data on the effectiveness of the Assessor's Tactics (i.e., by randomly assigning students to Assessor's Tactic and No Assessor's Tactics groups). This would have informed future modifications of the measure and the ability to create a hierarchy of effectiveness, which could be beneficial for clinicians. In addition, information on the frequency of Assessor's Tactic Use would have been helpful to not just have data on the different types of tactics used, but also the amount of each type of tactic used by assessors. Further, assessment into child understanding of some tactics (i.e., the Premack Principle of *first* this *then* that) would have been helpful, as the Assessor's Tactic Checklist includes use of some relational concepts (i.e., *first*).

While one of the strengths of this study is that it obtained its sample from specialized ABA schools that use the same individualized curriculum, the results of this study are unlikely to generalize to other populations. The children assessed through this dissertation have received an ideal curriculum in an ideal environment, which also likely contributed to the unexpected findings of demographic variables (i.e., age and SES) not correlating with BTBC3-P knowledge. This study should be replicated in more typical classroom settings for preschool children with ASD to improve generalizability.

Study Implications

This study adds to the literature regarding basic relational concept development. Using the understanding that basic relational concepts are the building blocks for later school and social success, in addition to higher order thinking, understanding how they develop within a growing population of developmentally disabled children (i.e., children with ASD) can inform parents and teachers of not only the current understanding of the differences between children with and without ASD in early development, but of the factors that contribute to those differences. For example, the implications suggest teachers and parents should consider a child's diagnosis, progression of VBD, and attainment of specific cusps when discussing basic concept knowledge. The findings contribute to the understanding that because of specific difficulties associated with

ASD (i.e., receptive language delays and difficulty staying on task), there is a reduction in the acquisition of relational concepts, which is also affected by a child's ability to learn incidentally.

The contribution to the literature regarding the importance of the naming capability is particularly exciting, since attainment of the naming cusp was a significant predictor of concept acquisition, regardless of diagnostic status. This finding suggests it is important for educators to focus on where a child is in terms of their VBD, as this informs the most effective way to teach children relational concepts. The finding that age was not a significant predictor of concepts known is also a possible indicator of the need to proactively teach relational concepts in early childhood settings, especially if a child has not attained the naming cusp. Those children who haven't obtained the naming cusp would benefit from MEI to learn relational concepts, whereas children who have attained the naming cusp require exposure to concepts, but can learn them without direct instruction.

This finding is also important for parents and teachers to know, so they can better prioritize learning objectives. For example, children without naming cannot learn simply by watching and listening to teachers instruct and demonstrate concepts (Corwin & Greer, 2014). They require direct instruction and MEI to learn concepts across the listener and speaker. Naming can be induced through MEI, an instruction that focuses on bringing initially independent abilities (i.e., listener and speaker) together. One way to achieve this is by rotating speaker and listener responses (i.e., pointing, matching, naming) to objects. Put more simply, if a teacher were trying to have a student identify an apple and a banana they would complete the following procedure: "match banana with banana," "point to apple," followed by, "What fruit is this?" (i.e., while holding up the banana). Then, the teacher would hold up a picture of the apple with no verbalization and wait for the child to say "apple." The MEI continues until a student is able to respond to all forms of questioning (Greer & Ross, 2008). Once a child is able to respond to untaught probes (i.e., answering the question "What is this?") following being taught to match *banana* with *banana*, they have attained naming.

According to Corwin (2011) the benefits of inducing naming far outweigh the short time an MEI procedure takes. Not only can children learn faster when they have attained naming, the way they can learn changes (i.e., can learn by observing). Further, this finding is imperative for school psychologists to understand such that probing for naming should be included in all assessments of young children having difficulty learning in a traditional classroom. These probes typically take less than 10 minutes and provide valuable information regarding how a child is likely to function within a classroom and the teaching style required to learn (i.e., modeling vs. direct instruction; See Corwin, 2011 for an outline of procedures). Naming has been linked to phonemic awareness and reading comprehension in addition to more complex verbal behavior such as writing and problem solving (Greer & Speckman, 2009; Helou-Care, 2008; Lee-Park, 2005; Reilly-Lawson, 2008). Naming should also be considered in low socioeconomic populations, especially those children coming from language impoverished homes who lag in developing naming and struggle in traditional classroom settings.

In terms of the Assessor's Tactic Checklist, the reported usefulness of the checklist by assessors and the surprising finding that it didn't add to the administration time suggest the continued need to consider behavior modification strategies when working with a developmentally disabled population.

Future Directions

Based on this dissertation, it is clear that additional research needs to be completed in order to bridge the ABA literature of VBD and VBD cusps and capabilities and developmental literature, especially in the area of naming and its relation to incidental learning and knowledge of basic, relational concepts. Future research should consider both the speaker and listener components of naming, as this dissertation focused specifically on the listener component (i.e., "Point to _____") of naming of relational concepts. While this dissertation used teacher assessments of naming (i.e., the VBD Assessment), it did not include student understanding of relational concepts across the listener and the speaker. Measuring both the listener and speaker component will inform teachers and parents if a child has obtained naming specifically for the concepts measured in the BTBC3-P.

In addition, future research should consider the mechanisms through which naming affects relational concept learning. For example, taking a group of students and comparing the rate of relational concept learning before and after inducing naming. In addition, investigating potential mediating factors in relational concept knowledge, such as attainment of specific types of naming (i.e., naming by exclusion) and/or engagement in fast mapping, slow mapping, and joint attention. Understanding the relationship between naming and concept knowledge would elucidate effective teaching practices and allow for greater depth of understanding of the underpinnings required for concept acquisition. For example, it is possible that naming by exclusion and fast mapping play a major role in concept development. Under this type of naming, a child is able to rapidly learn vocabulary words by following the assumption that concepts within sentences are mutually exclusive. Fast mapping involves a child extrapolating information. For example, if a child were asked to "bring me the red but not blue ball", if the child understands *blue* but not *red* then they can extrapolate to find the *red* ball. Further, understanding of relational concepts, as they are more challenging to learn than nouns, may also require slow mapping to fill in gaps of knowledge and to be able to apply concepts across contexts.

With regard to child motivation, in general, when children are off task and unmotivated, the validity of standardized test results become diminished. It becomes difficult to determine whether the assessor is capturing a child's ability in the target area (relational concepts in this example) or whether the assessor is instead measuring a child's attention or test interfering behavior. Future studies should investigate the effectiveness of the Assessor's Tactic Checklist in increasing the construct validity of BTBC3-P test results within a developmentally disabled population by comparing performance with and without the use of Assessor's Tactics. Adding this to the analysis will answer the question raised by the finding that as use of tactics increased, performance on the BTBC3-P decreased with regard to whether the use of different assessor's tactic types are effective in improving test performance. Another future direction would be to obtain data not just on the different types of tactics used, but also on how often each type of tactic were used. Then, a comparison can be made to determine which type of data tracking would be useful for administrations. In addition, further investigation into the perceived usefulness of the Assessor's Tactic Checklist and modifications to make the checklist more accessible should be conducted within the ASD population and with other populations.

Conclusions

The goal of this study was to explore basic relational concept development in preschool children with and without ASD who attend the same ABA preschool to better understand the general differences in concept development as well as the significant predictors of relational concept acquisition. Overall, findings support previous studies with children with other disabilities, in that preschool children with ASD exhibited more difficulty mastering basic relational concepts than their typically developing counterparts. Preschool children with ASD knew significantly fewer total concepts, quantitative concepts, and spatial concepts. A secondary aim of this study was to investigate basic concept acquisition using the lens of VBD theory from an ABA framework. In doing so, it was found that attainment of VBD cusps and capabilities predicted proportion of concepts known. However, when naming was added to the model, naming, regardless of VBD and diagnosis, was the only significant predictor of concepts learned overall and concepts learned not covered in the CPIRK curriculum. A tertiary aim of this study was to investigate Assessor's Tactics required to keep children focused and on task. Studies that continue to explore the importance of the naming cusp, VBD, and assessor's tactics should be taken so that interventions can be identified to help build relational concept development in preschoolers with ASD.

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Appendix A

DSM-IV-R Diagnostic Criteria for Autism Spectrum Disorders (American Psychiatric Association [DSM-IV-TR], 2000)

299.00 Autistic Disorder

A. Six or more items from (1), (2), and (3), with at least two from (1), and one each from (2) and (3):

1. qualitative impairment in social interaction, as manifested by at least two of the following:

    a. marked impairment in the use of multiple nonverbal behaviors such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction

    b. failure to develop peer relationships appropriate to developmental level

    c. a lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g., by a lack of showing, bringing, or pointing out objects of interest)

    d. lack of social or emotional reciprocity

2. qualitative impairments in communication as manifested by at least one of the following:
    a. delay in, or total lack of, the development of spoken language (not accompanied by an attempt to compensate through alternative modes of communication such as gesture or mime)
    b. in individuals with adequate speech, marked impairment in the ability to initiate or sustain a conversation with others
    c. stereotyped and repetitive use of language or idiosyncratic language
    d. lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level

3. restricted repetitive and stereotyped patterns of behavior, interests, and activities, as manifested by at least one of the following:
    a. encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus
    b. apparently inflexible adherence to specific, nonfunctional routines or rituals
    c. stereotyped and repetitive motor manners (e.g., hand or finger flapping or twisting, or complex whole-body movements)
    d. persistent preoccupation with parts of objects

B. Delays or abnormal functioning in at least one of the following areas, with onset prior to age 3 years: (1) social interaction, (2) language as used in social communication, or (3) symbolic or imaginative play.

C. The disturbance is not better accounted for by Rett's Disorder or Childhood Disintegrative Disorder.

Diagnostic Criteria for 299.80 Asperger's Disorder

A. Qualitative impairment in social interaction, as manifested by at least two of the following:
    a. marked impairment in the use of multiple nonverbal behaviors such as eye-to eye gaze, facial expression, body postures, and gestures to regulate social interaction
    b. failure to develop peer relationships appropriate to developmental level
    c. lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g., by a lack of showing, bringing, or pointing out objects of interest to other people)
    d. lack of social or emotional reciprocity

B. Restricted repetitive and stereotyped patterns of behavior, interests and activities, as manifested by at least one of the following:
    a. encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity of focus
    b. apparently inflexible adherence to specific, nonfunctional routines or rituals
    c. stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or twisting, or complex whole-body movements)
    d. persistent preoccupation with parts of objects

C. The disturbance causes clinically significant impairment in social, occupational, or other important areas of functioning.
D. There is no clinically significant general delay in language (e.g., single words used by age 2 years, communicative phrases used by age 3 years).
E. There is no clinically significant delay in cognitive development or in the development of age-appropriate self-help skills, adaptive behavior (other than in social interaction), and curiosity about the environment in childhood.
F. Criteria are not met for another specific Pervasive Developmental Disorder or Schizophrenia.

299.80 Pervasive Developmental Disorder Not Otherwise Specified

This category should be used when there is a severe and pervasive impairment in the development of reciprocal social interaction associated with impairment in either verbal or nonverbal communication skills or with the presence of stereotyped behavior, interests, and activities, but the criteria are not met for a specific Pervasive Developmental Disorder, Schizophrenia, Schizotypal Personality Disorder, or Avoidant Personality Disorder. For example, this category includes "atypical autism" - presentations that do not meet the criteria for Autistic Disorder because of late age at onset, atypical symptomatology, or sub-threshold symptomatology, or all of these.

DSM-5 Diagnostic Criteria for Autism Spectrum Disorders (American Psychiatric Association [DSM-5], 2013)

Diagnostic Criteria for Autism Spectrum Disorder (299.00)

A. Persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following, currently or by history (examples are illustrative, not exhaustive, see text):
   1. Deficits in social-emotional reciprocity, ranging, for example, from abnormal social approach and failure of normal back-and-forth conversation; to reduced sharing of interests, emotions, or affect; to failure to initiate or respond to social interactions.
   2. Deficits in nonverbal communicative behaviors used for social interaction, ranging, for example, from poorly integrated verbal and nonverbal communication; to abnormalities in eye contact and body language or deficits in understanding and use of gestures; to a total lack of facial expressions and nonverbal communication.
   3. Deficits in developing, maintaining, and understanding relationships, ranging, for example, from difficulties adjusting behavior to suit various social contexts; to difficulties in sharing imaginative play or in making friends; to absence of interest in peers.

   Specify current severity:

   Severity is based on social communication impairments and restricted repetitive patterns of behavior (see Table A1).

B. Restricted, repetitive patterns of behavior, interests, or activities, as manifested by at least two of the following, currently or by history (examples are illustrative, not exhaustive; see text):
   1. Stereotyped or repetitive motor movements, use of objects, or speech (e.g., simple motor stereotypies, lining up toys or flipping objects, echolalia, idiosyncratic phrases).
   2. Insistence on sameness, inflexible adherence to routines, or ritualized patterns or verbal nonverbal behavior (e.g., extreme distress at small changes, difficulties with transitions, rigid thinking patterns, greeting rituals, need to take same route or eat food every day).
   3. Highly restricted, fixated interests that are abnormal in intensity or focus (e.g, strong attachment to or preoccupation with unusual objects, excessively circumscribed or perseverative interest).
   4. Hyper- or hyporeactivity to sensory input or unusual interests in sensory aspects of the environment (e.g., apparent indifference to pain/temperature, adverse response to specific sounds or textures, excessive smelling or touching of objects, visual fascination with lights or movement).

   Specify current severity:

   Severity is based on social communication impairments and restricted, repetitive patterns of behavior (see Table A1).

C. Symptoms must be present in the early developmental period (but may not become fully manifest until social demands exceed limited capacities, or may be masked by learned strategies in later life).

D. Symptoms cause clinically significant impairment in social, occupational, or other important areas of current functioning.

E. These disturbances are not better explained by intellectual disability (intellectual developmental disorder) or global developmental delay. Intellectual disability and autism spectrum disorder frequently co-occur; to make comorbid diagnoses of autism spectrum disorder and intellectual disability, social communication should be below that expected for general developmental level.

Note: Individuals with a well-established DSM-IV diagnosis of autistic disorder, Asperger's disorder, or pervasive developmental disorder not otherwise specified should be given the diagnosis of autism spectrum disorder. Individuals who have marked deficits in social communication, but whose symptoms do not otherwise meet criteria for autism spectrum disorder, should be evaluated for social (pragmatic) communication disorder.

Specify if:

- With or without accompanying intellectual impairment
- With or without accompanying language impairment
- Associated with a known medical or genetic condition or environmental factor
- (Coding note: Use additional code to identify the associated medical or genetic condition.)
- Associated with another neurodevelopmental, mental, or behavioral disorder
- (Coding note: Use additional code[s] to identify the associated neurodevelopmental, mental, or behavioral disorder[s].)
- With catatonia (refer to the criteria for catatonia associated with another mental disorder, pp. 119-120, for definition) (Coding note: Use additional code 293.89 [F06.1] catatonia associated with autism spectrum disorder to indicate the presence of the comorbid catatonia.)

Table A1
Severity levels for autism spectrum disorder

Severity level	**Social communication**	**Restricted, repetitive behaviors**
Level 3 "Requiring very substantial support"	Severe deficits in verbal and nonverbal social communication skills cause severe impairments in functioning, very limited initiation of social interactions, and minimal response to social overtures from others. For example, a person with few words of intelligible speech who rarely initiates interaction and, when he or she does, makes unusual approaches to meet needs only and responds to only very direct social approaches	Inflexibility of behavior, extreme difficulty coping with change, or other restricted/repetitive behaviors markedly interfere with functioning in all spheres. Great distress/difficulty changing focus or action.
Level 2 "Requiring substantial support"	Marked deficits in verbal and nonverbal social communication skills; social impairments apparent even with supports in place; limited initiation of social interactions; and reduced or abnormal responses to social overtures from others. For example, a person who speaks simple sentences, whose interaction is limited to narrow special interests, and how has markedly odd nonverbal communication.	Inflexibility of behavior, difficulty coping with change, or other restricted/repetitive behaviors appear frequently enough to be obvious to the casual observer and interfere with functioning in a variety of contexts. Distress and/or difficulty changing focus or action.
Level 1 "Requiring support"	Without supports in place, deficits in social communication cause noticeable impairments. Difficulty initiating social interactions, and clear examples of atypical or unsuccessful response to social overtures of others. May appear to have decreased interest in social interactions. For example, a person who is able to speak in full sentences and engages in communication but whose to-and-fro conversation with others fails, and whose attempts to make friends are odd and typically unsuccessful.	Inflexibility of behavior causes significant interference with functioning in one or more contexts. Difficulty switching between activities. Problems of organization and planning hamper independence.

Appendix B

BTBC3-P

Table B1

Concepts in Order of Difficulty by Age Band – English (Standardization Sample)

	3-0 to 3-5	3-6 to 3-11	4-0 to 4-5	4-6 to 4-11	5-0 to 5-5	5-6 to 5-11
Least Difficult	Top	Under	Same	Nearest	Finished	Finished
	Another	Top	Both	Finished	Both	First
	Under	Finished	Finished	Both	Different	Middle
	Missing	Highest	Nearest	Tallest	Same	Many
	Highest	All	Tallest	Same	Bottom	Longest
	Finished	Empty	Largest	Many	Most	Bottom
	Nearest	Missing	Longest	Longest	Many	Same
	All	Down	Different	Largest	Longest	Tallest
	Up	Another	Many	Most	Largest	Both
	Empty	Tallest	Bottom	First	Tallest	Different
	Tallest	Both	First	Different	First	Nearest
	Both	Up	Smallest	Around	Nearest	Most
	Outside	Nearest	Around	Bottom	Smallest	Largest
	Down	Largest	Most	Smallest	Around	Around
	Largest	Outside	Before	Before	Middle	Lowest
	Different	Same	Across	Lowest	In front	Smallest
	Full	Many	In front	In front	Before	Together
	Same	Different	Middle	Middle	Lowest	In front
	Longest	Next	Together	Across	Together	Before
	In front	Longest	Lowest	Together	Across	Farthest
	Many	Full	Between	Some, but not many	Shortest	Last
	Across	Most	Farthest	Between	Farthest	Shortest
	Most	Smallest	Shortest	Shortest	Last	Across
	Smallest	Across	Some, but not many	Farthest	Between	Between
	Around	Around	Last	Last	Some, but not many	Some, but not many
Most Difficult	Next	In front	Least	Least	Least	Least

Table B2

BTBC3-P Concepts by Category and Age Band

BTBC3-P Concepts by Category 3-0 to 3-11			
Space	**Quantity**	**Time**	**Other**
Top	Empty	Finished	Missing
Down	Full		Another
Under	All		Different
Highest	Smallest		Same
Next	Longest		
Up	Both		
Outside	Tallest		
Nearest	Many		
Across	Most		
In Front	Largest		
Around			
BTBC3-P Concepts by Category 4-0 to 5-11			
Space	**Quantity**	**Time**	**Other**
Nearest	Smallest	Finished	Different
Across	Longest		Same
In Front	Both		
Around	Tallest		
Before	Many		
Farthest	Most		
Lowest	Largest		
Last	Shortest		
Bottom	Some, but not many		
Together	Last		
Middle			
First			
Between			

Appendix C

Assessor's Tactics Checklist
Boehm Test of Basic Concepts – 3rd edition Preschool Version

TACTIC	Used? Y/N	COMMENT(S)
Gaining Attention:		
Call the child by name before reading the directions		
Physically inhibiting a response (i.e., holding a child's hand until directions are completed)		
Physical Redirection of attention (i.e., tap on the shoulder)		
Increasing Motivation/ Reducing Problem Behaviors:		
Administration in the presence of a teacher/parent		
Presentation of material on the floor rather than table		
Short Break (i.e., pass to toy area)		
Visual Schedule (i.e., answer 5 items then break visually represented)		
Fixed Reinforcement (i.e., giving access to a desired activity after a specific number of items)		
Variable Reinforcement (i.e., giving a desired object after any number of items, rather than a specific amount of items)		
Contingent Reinforcement (i.e., first ______ then ______)		
Forced choice (i.e., *this* or *that*)		
Verbal, Labeled Praise (i.e., nice job sitting in your chair, nice looking, thanks for answering in a loud voice)		
Social Reinforcement (i.e., smile, head nod)		
Nonverbal Reinforcement (i.e., fist bump, high-five, thumbs up)		
Token Economy		
Preferred Edibles		
Other:		

Appendix D

PYRAMID SUMMARY VERBAL CAPABILITIES PRE-READERS

R. Douglas Greer

Mastered = ☑

In Process = ±

Not Present = No Mark

Advanced L.L.

OL for performance

OL for acquisition of new operants

Book Stimuli Conditioned Reinforcement for Observing

Self-Talk: Rotating Speaker & Listener Roles Within Own Skin

Say-Do in Speaker-as Own Listener Function

Contrived Stimuli **L** | Contrived Stimuli **S**

Noncontrived Stimuli **L** | Noncontrived Stimuli **S**

Transformation of Establishing Operations (Leaning Mand or Tact Results in Untaught Function Also)

Independent Mands: (1) Presence of Stimuli, (2) Absence of Stimuli)

Echoic-to-Tact (Generalized Reinforcement for at Least Two Tact

Echoic-to-Mand (Mand Function of Repeating Word Sounds)

Parroting (Speaking Words or Components of Words as Automatic Reinforcement)

Auditory Matching (Selection Response to Match Spoken Words)

Listener Literacy (Hear-Do, Consonant Vowel Sounds of Others Controls Responding)

Generalized Imitation/Basic

Match 2D and 3D Objects

"Capacity for Sameness" Across Senses ("Sameness" as Abstraction Across Smell, Taste, Touch, Hear)

Conditioned Reinforcement for 3D Objects/Print Stimuli

Conditioned Reinforcement for Voices

Teacher Presence Results in Instructional Control Over Child

Conditioned Reinforcement for Faces

PYRAMID SUMMARY READER/WRITER CAPABILITIES

Mastered = ☑

In Process = ±

Not Present = No Mark

Reader/
Writer Capabilities

Writing Governs Complex Operations of Others (Controls)

Textually Responding For Complex Operations (Solving Problems is Verbally Mediated, Algorithmic Control)

Writer Self-Editing (Writer as Own Reader for Target Audiences)

Aesthetic Writing Affects Emotions

Technical Writing Precisely Affects Reader's Behavior

Joint Stimulus Control Across Saying and Writing

Textually Responses function as Auditory Conditioned Reinforcer (Listening to Story is Reinforced by One's Own Speaker Responding)

Textual Responding Joins Naming Repertoire

Reading Governs Responding

Dictation (Hear-Write)

Print Transcription (See-Write)

Responds to Own Textual Responding as Listener (Textually Respond and Hear-Do, or Hear-Name)

Textually Responds 80 Words Per Minute

Naming Accrues from Listening to Story Read by Others

Responds to Own Textual Responding as Listener

Listening to Story Read by Others as Conditioned Reinforcer for Auditory Observing

Appendix E

Table E1

Participant Demographics and Variable Descriptive Statistics

	TD $n = 19$ $n_{Female} = 7$ $n_{Male} = 12$		ASD $n = 32$ $n_{Female} = 3$ $n_{Male} = 29$	
	Range	*M*(SD)	Range	*M*(SD)
Age (months)	37-63	47.84 (8.94)	36-64	50.01(8.39)
Proportion of children in poverty (School District)	.04-.30	.14 (.09)	.03-.37	.14 (.09)
BTBC-P Total Score	33-52	45.16 (6.50)	15-52	32.80 (10.22)
BTBC-P Percentile	25-99	68.53 (27.15)	1-99	27.81 (30.19)
Proportion BTBC Concepts Known	.63-1.00	.87 (0.13)	.28-1.00	.61 (.20)
Proportion BTBC Spatial Concepts Known	.54-1.00	.84 (0.15)	.23-1.00	.56 (.22)
Proportion BTBC Quantitative Concepts Known	.65-1.00	.88(0.13)	.25-1.00	.64(.21)
Error NR	0.00-0.00	0.00 (0.00)	0.00-3.00	.34(.83)
Error A	0.00-10.00	2.16 (2.63)	0.00-13.00	6.06(3.52)
Error E	0.00-9.00	.47(2.06)	0.00-13.00	1.38 (2.60)
Error M	0.00-12.00	4.05(4.01)	0.00-24.00	12.38(7.07)
Time to Completion (minutes; $n_{TD} = 7$; $n_{ASD} = 8$)	7.00-15.28	11.15 (2.83)	11.00-24.00	15.25 (5.53)
Number of Assessor's Tactics Used	2.00-9.00	5.26(2.10)	3.00-14.00	7.22(2.72)
Number of Gaining Attention Assessor's Tactics Used	0.00-2.00	0.84(.69)	0.00-3.00	2.16(0.85)
Number of Increasing Motivation Assessor's Tactics Used	2.00-8.00	4.27(1.81)	1.00-12.00	5.06(2.60)

Proportion of student VBD acquisition	0.50- 1.00	0.88(0.16)	0.06-1.00	0.69 (0.23)
Naming Cusp (Percent Acquired)	89%	-	56%	-
Proportion of concepts known on BTBC3-P also on CPIRK	0.54-1.00	0.88(0.17)	.171.00	.61(.24)
Proportion of concepts known on BTBC3-P **not** on CPIRK	0.67-1.00	0.86(0.12)	0.31-1.00	0.62 (.20)
Proportion of student VBD acquisition	0.50- 1.00	0.88(0.16)	0.06-1.00	0.69 (0.23)

Note: Error NR = then number of “no response” error responses; Error A = the number of “antonym” error responses; Error E = the number of “every” error responses (i.e., when a child points to each item on the response easel, rather than just one); Error M = the number of “miscellaneous” error responses

Table E2

Demographic Correlation Matrix

	TD					ASD				
	1	2	3	4	5	1	2	3	4	5
1 Age in months	-	.14	-.21	.15	-.43	-	.03	.03	.25	-.19
2 Proportion of BTBC3-P concepts known	.13	-	-.50*	.12	-.14	.03	-	-.10	.32	-.34
3 Proportion of children in poverty (school district)	-.21	-.50*	-	-.03	-.08	.03	-.10	-	-.16	.22
4 Proportion of VBD cusps and capabilities	.15	.12	-.03	-	-.24	.24	.32	-.16	-	-.28
5 Number of Assessor's Tactics Used	-.43	-.14	-.08	-.24	-	-.19	-.34	.22	-.28	-

Note: * = Correlation is significant at the 0.05 level; ** = Correlation is significant at the 0.01 level

Table E3

Multiple Regression of Diagnosis and SES on Proportion of Total Concepts Known

	Model 1			Model 2		
Variable	*B*	*SE (B)*	*β*	*B*	*SE (B)*	*β*
Constant	.87	.04	--	.92	.06	--
ASD Dx	-.26***	.05	-.58	-.26***	.05	-.58
Percent Poverty	--	--	--	-.39	.28	-.16
R^2 Change	.34			.03		
F for change in R^2	25.25***			1.90		

DV: Proportion Total Concepts Known

Note: ASD Diagnosis is dummy coded with TD = 0

*** = significant at the $p < .001$ ** = significant at the $p < .01$ * = significant at the $p <.05$

Figure E1

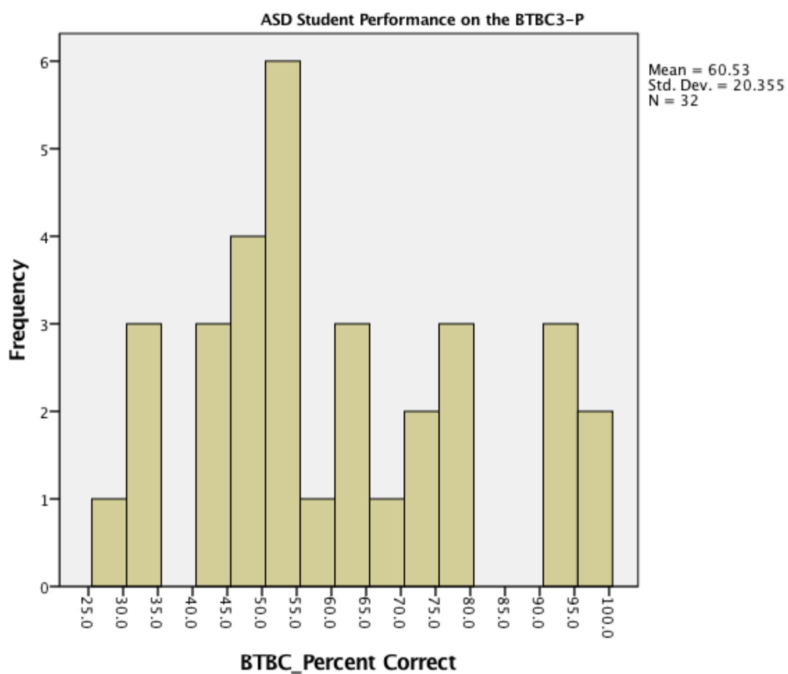

Figure E2

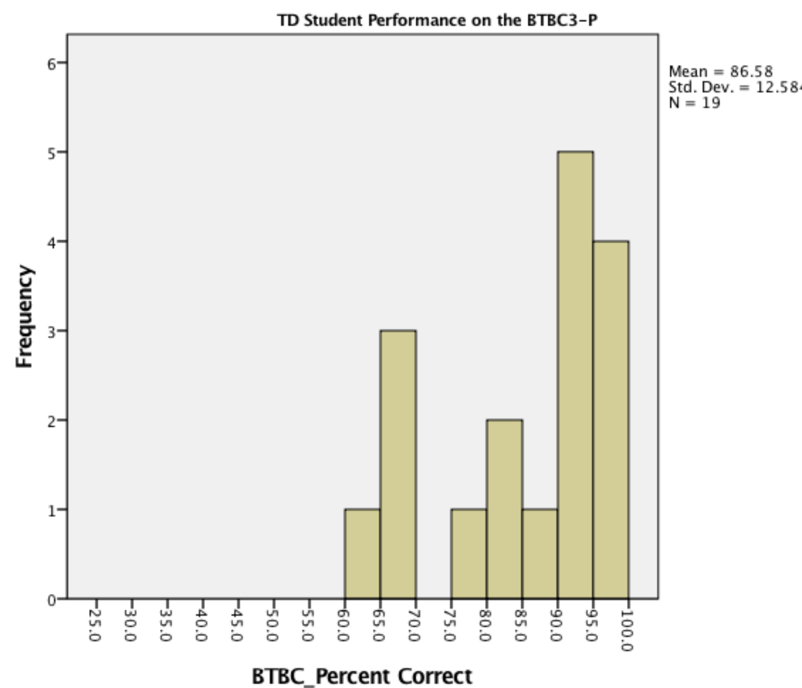

Table E4

Multiple Regression of Diagnosis, VBD, Naming and ASDxNaming on Proportion of Total Concepts Known

	Model 1			Model 2			Model 3			Model 4			Final Model		
Variable	*B*	*SE (B)*	*β*	*B*	*SE (B)*	*β*	*B*	*SE (B)*	*β*	*B*	*SE (B)*	*β*	*B*	*SE (B)*	*β*
Constant	.87	.04	--	.65	.11	--	.65	.10	--	.83	.11	--	.69	.06	--
Diagnosis	-.26***	.05	-0.58	-.21***	.06	-.48	-.19**	.05	-.42	-.35**	.12	-.79	-.19**	.05	-.44
VBD	--	--	--	.24*	.12	.25	.05	.12	.05	--	--	--	--	--	--
Naming	--	--	--	--	--	--	.19**	.06	.41	.05	.12	.10	.20***	.05	-.44
ASDxNaming										.19	.13	.43	--	--	--
R^2	.34				.39			.51			.53			.51	
F change	25.25***				4.2*			10.97**			2.27			--	

DV: Proportion Total Concepts Known

Note: ASD Diagnosis was dummy coded with TD = 0; Naming was dummy coded with No Naming = 0

*** = significant at the p < .001 ** = significant at the p < .01 * = significant at the p <.05

Table E5

Multiple Regression of Diagnosis, VBD, Naming and ASDxNaming on Proportion Concepts Known Not Directly Taught

	Model 1			Model 2			Model 3 (Final)			Model 4		
Variable	*B*	*SE (B)*	*β*	*B*	*SE (B)*	*β*	*B*	*SE (B)*	*β*	*B*	*SE (B)*	*β*
Constant	.864	.039	--	.743	.111	--	.730	.059	--	.865	.112	--
Diagnosis	-.249***	.050	-0.581	-.223***	.054	-.520	-.199***	.049	-.465	-.354**	.120	-.826
VBD	--	--	--	.137	.117	.149	--	--	--	--	--	--
Naming	--	--	--	--	--	--	.149**	.052	.335	-.002	.119	-.004
ASDxNaming										.186	.131	.428
R^2	.337				.356			.436			.459	
F change	24.932***				1.370			8.408**			1.996	

DV: Proportion Concepts Known **not** Directly Taught

Note: ASD Diagnosis was dummy coded with TD = 0; Naming was dummy coded with No Naming = 0

*** = significant at the p < .001 ** = significant at the p < .01 * = significant at the p <.05

Table E6

Multiple Regression of Diagnosis and Total Concepts Known on Spatial Concepts Known

	Model 1			Model 2		
Variable	*B*	*SE (B)*	*β*	*B*	*SE (B)*	*β*
Constant	.844	.045	--	-.056	.043	---
ASD Dx	-.281***	.056	-.579	-.010	.021	-.021
Total Concepts Known	--	--	--	1.039***	.047	.958
R^2	.336			.941		
F for change in R^2	24.775***			492.232***		

DV: Proportion of Spatial Concepts Known

*** = significant at the p < .001 ** = significant at the p < .01 * = significant at the p <.05

Table E7

Multiple Regression of Diagnosis and Total Concepts Known on Quantitative Concepts Known

	Model 1			Model 2		
Variable	*B*	*SE (B)*	*β*	*B*	*SE (B)*	*β*
Constant	.871	.042	--	.073	.058	--
ASD Dx	-.227***	.053	-.523	.013	.028	.029
Total Concepts Known	--	--	--	.921***	.063	.947
R^2	.274			.866		
F for change in R^2	18.456***			211.385***		

DV: Proportion of Quantitative Concepts Known

*** = significant at the p < .001 ** = significant at the p < .01 * = significant at the p <.05

Table E8

Multiple Regression of Diagnosis, VBD, and Naming on number of Assessor's Tactics Used

	Model 1			Model 2			Model 3			Final Model		
Variable	*B*	*SE (B)*	*β*	*B*	*SE (B)*	*β*	*B*	*SE (B)*	*β*	*B*	*SE (B)*	*β*
Constant	5.263	.576	--	8.16	1.576	--	7.245	.859	--	8.313	.595	--
ASD Dx	1.956**	.727	.358	1.33	.775	.244	1.220	.721	.358	--	--	--
VBD	--	--	--	-.097	.049	-.279	--	--	.224	--	--	--
Naming	--	--	--	--	--	--	-2.215**	.751	-.390	-2.655***	.718	-.467
R^2		.129		.065				.134			.218	
F for R^2 change		7.226**		3.87				8.700**			13.68***	

DV: Number of Assessor's Tactics Used

*** = significant at the p < .001 ** = significant at the p < .01 * = significant at the p <.05

Table E9

Assessor's Tactics Frequencies by Type and Diagnosis

	TD (n = 19)		ASD (n = 32)	
	Frequency	Percent	Frequency	Percent
Gaining Attention:				
Call the child by name before reading the directions	13	68.4	31	96.9
Physically inhibiting a response (i.e., holding a child's hand until directions are completed)	0	0	17	53.1
Physical Redirection of attention (i.e., tap on the shoulder)	3	15.8	21	65.6
Increasing Motivation/ Reducing Problem Behaviors:				
Administration in the presence of a teacher/parent	1	5.3	3	9.4
Presentation of material on the floor rather than table	0	0	4	12.5
Short Break (i.e., pass to toy area)	11	57.9	16	50
Visual Schedule (i.e., answer 5 items then break visually represented)	0	0	0	0
Fixed Reinforcement (i.e., giving access to a desired activity after a specific number of items)	5	26.3	7	21.9
Variable Reinforcement (i.e., giving a desired object after any number of items, rather than a specific amount of items)	3	15.8	15	46.9
Contingent Reinforcement (i.e., *first* ______ *then* ______)	8	42.1	14	43.8
Forced choice (i.e., *this* or *that*)	1	5.3	4	12.5
Verbal, Labeled Praise (i.e., nice job sitting in your chair, nice looking, thanks for answering in a loud voice)	19	100	29	90.6
Social Reinforcement (i.e., smile, head nod)	18	94.7	28	87.5
Nonverbal Reinforcement (i.e., fist bump, high-five, thumbs up)	10	53.6	25	78.1
Token Economy	1	5.3	3	9.4
Preferred Edibles	2	10.5	8	25
Other (e.g., Prompting before each question; repetition for items; Using intense interest to build motivation (i.e., whole session set up as super secret superhero mission to help green lantern answer questions about pictures.); Allow child to be comfortable during testing (i.e., removing shoes).	6	31.6	6	18.8

Table E10

Assessor's Tactics Frequencies by Type and Naming

	Naming (n = 35)		No Naming (n = 16)	
	Frequency	Percent	Frequency	Percent
Gaining Attention:				
Call the child by name before reading the directions	28	80	16	100
Physically inhibiting a response (i.e., holding a child's hand until directions are completed)	7	20	10	62.5
Physical Redirection of attention (i.e., tap on the shoulder)	14	40	10	65.6
Increasing Motivation/ Reducing Problem Behaviors:				
Administration in the presence of a teacher/parent	3	8.57	1	6.25
Presentation of material on the floor rather than table	1	2.86	3	18.75
Short Break (i.e., pass to toy area)	16	45.71	11	68.75
Visual Schedule (i.e., answer 5 items then break visually represented)	0	0	0	0
Fixed Reinforcement (i.e., giving access to a desired activity after a specific number of items)	5	14.29	7	43.75
Variable Reinforcement (i.e., giving a desired object after any number of items, rather than a specific amount of items)	10	28.57	8	50
Contingent Reinforcement (i.e., *first* ______ *then* ______)	13	37.14	9	56.25
Forced choice (i.e., *this* or *that*)	2	5.71	2	12.5
Verbal, Labeled Praise (i.e., nice job sitting in your chair, nice looking, thanks for answering in a loud voice)	33	94.29	15	93.75
Social Reinforcement (i.e., smile, head nod)	30	85.71	16	100
Nonverbal Reinforcement (i.e., fist bump, high-five, thumbs up)	22	62.85	13	81.25
Token Economy	2	5.71	2	12.5
Preferred Edibles	5	5.71	5	31.25
Other	7	20	5	31.25

Appendix F

Table F1

School District Demographics

School District	Number of TD	Children ASD	Average Percent in Poverty
1	-	2	3.80
2	-	1	2.00
3	-	1	10.10
4	1	-	6.70
5	2	-	4.60
6	-	1	37.00
7	1	-	8.40
8	-	2	7.80
9	-	1	2.90
10	4	-	13.1
11	-	1	5.20
12	-	1	4.90
13	2	-	3.80
14	-	1	5.10
15	1	-	4.90
16	-	4	21.80
17	-	3	14.90
18	2	-	29.50
19	-	1	8.20
20	-	1	22.60
21	-	1	3.50
22	1	-	8.50
23	-	1	3.80
24	-	2	2.60
25	5	8	21.5

Appendix G

Pilot Study

The following pilot study provides a preliminarily analysis of using the BTBC3-P in an ASD population attending a specialized ABA school.

Participants

Participants in this pilot study were recruited as part of a larger study aimed at establishing concurrent validity between the BTBC3-P and the individualized curriculum (i.e., C-PIRK©) used at CABAS© schools. Inclusion criteria for each child were the prerequisite skills of: maintaining attention for at least five minutes during a one-on-one task, being able to be re-directed back to task when prompted, following basic one step vocal directions, and being able to point when asked. Inclusion data was based on teacher interviews. The following is a presentation of pilot data that is anticipated to be included in the final dataset. There were 45 students considered for inclusion in the pilot study. Of the 45, three withdrew consent, two were out of age range at the time of data collection, and two students were unable to complete the sample items in the BTBC3-P, so testing was discontinued. The final pilot sample consisted of 39 preschool (n = 36) and early intervention students (n = 3) ranging in age from 3 years 0 months to 5 years 4 months (M_{age} = 49.79 months SD = 8.89 months; n_{males} = 29; n_{females} = 10). Of the 39 participants, 28 had Individualized Education Plans (IEPs) and were classified as a Preschool Student with a Disability, three received early intervention services, and 11 participants did not have an IEP, and are considered typically developing. Twenty participants had outside, verified diagnoses of PDD-NOS (n = 7) or ASD (n = 13) by a primary care physician (n = 1) or psychologist (n = 20). Diagnoses were verified by a review of school materials and IEP and diagnostic data were unavailable for two of the IEP students. The remaining diagnoses for students with IEPs include Mixed Expressive/Receptive Disorder (n = 1), Developmental Coordination Disorder (n = 1), Mixed Developmental Disorder (n = 1), and no formal diagnosis (n = 3). One student with ASD was identified as having a comorbid diagnosis of Attention Deficit Hyperactivity Disorder (ADHD).

Procedure

Institutional Review Board (IRB) approval was obtained from the CABAS© School IRB on January 9, 2015 and on March 23, 2015 from the Teachers College IRB. Data collection took place over two months (May and June 2015). The CABAS© system utilizes the Preschool Inventory of Repertoires for Kindergarten (PIRK©; Greer, 2014) curriculum, which was designed to include learning goals necessary for success in a mainstream classroom. This study fits in with the desired research framework of the CABAS© School. The students enrolled at CABAS© Schools are primarily classified as a Preschool Child with a Disability (approximately 75%) and approximate a developmentally delayed population in need of individualized learning goals and plans. Many of the children have diagnoses of ASD.

More specifically, the recruitment followed the following steps: 1. Recruitment Flyers and Consent forms were sent home to parents of all students to review. 2. Once the research team determined which parents have consented to participate, a teacher interview occurred to determine eligibility for inclusion. Inclusion in the study was based on two criteria: 1. Participants were between the ages of 3 years 0 months and 5 years 11 months. 2. Participants had prerequisite skills of: maintaining attention for at least five minutes during a one on one task, being able to be re-directed back to task when prompted, following basic one step vocal directions, and be able to point when asked. A file review of each student was also completed to obtain more information. Specifically, the child’s formal diagnosis, special education classification, date of birth, progress on the individualized curriculum (C-PIRK©), and assessments of verbal behavior development were obtained.

Once a child was deemed eligible to participate, the researcher first discussed an appropriate time to assess the child. Then, the experimenter entered the classroom so the participant could habituate to her presence. After approximately 10-15 minutes, the experimenter approached the student and said, "My name is ________________. How are you? [Wait for response]. I was hoping you could help me answer some questions about some pictures. Some of the questions may seem really easy, while others will be harder. If you don't know, it is ok. Just try your best." If the child declined, the child did not participate in the study and resumed his/her normal, individualized classroom activities. There was no punishment for declining participation. While there is a risk for missing instructional time, the risk is minimal, as preschool students generally have access to snack, recess and free play time throughout the day on a regular basis. Experimenters worked with classroom teachers to ensure the test took place during a non-instructional period of the day. The data collection took place in an office location outside of the classroom within the school building. The office was well-lit, well-ventilated room and was free of distractions. Testing occurred at a child-sized table or on the floor, depending on the individual child's needs. If a child appeared to be in distress, a break or access to a desired object (i.e., computer) was offered. If the child continued to refuse the task, then the child was returned to his/her classroom and was given a second opportunity on another day to participate in the study. If the child is unable to complete the practice items, testing stopped.

Masters level school psychology students, in addition to the principal investigator, assessing the children have extensive training in administering standardized and unstandardized tests to children. They have been trained in how to put children at ease and how to identify fatigue and frustration. Masters level school psychology students are assessing the children so the researchers can obtain ecological data regarding the usefulness of the Assessor's Tactics Checklist, and to possibly obtain a wider range of tactics utilized. Assessors underwent a three-hour training in the administration and scoring of the Preschool Version of the Boehm test of Basic Concepts (BTBC3-P). They completed practice administrations and practiced using the tactics listed on the Assessor's Tactics Checklist. Each of the students have taken a class in Behavioral Interventions, and many of them have worked in Applied Behavior Analysis schools while others have a history working with children with autism. Assigning identification numbers to all participants ensured subjects' confidentiality. Identifiable consent forms that link the subjects with their identification numbers are kept in a locked filing cabinet in the PI's office separate from the de-identified data.

Analysis of Pilot Study BTBC3-P Outcomes

Preliminary analyses for the BTBC3-P means and standard deviations can be found in Table G1 below.

Table G1
Means and Standard Deviations (SD) for the BTBC3-P (Pilot Study)

	Mean Total Score (SD)	Mean Percentage Correct (SD)	Mean Performance Range (SD)	Mean Percentile Score (SD)
IEP	33.89 (11.53)	64.82 (22.34)	2.11 (0.96)	34.18 (35.14)
Range	17-52	32-100	1-3	<1-99
TD	45.81 (6.31)	87.82 (12.24)	1.09 (0.30)	70.36 (26.68)
Range	33-52	63-100	1-2	30-99
Total (IEP+TD)	37.26 (11.60)	71.31 (22.45)	1.82 (0.94)	44.38 (36.56)
Range	17-52	32-100	1-3	<1-99

Note: Performance Range of 1 indicates a child knows most of the concepts, compared to age-level peers. A performance of 2 means the child knows many of the concepts, but lacks understanding of some key concepts, a performance of 3 means the child's knowledge is extremely low when compared to age level peers.

Table G2 *Assessor's Tactics Used in Pilot Study*	**USED IEP (% of 29)**	**USED TD (% of 11)**
<u>Gaining Attention:</u>		
Call the child by name before reading the directions	**27 (93.1%)**	**8 (72.7%)**
Physically inhibiting a response (i.e., holding a child's hand until directions are completed)	**16 (55.2%)**	**0 (0%)**
Physical Redirection of attention (i.e., tap on the shoulder)	**19 (65.5%)**	**2 (18.2%)**
<u>Increasing Motivation/ Reducing Problem Behaviors:</u>		
Administration in the presence of a teacher/parent	**4 (13.8%)**	**1 (9.1%)**
Presentation of material on the floor rather than table	**4 (13.8%)**	**0 (0%)**
Short Break (i.e., pass to toy area)	**17 (58.6%)**	**10 (90.1%)**
Visual Schedule (i.e., answer 5 items then break visually represented)	**0 (0%)**	**0 (0%)**
Fixed Reinforcement (i.e., giving access to a desired activity after a specific number of items)	**4 (13.8%)**	**4 (36.7%)**
Variable Reinforcement (i.e., giving a desired object after any number of items, rather than a specific amount of items)	**13 (44.8%)**	**1 (9.1%)**
Contingent Reinforcement (i.e., first _______ then _______)	**13 (44.8%)**	**5 (45.5%)**
Forced choice (i.e., *this* or *that*)	**4 (13.8%)**	**0 (0%)**
Verbal, Labeled Praise (i.e., nice job sitting in your chair, nice looking, thanks for answering in a loud voice)	**27 (93.1%)**	**11 (100%)**
Social Reinforcement (i.e., smile, head nod)	**23 (79.3%)**	**10 (90.1%)**
Nonverbal Reinforcement (i.e., fist bump, high-five, thumbs up)	**22 (75.9%)**	**6 (54.5%)**
Token Economy	**3 (10.3%)**	**0 (0%)**
Preferred Edibles	**9 (31.0%)**	**2 (18.2%)**
<u>Other:</u> "Whole session set up as super secret superhero mission to help green lantern answer questions about pictures" "Repeated some items that she wasn't focused when I first read them. This was helpful."	**6 (20.7%)**	**5 (45.5%)**

Appendix H

RESEARCH PROTOCOL for Research Assistants

1. Arrive at by 8:30 A.M.
2. Sign in to the front desk and say you are there to meet Lin Du, Ph.D. She is our contact person, and she will be assisting us with the research study.
3. You will each have assigned research participants you will be assessing. Pick up the folder that has the corresponding participant's ID number in Lin's office (this will be given to you by Alexis or Lin in advance)
4. Lin will introduce you to the teachers of the students you will be assessing and you will discuss with them their preferences, reinforcers, and anything else that is relevant for the study
   - ☐ Take notes
   - ☐ Ask the teacher whether they are a pre-listener, pre-speaker, listener, or speaker
   - ☐ Obtain the information Verbal Behavior Development Pyramid (please photocopy this or take a PDF and print)
   - ☐ Ask when you should come back to first observe for 10-15 minutes and then pull for 45 minutes
5. Lin will show you the testing room you will be in
6. Set up the testing room (all of this will be available at Keller)
   - ☐ Age appropriate chairs and table
   - ☐ BTBC Protocol
   - ☐ BTBC Manual
   - ☐ BTBC Easel
   - ☐ Pen
   - ☐ Assessors Tactic Checklist
   - ☐ RA "Cheat Sheet" for administration notes and script
   - ☐ Reinforcers (given by teacher, if applicable)
7. Return to the classroom of the child/children you will be assessing at the specified time (established with the teacher before school)
   - ☐ Observe/interact with the child/children for about 10-15 minutes
   - ☐ Stay there until the child/children is/are comfortable with you
   - ☐ Then pull the child to begin testing
8. Bring the child to the testing room and read the script on the RA "Cheat Sheet"
9. Administer the BTBC3R
10. Use behavior modification techniques listed on the Assessors Tactic Checklist and keep track of what you use
11. When you are done, reward the child and bring them back to class
12. Immediately Score the Protocol. Have a fellow RA double score your protocol.
13. Enter scores into the database

<u>INTRODUCING THE TASK:</u> Praise for nice sitting, cooperating, for coming with you. Give them some reinforcers at this point (i.e., toys, food, etc.) Then, remind them of your name. "Again, my name is ________________. I was hoping you could help me answer some questions about some pictures. Some of the questions may seem really easy, while others will be harder. If you don't know, it is ok. Just try your best." – then move swiftly into the task.

<u>**NOTE:**</u> If a child appears to be in distress, a break or access to a desired object will be offered. If the child continues to refuse the task, then the child will return to his/her classroom and will be given a second opportunity on another day to participate in the study. If the child is unable to complete the practice items, testing will stop. The examiners will also praise the child for his/her effort and tell him/her that, "It's alright if you make a mistake." They will also provide supportive statements such as, "That's very good thinking" or "You're doing just fine."

<u>**ADMINISTRATION:**</u>

1. Position Picture Manual between you and the child so pictures face the child and you can easily see the directions
2. Read the directions aloud to the child – **"I am going to show you some pictures. I want you to point to the picture I am talking about".**
3. Then show practice item A and say, **"Show me the *cup*. Now point to the *ball*. Point to the *shoe*. Now show me the *rabbit (bunny)*."**
    a. Incorrect response – show and verbalize correct response after repeating the question. Teach **three** times, then after the third time, physically move their hand to point.

        Example: Show me the cup [Px] This is a cup. Point to the cup [Px] This is a cup. Point to the cup. [Px] This is a cup. Point to the cup. [Physically prompt the student to point to the cup with their finger but still mark incorrect on protocol]

        Px = point incorrectly
4. Show the child Practice item B and say, **"Point to the dog that is *on the box*"**
    a. Incorrect response – show and verbalize correct response
5. If after practice the child still does not understand, discontinue testing.
6. <u>Sample item NOTES:</u>
    a. Emphasize the concept words that are in *italic*
    b. Do not read the practice item letters
    c. Read directions exactly as written
    d. Repeat directions and/or practice items and provide additional explanation, if needed, until the child knows what to do
7. Make sure the child is attentive when you begin to read a test item. You can ask, **"Ready?"**
    a. Use the **Assessor Tactics List** to help keep child on task
    b. **Manual Suggestions: a.)** Point to the choices and the child can nod or make some other form of acknowledgment "Tell me when I'm right. Is it this one?" **b.)** Place increased emphasis on key words of test directions **c.)** Give the test over multiple sessions
    c. If a child asks you which one is right you can say **"Point to the answer you think is best"**

Appendix I

Recruitment Flyer

Teachers College, Columbia University
525 West 120th Street
New York NY 10027
212 678 3000
www.tc.edu

Your child may be eligible to participate in a research study on relational concept development in preschool students attending the Fred S. Keller School!

Relational concepts include words like 'alike,' 'before,' 'first/second/third,' and 'part/whole.' Relational concept development is important for academic and social success in early childhood. Your child is being asked to take part in this study because we as educators are interested in learning how knowledge of relational concepts develop in young children attending the Fred S. Keller School.

Please consider having your child participate in this study. If you are interested, please read and sign the informed consent and send back to co-investigator Lin Du, Ph.D. If you have any questions about the study, please contact co-investigators, Lin Du, Ph.D. at (914) 965-1152 or Alexis Branca Bancroft at (914) 403- 3822.

Appendix J

Teachers College, Columbia University
525 West 120th Street
New York NY 10027
212 678 3000
www.tc.edu

INFORMED CONSENT

Principal Investigator: Alexis Branca Bancroft, M.A., Ed.M.
Co-Principal Investigator: Lin Du, Ph.D.

Research Title: Basic Concept Development in Preschool Children with Autism Spectrum Disorder (ASD)

DESCRIPTION OF THE RESEARCH: Your child is invited to participate in a research study on relational concept development in preschool students with Autism Spectrum Disorder (ASD). Relational concepts are words such as ‘alike,’ ‘before/after,’ ‘first/second/third,’ and ‘part/whole.’ They describe qualities of people or objects (pretty, tall, angry, small), spatial relationships (in, on, under, beside), time (before, after), and quantity (more, few, some). Your child is being asked to participate in this study because we, as educators, want to learn more about how knowledge of basic concepts develops in young children with ASD. This is an educational research study. It only includes people who choose to participate. Please take your time to make a decision.

If your child takes part in this study, he/she will be given the Preschool Version of the Boehm Test of Basic Concepts – 3rd edition. As part of this task, your child will be asked to pick a picture best describes 38 separate concepts. Each concept is tested two times. Master’s level students in the School Psychology program at Teachers College, Columbia University, will complete the testing. Testing will take place during school hours at the Fred S. Keller School and will last between 30 minutes – 1 hour. This activity will occur during non-instructional time such as recess or free time.

RISKS AND BENEFITS

There are no direct benefits or risks for participation. Minimal risk may include tiredness or boredom. This activity is similar to standardized academic testing but is briefer in duration. If your child becomes distressed, a break or access to an enjoyable activity will be offered. If your child refuses the task, he/she will return to his/her classroom and will be given a second opportunity to participate on another day. If your child is unable to complete the practice items, testing will stop. Examiners will provide comforting statements such as, “That’s very good thinking,” “You’re doing just fine,” or “It’s ok if you make a mistake.”

PAYMENTS: You will receive no payment for taking part in the study.

DATA STORAGE TO PROTECT CONFIDENTIALITY: A number of measures will be taken to ensure your child’s confidentiality. Each child will be given a unique identification code. All materials will be stored in locked filing cabinets. Information will only be used for professional purposes and will not include identifiable information.

TIME INVOLVEMENT: Participation in this study will last between 30 minutes – 1 hour and will take place in one day.

HOW WILL RESULTS BE USED: The outcomes will be used to inform parents and teachers and will not be used for classification purposes. The data will be used for publication, but there will be no way to identify individuals, since each child will have their own unique identification code.

ROLE OF THE PRINCIPAL INVESTIGATORS: Alexis Branca Bancroft, M.A., Ed.M. will work closely with Lin Du, Ph.D., co-principal investigator and Keller School Liaison. We will make sure this research study is completed according to Institutional Review Board standards. For questions about the study, please contact the Keller School researcher liaison and co-principal investigator, Lin Du, Ph.D. at (914) 965- 1152. You may also contact co-principal investigator Alexis Branca Bancroft, M.A., Ed.M. at (914) 403-3822 at any time with questions.

Appendix K

Teachers College, Columbia University
525 West 120th Street
New York NY 10027
212 678 3000
www.tc.edu

INFORMED CONSENT -- Addendum

Principal Investigator: Alexis Branca Bancroft, M.A., Ed.M.
Co-Principal Investigator: Lin Du, Ph.D.
Research Title: Basic Concept Development in Preschool Children

Dear Research Participants,

Thank you for returning the consent form for the study on Basic Concept Development in Preschool Children!

We are writing to inform you of a small change to our study. In order to give teachers at Fred S. Keller School strategies to increase student knowledge of basic concepts, which have been linked to student academic and social success in first grade, we first need to understand the children who attend the Fred S. Keller School more completely. Therefore, we ask your permission to complete a file review. If granted permission, we will obtain three specific pieces of information: your child's current classification, related services received (i.e., speech and language therapy), and previous standardized test scores. We ask for this information so we can compare your child's performance on the present task to his/her performance on other, similar standardized tasks. We will not use any other information from your child's file. Please note that you and your child's identity will continue to remain completely confidential, and the information will not be used for any other purpose.

If you **no longer** wish to have your child participate, please sign and return this form to Lin Du, Ph.D. by **Friday May 22, 2015**. If you do not return this form, we will assume your continued consent for participation. For questions, please contact Lin Du, Ph.D. at (914) 965- 1152 or Alexis Branca Bancroft at (914) 403- 3822.

I am the parent /legal guardian of ____ and I voluntarily **withdrawal** his /her participation.

Guardian's Signature/consent: ____________________________________ Date:____/____/____

Name: ____________________________________

Appendix L

Teachers College, Columbia University
525 West 120th Street
New York NY 10027
212 678 3000
www.tc.edu

PARTICIPANT'S RIGHTS

Principal Investigator: Alexis Branca Bancroft, M.A., Ed.M.
Co-Principal Investigator: Lin Du, Ph.D.
Research Title: Basic Concept Development in Preschool Children with Autism Spectrum Disorder (ASD)

- I have read and discussed the Research Description with the researcher. I have had the opportunity to ask questions about the purposes and procedures regarding this study.
- My participation in research is voluntary. I may refuse to participate or withdraw from participation at any time without jeopardy to future medical care, employment, student status or other entitlements.
- The researcher may withdraw me from the research at his/her professional discretion.
- If, during the course of the study, significant new information that has been developed becomes available which may relate to my willingness to continue to participate, the investigator will provide this information to me.
- Any information derived from the research project that personally identifies me will not be voluntarily released or disclosed without my separate consent, except as specifically required by law.
- For questions about the study, please contact the Keller School researcher liaison and co-PI, Lin Du, Ph.D. at (914) 965- 1152. You may also contact the principal investigator, Alexis Branca Bancroft at (914) 403- 3822 at any time with questions.
- If at any time I have comments, or concerns regarding the conduct of the research or questions about my rights as a research subject, I should contact the Teachers College, Columbia University Institutional Review Board /IRB. The phone number for the IRB is (212) 678-4105. Or, I can write to the IRB at Teachers College, Columbia University, 525 W. 120th Street, New York, NY, 10027, Box 151.
- I should receive a copy of the Research Description and this Participant's Rights document.
- My signature means that I agree to participate in this study.

I am the parent /legal guardian of ____and I voluntarily approve of his /her participation.

Guardian's Signature/consent: ______________________________Date:____/____/____

Name: ______________________________