Peer Relationships in School-Age Children with Autism: Concurrent and Longitudinal Predictors

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Abstract

Peer Relationships in School-Age Children with Autism: Concurrent and Longitudinal Predictors

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This study investigated contributors to peer competence and friendship quality in 26 children with autism (age *M*=11.7 years, *SD*=.72; 20 boys, 6 girls) and 25 children with typical development (TD; age *M*=10.2 years, *SD*=1.5; 18 boys, 7 girls). Peer competence was indicated by a child's ability to use prosocial behaviors to interact with peers. Friendship quality was indicated by a child's interactions with one specific "focus" friend. Both outcomes were assessed via parent report. Prior to this dissertation, parents and children with autism at age 4 years completed a play task that captured mutual responsiveness behaviors, defined as two-part interactions in which a participant engaged his or her partner, and the partner responded positively. The play task was coded with two coding systems: the Relationship Affect Coding System (RACS) and Coder Impressions (Co-Imps). For the purposes of this dissertation, three subdomains of mutual responsiveness were created using the RACS and Co-Imps: Micro Responsiveness, Shared Control, and Global Impressions. Results revealed that group (autism or TD) and language together concurrently predicted peer competence and friendship quality. Furthermore, group uniquely contributed to peer competence, and language uniquely contributed

to friendship quality. Together, the three subdomains of mutual responsiveness between parents and children with autism at age 4 years did not longitudinally predict peer competence or friendship quality at age 10 years. A trend toward significance was detected between Shared Control, i.e. children's attempts to influence parents' behavior, and peer competence, but a follow-up analysis did not reach significance. Children who had more control in the play interaction at age 4 years had higher peer competence at age 10 years. Furthermore, two subdomains of mutual responsiveness, Global Impressions and Shared Control, were correlated with language abilities at age 4 years. Specifically, children who were in more globally responsive dyads and who had more control during play with their parents had better language abilities. This is the first study to describe unique contributions of group and language to peer competence and friendship quality. In addition, language appeared to play an important role to social outcomes for children with autism, as demonstrated by linkages between language and mutual responsiveness at age 4 years and language and friendship quality at age 10 years.

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DEDICATION

This work is dedicated to my family. To my mother, who assured me that I could finish; my father, who instilled in me tenacity and endless optimism that only a Cubs fan can have; my husband, who gave me the confidence to believe in my own ideas, and my daughter, whose everyday joy reminded me to see the bigger picture.

Peer competence and friendships are seminal achievements of middle childhood and contribute to a child's quality of life. Peer competence reflects a child's ability to function within a network of peers by entering peer groups, maintaining play, and resolving conflicts (Fujiki, Brinton, Hart, & Fitzgerald, 1999; Guralnick, 1999). Friendship, a construct that is distinct from peer competence, is a one-to-one relationship between a child and a peer, requiring a "social contract" and necessitating reciprocity (Fujiki et al., 1999). Peer competence and friendships contribute to social and cognitive development (Guralnick, Neville, Hammond, & Carter, 2007), are integral in refining prosocial behaviors (Gest, Graham-Bermann, & Hartup, 2001), enhance school performance (Doll, 1996), decrease victimization (Petrina, Carter, & Stephenson, 2014), and create a positive school environment (Fujiki et al., 1999).

Children with autism display social communication deficits including diminished interest in peers and difficulty establishing and maintaining relationships (American Psychiatric Association, 2013). Peer competence and friendship challenges for children with autism have been described in the literature, although not extensively. However, nearly all studies have focused exclusively on children with autism who do not have intellectual disability (ID) or language impairment (LI) (Petrina et al., 2014), although many children with autism may have ID (Fombonne, 2003; Chakrabarti & Fombonne, 2005). In addition, few studies have identified factors that contribute to peer competence and friendship (Locke, Ishijima, Kasari, & London, 2010). In this dissertation, I will examine longitudinal and concurrent contributors to peer competence and friendship outcomes for children with autism, including children with ID.

Peer Competence in Children with Autism

Peer competence refers to a set of skills allowing children to apply their social knowledge in complex and dynamic interactions with their peers (Guralnick, 1992). Children with peer

competence frequently engage in proactive social skills such as 1) gaining entry into peer groups, 2) maintaining play with peers, and 3) resolving conflict (Dodge et al., 1986 in Guralnick, 1999); and children with autism have shown deficits across these prosocial peer behaviors. Preschool children with autism without ID or LI were less proactive in conversations and joining peer groups (Bauminger-Zviely, Karn, Kimhi, & Agam, 2013) and children age 10-13 years with autism, some with ID and LI, were less likely to help a person in need than were peers with TD and other DD (Sigman et al., 1999). Sixteen children with autism, age 8-17 years without ID or LI, demonstrated understanding of peer group entry in a lab task, but did not demonstrate the ability to enter peer groups commensurate with their level of stated understanding (Bauminger, Shulman, & Agam, 2003). Investigators have documented extensive play deficits for children with autism, including difficulty with object-based play and social games for children with ID (e.g. peekaboo) (Walton & Ingersoll, 2013), lack of novelty and spontaneity in pretend play for younger children with autism and a range of intellectual ability (Rutherford, Young, Hepburn, & Rogers, 2007), and more parallel play than interactive play for school-age children without ID or LI (Bauminger et al., 2008[b]). When faced with conflict resolution scenarios such as negotiating and taking turns, eight children with autism, age 5-8 years without ID or LI, generated fewer novel ideas to solve a problem in hypothetical vignettes compared to younger, IQ-matched children with TD (Bernard-Opitz, Sriram, Nakhoda-Sapuan, 2001). Thus, children with autism have displayed consistent difficulties deploying proactive social skills across partners, places, and activities.

Another way to examine peer competence is via acceptance, i.e. popularity, which reflects how peers view a child, because of his ability to use prosocial behavior to function within their group (Fujiki et al., 1999). Previous studies examining acceptance of children with

autism have shown mixed results. Although 20 preschool children with autism without ID or LI were more excluded by peers than developmentally-matched children with TD (Meek, Robinson, & Jahromi, 2012), 10 children with autism age 7-12 years, with IQs ranging from below-average to average range, tended to be accepted in inclusive classrooms that supported children with TD and DD (Boutot & Bryant, 2005). However, even in the more supportive environment of an inclusive classroom, fewer peer accepted seven high school children with autism compared to children with TD, and peers who accepted them were more likely to be children with special needs (Locke et al., 2010). Of a sample of children with autism age 6-11 years without ID or LI, younger children with autism were more accepted than older children with autism (Kasari, Locke, Gulsrud, & Rotheram-Fuller, 2011), which was also found in a sample of 79 children with autism, grades kindergarten through 5th, with a range of IQ from impaired to above average (Rotheram-Fuller, Kasari, Chamberlain, & Locke., 2010).

Examining children with autism's peer competence, researchers used primarily laboratory-based observations (Bauminger-Zviely et al., 2013; Sigman et al., 1999; Meek et al., 2012), and one employed school-based observations (Locke et al., 2010). The number of participants varied, but commonly included approximately 20-30 children with autism (Bauminger-Zviely et al., 2013; Sigman et al., 1999; Meek et al., 2012). Participants included both "high functioning" children with autism (Bauminger-Zviely et al., 2013; Meek et al., 2012) as well as those with ID (Rotheram-Fuller et al., 2010; Sigman et al., 1999). Children with autism were compared to children with TD (Bauminger-Zviely et al., 2013; Locke et al., 2010; Meek et al., 2012; Rotheram-Fuller, et al., 2010), as well as children with ID (Sigman et al., 1999). With the exception of Meek et al., (2012), all reviewed studies were cross-sectional. Thus,

peer competence outcomes for younger children with autism, and those who do not have LI are not currently well-known.

Friendship in Children with Autism

Friendship is a reciprocal relationship (Bauminger & Kasari, 2000) of at least six months in duration (Bauminger et al., 2008[a]; Bauminger et al., 2008[b]) including meetings outside of school or pre-arranged groups (Bauminger et al., 2008[a]; Bauminger et al., 2008[b]; Mazurek & Kanne, 2010), with shared interests and activities (Mazurek & Kanne, 2010). Friendships were less likely to be reciprocal in children with autism age 6-11 years without ID or LI (Calder, Hill, & Pellicano, 2013; Kasari et al., 2011), and reciprocity decreased as autism symptoms increased for school-age children with IQ scores ranging from below average to above average (Rotheram-Fuller et al., 2010). Furthermore, children with autism identified friendships as reciprocal although their parents did not consistently endorse that claim (Calder et al., 2013). Though school-age children with autism without ID or LI established stable friendships of more than six months (Bauminger & Shulman, 2010; Daniel, Billingsly, & Bonnie, 2010), children with autism similar in age and IQ had fewer friends than children with TD (Bauminger & Shulman, 2003; Macintosh & Dissanayake, 2006; Rowley et al., 2012; Solish, Perry, & Mines, 2010), and children with special needs including ID (Solish et al., 2010), LI, and other neurodevelopmental conditions (Rowley et al., 2012). School-age children with autism without ID or LI were more likely than children with TD not to have a best friend (Bauminger, Shulman, & Agam, 2004; Rowley et al., 2012) or no friends at all (Solish et al., 2010). Adolescents with autism without ID or LI tended to have friends who also had special needs (either autism or other DD) (Locke et al., 2010), but this was not the case for adolescents with learning disabilities, ID, and LI (Shattuck et al., 2011).

Using a frequently-used self-report of friendship quality (Bukowski, Hoza, & Bolvin, 1994), children with autism tended to have lower quality friendships compared to children with TD. School-age children with autism, without ID or LI spent less time with friends at home and at school (Bauminger & Kasari, 2000; Chamberlain et al., 2007; Kasari et al., 2011; Locke et al., 2010), received less aid during challenging situations from their friends (Bauminger & Kasari, 2000; Calder et al., 2013; Kasari et al., 2011; Locke et al., 2010; Solomon et al., 2011), experienced less security (Bauminger & Kasari,2000; Kasari et al., 2011; Solomon et al., 2011), and felt less cared for in friendships (Calder et al. 2013; Kasari et al., 2011; Solomon et al., 2011). However, they often did not report different levels of conflict (Calder et al., 2013; Kasari et al., 2011; Locke et al., 2010; Solomon et al., 2011).

Friendship quality differences were apparent in children with autism based on whether they were in mixed friendships with a child with TD, or non-mixed friendships with another child with autism (Bauminger et al., 2008[a]). Forty-two children with autism and 31 TD peers, age 8-12 years, all without ID or LI, participated in a study examining the differences in friendships, completing non-competitive tasks with self-identified friends. Twenty-six children with autism had mixed friendships and 16 children with autism had non-mixed friendships. Their behaviors with friends were characterized by verbal and nonverbal indicators of positive social interaction, such as cooperating during the task, helping, positive affect, conversational flow, and coordinated play. Children with autism in mixed friendships and children with TD had greater positive social orientation, cohesiveness, responsiveness, and coordinated play during the play interaction than children with autism in non-mixed friendships. Mothers reported friendship duration and stability of friendships. Children with TD had friendships of longer duration than children with autism in non-mixed friendships, but within the children with autism, the duration

of friendships was not significantly different between the mixed and non-mixed groups. The children with mixed friendships had more stable friendships than children with non-mixed friendships, but differences in stability were not significant between either group with autism and the children with TD.

Studies of friendships in children with autism most commonly used self-report measures of friendship quality (i.e. specific aspects of a relationship between two friends, such as level of intimacy; Bauminger & Kasari, 2000; Bauminger, et al, 2010; Bauminger, et al., 2004; Bauminger et al., 2008[b;] Calder et al., 2013; Chamberlain et al, 2007; Kasari et al., 2011; Locke et al., 2010; Solomon et al., 2011), although several used parent report to describe characteristics of friendship (e.g. length, stability, and reciprocity of friendship; Bauminger et al., 2008[a]; Bauminger et al., 2008[b]). One study sought parent and teacher input to describe both friendship quality and friendship characteristics (Calder et al., 2013). Reciprocity often was established by examining reciprocal nominations of friendship within a classroom (Chamberlain et al., 2007; Kasari et al., 2011; Locke et al., 2010), having children with autism identify friends who were then included in the study (Bauminger et al., 2010; Bauminger et al., 2013), or by verifying the friendship with an outside source such as parents (Bauminger et al., 2008[b]; Calder et al., 2013) or teachers (Daniel et al., 2010), although not all studies verified friendship reciprocity (Bauminger & Kasari, 2000; Mazurek and Kanne, 2010). The number of participants ranged widely, with as few as five participants with autism (Carrington et al., 2003) to as many as 1,202 (Mazurek & Kanne, 2010), with most including approximately 20-30 participants with autism (Bauminger et al., 2010; Bauminger-Zviely et al., 2013; Chamberlain et al., 2007; Kimhi et al., 2012; Whitehouse et al., 2009). Many studies examined children in schools (Calder et al., 2013; Chamberlain et al., 2007; Kasari et al., 2011; Locke et al., 2010; Rotheram-Fuller, et al., 2010),

but some used laboratory-based tasks (Bauminger & Shulman, 2003; Meek et al., 2012) Participants were mostly of higher intellectual ability, although four studies included children with IQ -1.5 standard deviations from the mean (Boutot & Bryant, 2005; Calder et al., 2013; Mazurek & Kanne, 2010; Rotheram-Fuller et al., 2010). Most studies focused on school-age and adolescent participants age 8-17 years, although Bauminger-Zviely et al., (2013) included preschoolers. Children with autism frequently were compared to children with TD (Bauminger & Kasari, 2000; Bauminger & Shulman, 2003; Bauminger et al., 2008[a]; Bauminger et al., 2008[b]; Bauminger et al., 2004; Bauminger et al., 2003; Bauminger et al., 2010; Bauminger-Zviely et al., 2013; Calder et al., 2013; Chamberlain et al., 2007; Kasari et al., 2011; Kimhi et al., 2012; Locke et al., 2010; Whitehouse et al., 2009), but also to children with intellectual disability (Rowley et al., 2012) and learning disability (Boutot & Bryan, 2005). All reviewed studies of friendship in children with autism were cross-sectional.

In summary, children with autism by definition have difficulty interacting with their peers. They consistently demonstrate fewer prosocial behaviors and are less accepted by their peers than children with TD. One limitation in the peer competence literature is a lack of an agreed-upon definition of peer competence for children with autism (Rao et al., 2008). By focusing on prosocial skills of entering peer groups, maintaining play, and resolving conflict, this review generated a cohesive picture of peer competence in children with autism. Because most studies of peer competence have been cross-sectional, little is known about factors that contribute to peer competence outcomes in children with autism (Meek et al., 2012).

Friendships are less likely for children with autism, and children with friends have fewer friends than children with TD and special needs. Furthermore, children with autism's friendships are of lower quality compared to children with TD. However, there are limitations to this

literature. As Locke et al., (2010) noted, a widely-held belief that children with autism cannot develop and maintain friendships seems to have been disproven, but the bulk of this research focused on children with autism who did not have ID. The studies that included children with autism and ID were in mainstream or inclusive classrooms, which indicated a higher level of functioning. Because many children with autism have ID (Fombonne, 2005), their friendships remain largely unknown. Knowing the importance of friendships to children's well-being, investigating friendships in children with autism and ID is a critical need. Participants in friendship studies were mostly school-age, which is a crucial time for the development of friendships, and often when important characteristics such as intimacy and trust develop (Bauminger, Shulman, & Agam, 2004). All of the reviewed studies of friendship were cross-sectional, thus, it is difficult to infer factors that contributed to friendship outcomes for children with autism.

Conceptual Frameworks

To better understand the developmental influences on specific social outcomes of peer competence and friendship, broader social competence theories were examined. First, the theory of cultural cognition (Tomasello, 2008) posits that social competence stems from shared intentionality, or "we" intentionality (hereafter italicized). Specifically, *we* intentionality yields important outcomes such as learning language with communicative partners, using language within a society's expectations, and behaving in socially-expected ways with peers (Tomasello et al., 2005; Tomasello, 2008). Social interaction theories and their models illustrate the actors and influences within a child's social context that lead to social competence. The transactional model Sameroff (2000) demonstrates how the child, his social partners, and their environment influence each other over time, and how the interactions impact social development. A model of social

competence for children with developmental delays (Guralnick, 1999) includes contemporary child-specific cognitive processes as well as family influences. Finally, social learning theory (Patterson & Reid, 1984) ties contemporary and longitudinal factors, including specific behaviors between parents and children that impact children's social competence.

Cultural cognition theory states that people not only understand others' intentions (e.g. "he wants to build a house"), but *share* intentions (e.g. "*we* want to build a house") including mutual knowledge and beliefs (Tomasello, 2008). Sharing intentions leads to shared goals, and in turn, collaborative behavior (e.g. "we are building a house"; Tomasello et al., 2005). *We* intentionality can be applied broadly at a societal level. For example, a large group of people working together to communicate effectively demonstrate shared intentions, i.e. they share important cultural knowledge and act on it in expected ways. One result of a society acting as *we*, is linguistic consistency (Tomasello, 2008). For example, speakers in the United States refer to round bouncy toys as "ball" and people in Mexico refer to these objects as "pelota." In both cases, speakers benefit from linguistic consistency, making it possible to communicate effectively about an object, even if they lack shared experience. Societal "we-ness" is also evident in a culture's pragmatic language expectations. Grice's (1975) maxims of quantity, quality, relation, and manner encapsulate culturally agreed-upon rules necessary to using language functionally. In order to remain within the social expectations of a communicative exchange, partners must make their contribution as informative as required, speak truthfully, speak of matters relevant to the context, and use orderly language devoid of obscure expressions and ambiguity. Thus, when people engage in conversation, they act as *we* by using consistent language and abiding by pragmatic maxims. Furthermore, acting as *we* contributes to a child's social competence. Although *we* intentionality covers much conceptual ground, it does not

address the ongoing contribution of the environment to a child's social development. Thus, social interaction theories are necessary to describe how repeated interactions with others affect peer competence and friendships over the course of a child's development.

The transactional model (*Figure 1*) illustrates how social development results from recurring cyclical interactions between a child and her environment, including parents and other social partners. Two particularly compelling aspects of a developmental transactional model are: 1) the child's behavior affects the parents' behavior and vice versa and 2) interactions build upon themselves over time. The transactional model integrates individual and environmental factors to explain social outcomes such as peer competence and friendships. The environtype (the family/cultural patterns), the phenotype (a child/individual and her actions), and the genotype (the biological makeup of the child/individual) interact repeatedly and change frequently throughout development, which enhances (or detracts from) the child's skills (Sameroff, 2000). This model demonstrates the mutual impact of the parent and child within the social context. However, it does not address more specific child factors contributing to peer competence and friendships.

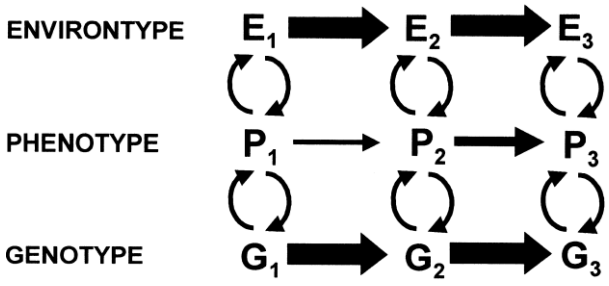

Figure 1, Transactional model, by Sameroff, 2000, *Development and Psychopathology, 12*, p. 309. Copyright 2000 by Cambridge University Press.

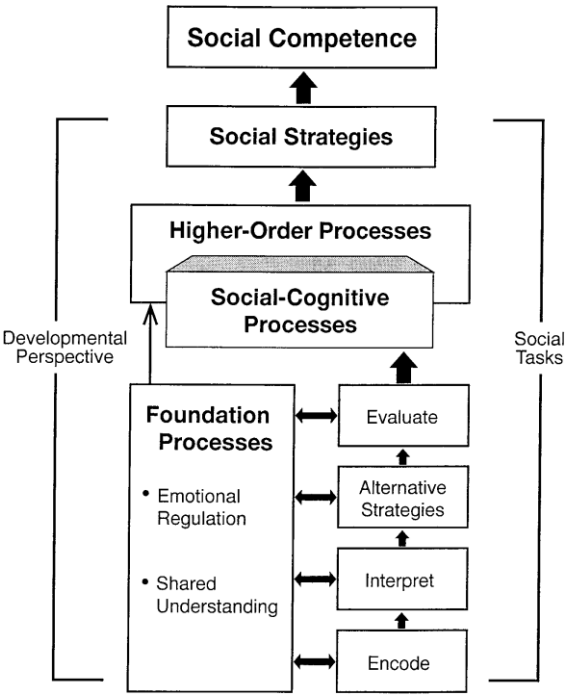

Figure 2, Social competence model, by Guralnick, 1999, *Mental Retardation and Developmental Disabilities Research Reviews, 5*, p. 23. Copyright 1999 by Wiley Periodicals, Inc.

The model of social competence (*Figure X*) illustrates contemporary internal and external factors that impact a child's ability to interact successfully with peers (Guralnick, 1999). Foundation processes include emotional regulation and shared understanding. Shared understanding includes "mutually agreed-upon social roles, social rules, and expectations that regulate social behavior in the peer context" (Guralnick, 1999, p 22). Cognitive processes facilitate the child's ability to understand (encode) and interpret others' social behavior. A child calls upon his previously-learned social abilities to generate alternative strategies and to evaluate the effectiveness of these strategies during the interaction. Higher-order processes (i.e. executive functioning) govern the complex interplay of cognitive and foundation processes. Furthermore, these activities take place within a social context that includes the developmental expectations for the child's actions, and the parents' support of the child's peer network and interactions with peers. The social competence model demonstrates that learning social behaviors is reliant on a complex system of monitoring and evaluating one's own behavior as well as others' social behavior. It does not indicate longitudinal factors or specific behaviors between the child and social partners.

Social learning theory links contemporary and longitudinal factors, including the child and his environment, to social competence (Patterson & Reid, 1984). The social environment

includes the partners with which the child interacts. When the child is young, his interactions occur mostly with parents, and as he ages, they occur more with peers (Snyder, Reed, & Patterson, 2003). Children's social competence is dependent on the repeated experiences during social interactions with familiar partners throughout development (Snyder et al., 2003). Investigations of social learning theory specified behaviors that shape social competence. For example, researchers found that social environments that included aggressive behavior (by both parents and children) facilitated more aggressive behaviors in children than positive adaptive behaviors (Patterson & Reid, 1984). Similarly, environments with fewer salient positive social behaviors, which could be possible for a child with autism, likely provide fewer opportunities to be reinforced for positive social behavior, resulting in fewer social behaviors exhibited by the child.

In summary, children's social competence is supported by *we* intentionality, and through repeated interactions during development with people in their social environment. Children's interactions serve to reinforce or diminish social behaviors. A child with autism, by definition, emits fewer social behaviors than a child with TD. Following the aforementioned models, it is expected that a child's diminished social behaviors impact parents' social behaviors, and ultimately, peer competence and friendship. It is possible that parents emit fewer social behaviors, or qualitatively different social behaviors over time because their attempts to engage with their child are not reinforced. Thus, fewer social behaviors exist in the child's environment over time, leading to more severe social deficits. There is partial support for this perspective based on comparisons of mothers' social approaches to their children with autism and siblings without autism. Mothers approached children with autism using fewer verbal behaviors and were more directive in their approaches compared to how they approached siblings without autism

(Doussard-Roosevelt, et al., 2003). Alternatively, children with autism emit fewer social behaviors, but their parents may compensate and produce *more* behaviors that are social. In this scenario, the child's environment has an adequate number of social behaviors, positively impacting the child's social development, although perhaps not enough to catch up to peers with TD. Evidence supports the second scenario: parents of children with autism provided as many social behaviors as parents of children with developmental delay and TD (Siller & Sigman, 2002), and parents of children with and without autism provided more object-based approaches to their children with autism, but did not differ in the overall number of approaches between their children with autism and siblings without autism (Doussard-Roosevelt et al., 2003). Furthermore, researchers showed that parents' social behaviors predicted the child's language development concurrently and longitudinally (Siller & Sigman, 2002 and Siller & Sigman, 2008, respectively). Thus, it is expected that a child with autism emits fewer and/or lower quality social behaviors, but their parents emit social behaviors to compensate, creating a rich social environment. The conceptual frameworks indicate that better interactions with parents yield better outcomes with peers. However, other factors influence a child with autism's social interactions with parents and peers, which will be explored next.

Contributors to Peer Competence and Friendships

Mutual responsiveness. Mutual responsiveness develops early in children with TD, is important throughout development, and may influence social competence. In a social interaction, partners respond positively to one another and objects or activities of interest (Haven et al., 2013; Kochanska, 1997; Siller & Sigman, 2008). Responsiveness is mutual when both parent and child attend to each other's initiations (Kochanska, 1997). As early as 2 months of age, infants and their mothers engage in "protoconversations," contingently exchanging facial expressions,

sounds, and gestures (Trevarthen & Aitken, 2001). Between 9-12 months, children read and respond to others' intentions while sharing triadic activities (i.e. child, partner, some other entity) (Tomasello *et al.,* 2005). Mutual responsiveness between young children with TD and their mothers appeared to increase with age as demonstrated by more cooperation and positive affect from age 26-41 months to 43-56 months (Kochanska, 1997). A review of mutual responsiveness literature found several studies relating responsiveness between toddlers and preschoolers with TD and direct observations of higher peer acceptance, more interactive play, and better teacher ratings of social competence in the classroom (Harrist & Waugh, 2002).

Two studies to date have investigated the relationship between mutual responsiveness and peer competence in children with autism. Twenty children with autism, mean age six years, all of whom could generate complete sentences and had at least three-year-old receptive language equivalents, completed a five-minute low-structured play task with parents in a laboratory setting (Meek et al., 2011). One year later, parents completed questionnaires regarding their children's peer competence, including prosocial behaviors (e.g. helping and cooperation), asocial behaviors (e.g. solitary play), exclusion (i.e. the extent to which the child is excluded from peer activities), aggressive behaviors (verbal and physical), hyperactive-distractible behaviors (e.g. restlessness), and anxious-fearful behaviors (e.g. showing distress). Coders analyzed the play-based task for evidence of joint engagement states and child-initiated engagements. Engagement was indicated by coordinated eye contact, talking about a shared subject, and directed gestures. Additionally, parent behaviors were coded, including attention regulation (calling child's attention to objects or events without physical contact), behavioral regulation (managing the child's behavior), and responsiveness (reacting to a child's initiation).

Controlling for mental age and parent initiation of joint engagement, children who initiated engagement with parents displayed greater peer competence.

Cohesiveness between parents and children, defined as level of reciprocity between parent and child, degree of engagement and responsiveness, and mutual enjoyment within the interaction, concurrently predicted peer competence in children with and without autism (Haven et al., 2013). Twenty-one children with autism without LI (could follow three-step commands and answer basic questions) and 21 children with TD, age 3-6 years, participated in a five-minute book-reading interaction with parents, which subsequently was coded for cohesiveness. Cohesiveness predicted teacher-rated peer competence, including congratulating, encouraging, and helping peers during interactions. A follow-up analysis revealed that cohesiveness mediated the relationship between developmental status and peer competence i.e. group (autism/TD) predicted peer competence, but the direct effect of group was reduced when cohesiveness was introduced into the model. In preliminary analyses, cohesiveness correlated with peer competence for children with autism, but not children with TD.

There is emerging support for the relationship between mutual responsiveness and peer competence in preschool-age children with autism (Haven et al., 2013; Meek et al., 2012), but it is not clear whether mutual responsiveness plays a causal role in peer competence outcomes because only one longitudinal study has been conducted (Meek et al., 2012). Furthermore, both studies investigated children with autism without ID or LI, so children may have demonstrated higher levels of mutual responsiveness than would more severely-impacted children with autism. The relationship between mutual responsiveness and friendships has not yet been investigated, nor has the relationship between mutual responsiveness and peer competence in children with autism who are older than preschool, have ID, and have LI.

Language. Communication skills are an essential prerequisite for interaction with peers (Sigman et al., 1999). Children with TD quickly develop sophisticated language (Paul & Nordbury, 2012), and children with LI are likely to be left out of dynamic peer interactions (Fujiki et al., 1999). Few studies have investigated direct relationships between language and peer competence and friendships in children with ASD, but this is a critical need given the important role of language in social interactions.

Receptive vocabulary (i.e. the words a child knows) related to higher quality social behaviors between friends, greater peer competence, and higher friendship quality for children with autism in several studies. First, 44 school-age children with autism and 33 peers with TD, age 8-12 years, without ID or LI, were examined during non-competitive tasks with self-identified friends (Bauminger et al., 2008[b]). Analyses indicated that higher PPVT scores were associated with less parallel play and more interactive play with their friends. Relationships between PPVT and self-reported friendship qualities varied by group; with a negative relationship between PPVT and companionship for children with autism, and a positive relationship between PPVT and intimacy for children with TD.

Another study included children with autism age 8-12 years without ID and LI, and demonstrated the contribution of PPVT scores to self-reported friendship quality for children with autism and TD (Bauminger, Solomon, & Rogers, 2010). Surprisingly, lower PPVT scores predicted higher companionship for the entire sample, but the interaction between group and PPVT was not a significant contributor to companionship, indicating that the contribution of PPVT to companionship was not different for children with autism compared to children with TD.

Expressive language (i.e. spoken communication) has been related to how children with autism describe friendships. First, 16 school-age children and adolescents with autism without ID or LI were compared to 16 age- and IQ-matched peers with TD (Bauminger, Shulman, & Agam, 2004). Children described pictures depicting social interactions. Children with autism less frequently used affective or intersubjective language to describe interactions between friends in a structured picture description task. For example, children with autism were more likely to say "two children are talking," but children with TD were more likely to say "the friends are telling secrets." All but two of the children with autism also completed a self-report of the quality of friendship with a self-identified best friend. Thus, difficulty describing friendships was not because of a lack of friendships. A qualitative study of five adolescents with autism, age 14-18, who were verbally capable of describing friendship characteristics (although they did not complete a direct measure of language) completed interviews targeting details of their friendships (Carrington et al., 2003). Interviewers probed children for details about their friendships and examined transcripts for evidence of understanding concepts surrounding friendships. Children with autism demonstrated difficulty describing their friendships during the interviews. For example, one participant used the word "friendly," but could not define it other than saying "nice." These children tended to use non-specific vocabulary such as "and stuff" or "all the aspects" to describe their friendships. Thus, children with autism had sufficient language to conduct an in-depth interview, but seemed quite challenged to identify and describe characteristics of their friendships.

Finally, one study examined the role of expressive language while children with autism interacted with friends. Spontaneous peer conversations were examined in 27 children with autism and 30 children with TD, age 3-6 years, without ID or LI (Bauminger et al., 2013).

Observations took place in their preschool. Teachers identified a friend for each participant, which was verified by their mothers. During free play interactions, one with a friend, and one with a non-friend, children with autism were more pragmatically appropriate while speaking to self-identified friends compared to their interactions with non-friends, and showed greater conversational quality by initiating conversations more frequently and being more responsive to friends than non-friends.

Holistic language has not been investigated in peer competence and friendship for children with autism, but receptive vocabulary and expressive language have. Receptive vocabulary related to better play with peers (Bauminger et al., 2008[b]) and higher self-reported friendship quality (Bauminger et al., 2008[b]). A puzzling finding was that of a negative relationship between PPVT and companionship for children with autism, but a positive relationship between PPVT and intimacy for children with TD (Bauminger et al., 2008[b]). It is unexpected that lower receptive vocabulary would correlate with higher friendship quality, and it is interesting that the relationships between receptive vocabulary and friendship quality were different between children with autism and TD. However, another study investigating similar children, also using PPVT and self-reported friendship quality, did not find a difference in the relationship between PPVT and friendship by group (Bauminger et al., 2010). Thus, the relationship between receptive vocabulary and friendship in school-age children with autism without LI is not well-understood.

Expressive language has been investigated in terms of its relationship with children's descriptions of friendships. Children with autism use fewer relationship-specific terms and generally less-specific vocabulary to describe friendships (Bauminger et al., 2004; Carrington et al., 2003, respectively). In all reviewed studies, children with autism were limited to those

without LI, making it difficult to generalize findings to children with autism whose language is impaired. Furthermore, all studies were cross-sectional, making contributing factors difficult to identify. Most studies included school-age children and adolescents (Bauminger et al., 2008[b]; Bauminger et al., 2004; Bauminger et al., 2010; Carrington et al., 2003), although one included preschool children (Bauminger et al., 2013). Friendships were more commonly studied (Bauminger et al., 2013; Bauminger et al., 2008[b]; Bauminger et al., 2004; Bauminger et al., 2010; Carrington et al., 2003) than peer competence (Bauminger et al., 2008[b]).

Intellectual Ability. An intelligence quotient (IQ), is a complex construct that is highly variable in children with autism and is not yet well understood in relation to peer competence and friendship outcomes. Also referred to as intellectual ability, or developmental level in younger children, IQ reflects a combination of factors including verbal abilities, nonverbal reasoning, and visual-spatial processing. Children with autism present with a broad range of intellectual ability, and estimates of children with autism and ID range from 70% of the population (Fombonne, 2003) to 30% (Chakrabarti & Fombonne, 2005). IQ presentation is heterogeneous in children with autism, with some children demonstrating commensurate verbal and nonverbal abilities, and others demonstrating significant differences in these domains (Munson et al., 2008).

Studies of peer competence and friendship have not extensively examined children with autism and ID (Petrina et al., 2014). Several studies included children with autism who had IQ 1.5 standard deviations below the mean, but did not investigate IQ in relationship to peer competence and friendship (Boutot & Bryant, 2005; Rotheram-Fuller et al., 2010). One study demonstrated that within a group of preschoolers with autism without ID , children with higher IQ were more responsive to a partner and initiated more exchanges in conversations with peers

during ten minutes of free play in a laboratory-based task (Bauminger-Zviely et al., 2013). An examination of 1,202 children with autism, mean age 9 years, with a wide range of IQ scores, revealed a significant correlation between IQ and parent-reported friendship quality, indicating higher IQ was linked to better friendship quality and vice versa (Mazurek & Kanne, 2010). In contrast, a study of 12 children with autism, age 9-12 years who had broadly average IQ (full scale IQ range from 75-131), in mainstream educational settings detected no significant relationship between verbal and nonverbal IQ and self-reported friendship quality with a best friend (Calder et al., 2013).

Studies of peer competence and friendship in autism commonly matched participants on intellectual ability but did not examine its contribution to those outcomes (Bauminger et al., 2003; Bauminger et al., 2004; Bauminger et al., 2013; Calder et al., 2013; Kimhi et al., 2012; Rowley et al., 2012; Travis et al., 2001). Furthermore, the current literature on peer competence and friendship in autism largely includes children without ID, and only a few studies included children with lower IQ (Boutot & Bryant, 2005; Calder et al., 2013; Mazurek & Kanne, 2010; Rotheram-Fuller et al., 2010). Children with average or higher IQ demonstrate a range of peer competence deficits and friendship challenges, indicating that IQ is not sufficient to facilitate adequate peer competence or high quality friendships. Thus, intellectual ability is likely to play an important role in the development of peer competence and friendships for children with autism. Even with relatively homogeneous samples of children with autism without ID, there are a range of outcomes, suggesting factors over and above IQ are important to consider. Very few studies have included children with lower IQ, and the way in which ID influences peer competence and friendships is not yet well understood.

Summary

A review of the literature indicated friendship and peer competence differences for children with autism compared to children with TD and other types of developmental disabilities. Evidence suggests mutual responsiveness, language ability, and intellectual ability contribute to peer competence and friendship outcomes, although this evidence is limited to a small number of studies. The existing studies are almost exclusively cross-sectional and exclude children with autism who are minimally verbal and have below-average intellectual ability. The peer competence and friendships literature for children with autism currently lacks studies of longitudinal and concurrent predictors, and outcomes for children across the autism spectrum.

Specific Aims

1) To examine the concurrent contribution of group and language to peer competence and friendship in children at age 10 years with autism and TD. To achieve this aim, a multiple predictor model (one per outcome) will be applied to evaluate peer competence and friendship quality, including group (autism/TD) and language as primary predictors, controlling for nonverbal IQ.
2) To examine the longitudinal contribution of mutual responsiveness between children with autism at age 4 years and their parents to peer competence and friendship quality outcomes when children are age 10 years. To achieve this aim a multiple predictor model (one per outcome) will be applied to evaluate peer competence and friendship, including mutual responsiveness as the primary predictor, controlling for language at age 4 years.

Method

Participants

Fifty-one children and their parents participated in this dissertation: 26 children with autism and 25 children with TD. All participants in the current study were recruited as part of the Time and Movement Study (TAM, RO1, MH100887), an ongoing investigation of social and developmental outcomes, and brain function during an eye blink conditioning task. The TAM study includes a longitudinal follow up of children with ASD who participated in previous studies. Details on the TAM study and the previous studies in which children participated are below.

The current sample of children with autism previously participated in an early intervention study that examined the efficacy of the Early Start Denver Model (ESDM) treatment. This larger study enrolled children with autism age 18-30 months in a two-year intervention study, who were randomized into two conditions: ESDM (*n*=24) and community treatment (*n*=24; Dawson et al., 2010). Participants in the ESDM study were recruited from community settings including birth-three centers, preschools, hospitals, and state and local autism organizations and lived in the greater Seattle area. At enrollment in the ESDM study at 18-30 months, children with autism were assessed by clinical psychologists and met diagnostic criteria for autism or autism spectrum disorder using the ADOS, DSM-IV, and all available information. Exclusionary criteria were: significant history of sensory or motor impairments, major physical problems such as chronic serious health condition, seizures at the time of entry, use of psychoactive medications, serious brain injury, genetic disorders associated with autism (e.g. fragile X syndrome), seizure disorder, or prenatal drug or alcohol exposure (Dawson et al., 2010). Participants with autism had to live within 30 minutes of the University of Washington

and be willing to participate in a ≥2-year intervention. Children with autism completed either two years of ESDM treatment at 20 hours per week in 1:1 sessions with trained ESDM providers, or two years of community treatment, with an average of 9.1 hours of individual therapy and 9.3 hours of group interventions (Dawson et al., 2010). At age 4 years (henceforth referred to as "age 4 years"), children with autism (*n*=45) were assessed by raters blind to intervention group. Children with autism (n=39) also completed a follow-up study at age 6 years (Estes et al., 2015). Of the original sample, 26 children with autism have completed TAM at age 10 years and are in the current dissertation. Attrition rates between the ESDM and Com treatment groups were similar (Estes et al., 2015), with 14 children in the ESDM group and 12 children in the Com group completing this dissertation. For this dissertation, data were examine from ages 4 years and 10 years for the autism group. See *Figure* 3 for their timeline.

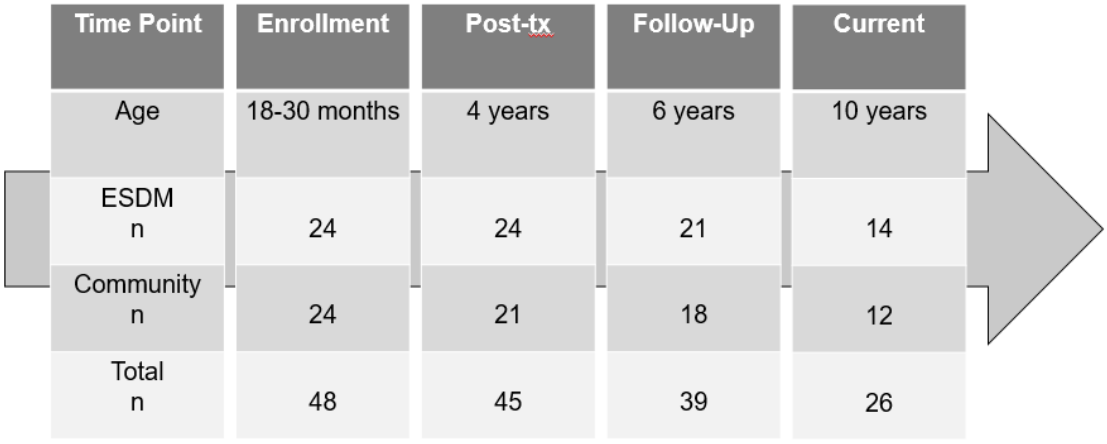

Figure 3. Longitudinal autism group RCT

Participants with TD came from three sources: enrollment at age 18-30 months in the ESDM study described above (*n*=7), enrollment at age 3 months in the IBIS study at the University of Washington described next (*n*=2), and enrollment at age 8-12 years from the University of Washington Speech and Hearing Sciences subject pool (*n*=16). The Infant Brain Imaging Study (IBIS) is an ongoing Autism Center of Excellence study including four sites:

University of North Carolina, Chapel Hill; University of Washington, Seattle; Children's Hospital of Philadelphia; and Washington University, St. Louis that prospectively examines brain and behavioral data from children who have older siblings with autism. The TD group consists of low risk participants, whose older siblings do not have autism and who had no first-degree relatives with autism or intellectual disability. Participants were excluded if they demonstrated any of the following: genetic condition or syndrome, medical conditions affecting growth, development, or cognition (e.g. seizures), significant sensory impairments, low birth weight, prenatal drug or alcohol exposure, non-English home language, were adopted or half-sibling, had a first-degree relative with psychosis, schizophrenia, or bipolar disorder, or was a twin (see Estes et al., 2015). At age 10 years, exclusionary criteria for all children with TD were: significant sensory impairment (e.g. hearing or vision deficit), non-English home language, previous or current diagnosis of autism, previous or current concerns that the child may have autism, diagnosis of known genetic condition associated with intellectual disability (e.g. fragile X syndrome), significant motor impairment (e.g. cerebral palsy), receipt of special education services, or advanced placement in school or school program for gifted children.

Participants were recruited with approval of University of Washington's Human Subjects Division. Parents provided consent prior to participation, and at age 10 years children provided written assent when possible**.**

Table 1 displays sample characteristics. The ASD group consists of 20 males and 6 females. The TD group consists of 18 males and 7 females. Participants did not differ on sex (Fisher's exact test, p=0.37). Forty-four parents reported maternal education. Mothers were highly educated, with all completing at least some college (25% some college, 41% college graduate, 34% graduate degree; Fisher's exact test, p=.47). Thirty-eight participants reported

median household income. The autism group had a significantly lower median income than the TD group ($97,500 and $195,000, respectively; Mann-Whitney U=90, n_1=18, n_2=20, p<.01). Despite differences in income, groups were considered to be of equivalent socioeconomic status because they did not differ on maternal education, which is a robust predictor of child outcomes (Dollaghan et al., 1999; Hoff, Laursen, & Bridges, 2012). In the autism sample, 20 children were white, and 6 were non-white. In the TD sample, 21 children were white, and 4 were non-white. The children with autism and TD did not differ on race (Fisher's exact test, p=0.72). At age 10 years, mean chronological ages of participants in autism and TD groups were 141.58 months (SD=8.86) and 125.48 months (SD=18.68), respectively. Children with TD were younger on average than children with autism, $t_{(33.98)}$=-3.91, p<.001, d=1.10.

Table 1
Sample Characteristics for Children With Autism and TD

	Autism	TD	p^a
Sex			.37
M	20	18	
F	6	7	
Maternal education			.47
No college	0	0	
Some college	10	4	
College degree	9	8	
Graduate degree	4	7	
Missing	3	7	
Household income			<.01
<$49,000	4	0	
$50,000-$74,999	5	0	
$75,000-$99,999	1	3	
$100,000-$149,999	3	2	
$150,000 or more	7	12	
Race			.72
White	20	21	
Non-white	6	4	
Age (months)	Mean (*SD*)	Mean (*SD*)	<.001
Time point: 4 years	51.6 (3.48)	-- --	
Time point: 10 years	141.58 (8.86)	125.48 (18.68)	

[a]Fisher's exact test for categorical variables (sex education, race), *t* test for age, all tests two-tailed

Procedures

At age 4 years, children with autism and their parents attended sessions at the University of Washington Autism Center in a quiet clinic room. They completed assessments described below to examine parent-child interactions, characterize autism symptoms, measure adaptive functioning, and evaluate developmental level. During one of the visits, the parents and children completed the Parent-Child Interaction Task (PCIT), in which examiners provided the parents and children with a variety of developmentally-appropriate and engaging toys (e.g. pretend food, balls, and cause-and-effect toys). The examiner asked the parents to play with their child as they normally would. The interaction was standardized by time (13 minutes), materials present, and

components of the interaction: child-directed play (5 minutes), teaching (5 minutes) and clean-up (3 minutes). The room was cleared of all items except the PCIT items and the parent and child remained on the floor throughout the task. The examiner remained outside of the testing room and entered only to give directions to the parent regarding timing of activities. The PCIT was video-recorded and sent to the University of Oregon Child and Family Center and coded with two coding systems described below.

At age 10 years, children with autism and TD and their parents attended five sessions at the University of Washington Autism Center in a quiet clinic room. Prior to the first session, parents received questionnaires about their child's peer competence, playmates, and adaptive functioning. They either completed the questionnaires and returned them or completed them in one of their sessions. The first session was a diagnostic evaluation that took three to five hours, conducted by expert clinical psychologists blinded to the children's pre-existing diagnoses. During the diagnostic session, parents completed interviews about autism symptoms, including the Autism Diagnostic Interview-Revised (ADI-R; Rutter, LeConteur, & Lord, 2003) and the Social Communication Questionnaire (SCQ; Rutter, Bailey, & Lord, 2003). Children completed tests of intellectual ability and autism symptoms described below, as well as measures not included in this dissertation. The psychologists used all available information to determine if the child met criteria for autism based on a combination of test results, DSM-IV-TR (American Psychiatric Association, 2000), and DSM-5 (American Psychiatric Association, 2013) criteria.

After the diagnostic visit, children and their parents attended 4 additional visits to complete eye blink conditioning tasks. At one of these visits, which took approximately one and a half hours (including eye blink conditioning task), the primary investigator of this dissertation, a nationally-certified speech-language pathologist at the University of Washington Autism

Center, completed parent interviews regarding their children's friendships. If the investigator was not available, a trained clinician collected data. Some parents completed friendship measures via phone interview, in accordance with their availability.

Measures

Autism symptoms. At the diagnostic visit, children completed the Autism Diagnostic Observation Schedule (ADOS). The ADOS (WPS version at age 4 years; Lord, Rutter, DiLavore, & Risi, 2003, and 2nd edition at age 10 years; Lord, Rutter, DiLavore, & Risi, 2012) is a semi-structured standardized observation that measures autism symptoms in social relatedness, communication, play, and repetitive behaviors. Autism symptoms were quantified via the Comparison Score, which is a standardized severity score from 1-10. Scores from 1-3 indicate nonspectrum, 4-10 indicate autism, with higher scores representing higher autism impairment. The severity score enabled comparison of autism symptoms across modules, concentrating on autism-specific behaviors with a reduced influence of verbal ability and age (Gotham, Pickles, & Lord, 2009).

Intellectual ability. At age 4 years, children with autism completed the Mullen Scales of Early Learning (MSEL). The MSEL (Mullen, 1997) is a standardized developmental test for children from birth to 68 months of age. The Early-Learning Composite includes gross motor, visual reception, fine motor, expressive language, and expressive language. This score indicated the child's developmental level at age 4 years (M=100, SD=15).

At age 10 years, children with autism and TD completed the Differential Abilities Scales-2nd edition (DAS-II; Elliot, 2007), a battery of cognitive tests for children and adolescents from ages two to 17 years.. The DAS yields a composite score called General Conceptual Ability

(GCA), reflecting conceptual and reasoning abilities and verbal skills. GCA was used for descriptive purposes as the IQ score at age 10 years. The Nonverbal Reasoning score was used for nonverbal IQ (NVIQ) at age 10 years, (both scores: *M*=100, *SD*=15).

Language. The Vineland Adaptive Behavior Scales-second edition (VABS; Sparrow *et al.,* 2005) is a parent/caregiver-completed measure that assesses social, communication, motor, and daily living skills. Researchers mailed the VABS to parents, who independently completed it at home or at one of their visits. The standard score from the Communication domain, which consists of receptive, expressive, and written language capabilities, was used as the language score for ages 4 years and 10 years (*M=100*, *SD*=15).

Peer relationships. Parents of 10-year-olds received the Social Skills Rating System questionnaire (SSRS*;* Gresham & Elliot, 1990) in the mail prior to their first visit at UWAC. They completed it either at home or at UWAC. The SSRS was normed for ages three to 18 years, measuring social skills and problem behaviors that can affect teacher-student relationships, peer acceptance, and academic performance. The SSRS documents the perceived frequency and importance of behaviors, emphasizing positive behaviors. A validated subset of questions from the SSRS was used as the peer competence score (Booth-LaForce, personal communication, September, 2014; Roisman, Booth-LaForce, Cauffman, & Spieker, 2009). The peer competence subscale is the sum of "how often" responses to 10 items from the social skills section, including measures of proactive social skill (e.g. "joins group activities without being told"),play (e.g. "accepts friends' ideas for playing"), and conflict resolution ("controls temper when arguing with other children"). These questions were selected from a data set of SSRS questionnaires completed by over 1,000 caregivers of 5th graders (Booth-LaForce, personal communication, September, 2014; NICHD, 2004). Scores have a range from 0-20, with higher scores indicating

higher positive interactions between the child and peers. The raw items in the peer competence subscale have moderate internal reliability in the original sample (10 items, Cronbach's alpha= 0.77; NICHD, 2004), and good internal reliability in this dissertation's sample (Cronbach's alpha=.88; George & Mallery, 2003). Please see Table 2 for all questions.

Table 2
Peer Competence Items from SSRS

1	Joins group activities without being told to
2	Responds appropriately when hit or pushed by other children
3	Makes friends easily
4	Controls temper when arguing with other children
5	Is liked by others
6	Gives compliments to friends or other children in the family
7	Is self-confident in social situations such as parties or group outings
8	Responds appropriately to teasing from friends or relatives of his or her own age
9	Accepts friends ideas for playing
10	Acknowledges compliments or praise from friends

Characteristics of participants' playmates were described in the Peer Social Contact Questionnaire (PSCQ; Guralnick, 1997), which was created for research at the University of Washington. The PSCQ characterizes children's social networks, including children with whom they have had frequent interactions (i.e. playmates) over the prior three months. For this dissertation, I focused on parents' reports of barriers to their children developing and maintaining friendships.

Friendships. Parents of 10-year-olds first completed the Friend Information Interview (FII) with the primary investigator. The FII was created for this dissertation in order to identify a "focus friend," who was usually the child's best friend, before completing an additional measure of friendship (please see Appendix D for the FII). If the child did not have a best friend, the investigator worked with the parent to identify a close friend of the child. The FII was

administered to ensure that the focus friend: 1) knew their child outside of structured group settings, 2) reciprocated the friendship, 3) had seen their child within the last six months, and 4) had at least one shared interest 5) was not a 1st-degree relative and 6) lived in a different house. The FII was also used to gather descriptive information on types of activities in which friends engaged, how often friends saw each other, how they knew their focus friend, and how many friends they had in addition to their focus friend.

After completing the FII, the primary investigator determined whether the focus friend met the previously-stated criteria for friendship. If so, parents completed the Friendship Qualities Scale (FQS; Bukowski, et al., 1994), a 23-item survey via interview, either in person or over the phone, depending on parents' availability. Parents rated statements using a Likert scale with 1= "not true" to 5= "really true" (e.g. "Sometimes your child's friend does things for him or makes him feel special"). Please see Appendix A for the FQS. When possible, the investigator provided parents with a visual Likert scale. If they completed the measure over the phone, the investigator described the number scale to them so they could create a visual scale. The FQS yields five subscales: companionship, conflict, help/aid, security, and closeness. The friendship score for children age 10 years was a mean score ("conflict" reverse-scored) that indicated overall friendship quality. Data from this dissertation's sample indicated good internal consistency (Cronbach's alpha=.89; George & Mallery, 2003).

Mutual responsiveness. At age 4 years, children with autism and their parents completed the previously-described parent-child interaction task. Videos of the PCIT were coded via the Relationship Affect Coding System (RACS) and Coder Impressions (Co-Imps). Dr. Estes worked with a team at the Oregon Social Learning Center (OSLC) to develop a unique set of RACS and Co-Imps to describe the relationship qualities of parents and their children with

autism. Highly-trained coders from the Oregon Social Learning Center watched 13-minute parent-child interaction videos and coded verbal, affective, and physical behaviors using the RACS via Noldus Observer. Next, they rated 62 items on the Co-Imps. Coders achieved and maintained high levels of reliability (RACS, Kappa>.80; Co-Imps, >80% agreement). Details are described in the psychometric properties of RACS and Co-Imps section. For this dissertation, I created three subdomains of mutual responsiveness: Micro Responsiveness, Shared Control, and Global Impressions. Operational definitions of the mutual responsiveness subdomains are described below.

Procedures of coding systems. The RACS (Peterson *et al.*, 2010) is a micro-social coding system that captures the topography of relationship behaviors and affect within parent-child interactions. Verbal, affective, and physical behaviors were captured simultaneously. Verbal codes describe spoken language for a variety of purposes, affect codes quantify facial expression, vocal tone, and nonverbal cues, such as body posture and/or orientation, and physical codes indicate positive, negative, or neutral bodily actions. The participant (parent or child) can be assigned one code from each stream (verbal, affective, and physical) at any moment during the interaction. Please see Appendix B for descriptions of all RACS codes.

Micro Responsiveness captured positive, active engagement between parents and children, characterized by a sequence of events called a "responsive bout." The primary investigator selected RACS codes that demonstrated either positive engagement behaviors (PEBs; Table 3) or negative/disengaged behaviors (NDBs; Table 4). In accordance with Dishion et al., (2012), PEBs included positive verbal and nonverbal behaviors and neutral converse behaviors, while NDBs included negative verbal and nonverbal behaviors. A bout began when either the parent or the child emitted one of the PEBs and the partner responded with another

PEB. A responsive bout ended when either participant emitted one of the NDBs. PEBs and NDBs consisted of mutually exclusive and exhaustive behavior-affect code combinations. The Micro Responsiveness scores for each child/parent dyad were: 1) the number of responsive bouts and 2) the average duration of responsive bouts (e.g. Bout 1= 50 seconds, Bout 2=20 seconds, Bout 3=30 seconds; score=33.3 seconds).

Table 3
Positive Engagement Behaviors (PEBs)

Talk-*Orienting*-Positive Physical	Positive Verbal-*Positive Affect*-Positive Physical	Positive Verbal-*Neutral*-Positive Physical	No Talk-*Orienting*-Positive Physical
Talk-*Orienting*-Physical	Positive Verbal-*Positive Affect*-Physical	Positive Verbal-*Neutral*-Physical	No Talk-*Orienting*-Physical
Talk-*Orienting*-No Physical	Positive Verbal-*Positive Affect*-No Physical	Positive Verbal-*Neutral*-No Physical	No Talk-*Orienting*-No Physical
Positive Verbal-*Orienting*-Positive Physical	Vocalization-*Positive Affect*-Positive Physical	Vocalization-*Neutral*-Positive Physical	No Talk-*Orienting*-Positive Physical
Positive Verbal-*Orienting*-Physical	Vocalization-*Positive Affect*-Physical	Vocalization-*Neutral*-Physical	No Talk-*Positive Affect*-Positive Physical
Positive Verbal-*Orienting*-No Physical	Vocalization-*Positive Affect*-No Physical	Vocalization-*Neutral*-No Physical	No Talk-*Positive Affect*-Physical
Vocalization-*Orienting*-Positive Physical	Positive Structure-*Positive Affect*-Positive Physical	Positive Structure-*Neutral*-Positive Physical	No Talk-*Positive Affect*-No Physical
Vocalization-*Orienting*-Physical	Positive Structure-*Positive Affect*-Physical	Positive Structure-*Neutral*-Physical	No Talk-*Neutral*-Positive Physical
Vocalization-*Orienting*-No Physical	Positive Structure-*Positive Affect*-No Physical	Positive Structure-*Neutral*-No Physical	No Talk-*Neutral*-Physical
Positive Structure-*Orienting*-Positive Physical	Positive Structure-*Orienting*-Physical	Positive Structure-*Orienting*-No Physical	

Note: Affect codes in italics

Table 4
Negative or Disengaged Behaviors (NDBs)

Negative Verbal-(any affect/physical)	*Ignore*-(any verbal/physical)
Negative Directive-(any affect/physical)	*Anger/Disgust*-(any verbal/physical)
Directive-(any affect/physical)	*Distress*-(any verbal/physical)
Question-(any affect/physical)	Negative Physical-(any affect)
No Talk-*Neutral*-No Physical	

Note: Affect codes in italics

Shared Control occurred when children attempted to influence their parents' behavior, rather than their parents having sole control. Ostensibly, parents allowing shared control were more responsive to their children's attempts to control activity and were less directive (Guralnick

et al., 2008). More child control indicated a "horizontal" relationship between the parent and child, as opposed to a "vertical" relationship in which the parent was more directive and controlling (Russell, Pettit, & Mize, 1998). In accordance with Guralnick et al., (2008), who examined children's influence attempts, verbal RACS codes "Question" and "Directive" (paired with any affect or physical behavior) indicated instances of a child or parent asking questions for the purposes of behavior change and directing behavior during the play interaction. The score for Shared Control was the parent-to-child (PC:TC) control frequency ratio, i.e. the number of times the parent emitted a Question or Directive over the number of times the child emitted a Question or Directive (e.g. parent score=12 child score=4; Parent-child control frequency ratio= 3). If the child emitted no Questions or Directives, the total was divided by one rather than zero.

The Coder Impressions (Co-Imps; Peterson *et al.,* 2010) are composed of 62 questions coders answer after coding each video with the RACS, quantifying global behaviors of parent-child interaction on a scale of 1-9, with higher scores indicating a higher quality relationship between the parent and child. Please see Appendix C for descriptions of the Co-Imps.

Global Impressions captured relationship qualities during the parent-child interaction via ratings of 1-9 (1= "not at all" and 9= "very much"). Twenty-five of 62 Co-Imps indicated mutual responsiveness between parents and children, (e.g. "parent follows child's activity with eyes" and "child vocalizes in response to parent"). For this dissertation, raw scores of the selected Co-Imps were tallied and used as a global indicator of mutual responsiveness between parents and children. Please see Appendix C for selected Co-Imps. The selected Co-Imps were analyzed, yielding a Cronbach's alpha of 0.93 which indicated excellent internal consistency (George & Mallery, 2003) and that the selected Co-Imps measured a unified construct.

Psychometric properties of RACs and Co-Imps. To our knowledge, this dissertation is the first time the RACS and Co-Imps have been used to measure mutual responsiveness. Psychometric properties of these coding systems were examined in the extant literature and in this dissertation's sample. Of particular concern was whether the behaviors were coded consistently (inter-rater reliability) and if unique RACS codes combinations indicated a unified construct (internal consistency). A review of the literature yielded seven published articles reporting psychometric properties of the RACS and/or the Co-Imps.

Four of the studies reported only inter-rater agreement for the RACS as a whole (i.e. not at individual code level), with all studies reporting Kappa=0.93 (Dishion *et al.,* 2012; Sitnick *et al.,* 2014; Smith *et al.,* 2013; Smith *et al.,* 2014). considered "almost perfect" agreement (Viera & Garrett, 2005). Two studies selected RACS codes that indicated "coercive behavior," reporting inter-rater reliability with high agreement (Kappa=0.93 and 85% agreement; Smith *et al.,* 2014; Van Ryzin & Dishion., 2013, respectively). Internal consistency of the RACS was high in one study in which "family coercion methods" described a unified construct based on combined dyad scores (child-to-mother, mother-to-child, child-to-father, and father-to-child) with Alpha=0.87-0.93 (Van Ryzin & Dishion, 2013). None of the studies reported inter-rater agreement for the Co-Imps. Two studies reported internal consistency of the Co-Imps, and both indicated the creation of a unified construct from selected Co-Imps. The first examined three Co-Imps for child non-compliance (Alpha=0.84-0.86 for four age-related time points) (Smith et al., 2014). The second created a "lack of parental monitoring" composite score from 7 macroratings of family behavior, each rated on a scale of 1-9 (Alpha=0.77). Available studies demonstrated that the RACS was coded reliably with Kappa of at least 0.93 consistently, and that Co-Imps

were combined to form a single construct that demonstrated high levels of internal consistency, with Alpha values ranging from 0.77-0.93.

For this dissertation, similar methods were employed as those in the extant literature, i.e. RACS scores and Co-Imps described parent-child behavior. This dissertation's data were analyzed to determine whether 1) RACS and Co-Imps ratings were coded reliably and 2) selected questions from the Co-Imps measured mutual responsiveness as a unified construct.

Reliability of the RACS and Co-Imps was calculated by double-coding 20% of the parent-child interaction videos. Inter-rater agreement of the RACS was high, During training, coders were required to reach 70% agreement, .70 Kappa on the RACS. They maintained 83% agreement and .82 Kappa (Peterson, personal communication, March, 2015) indicating "almost perfect" agreement (Viera & Garrett, 2005). Coders were required to meet training criteria of 85% agreement on the Co-Imps. They maintained 81.5% agreement (Peterson, personal communication, March, 2015). The double-coded reliability data were no longer available, and thus item-level reliability for the RACS unfortunately could not be reported. However, given the high level of reliability maintained by coders, the RACS likely were coded accurately and consistently.

Research Questions

The first aim of this dissertation was to examine the concurrent contribution of group and language to peer competence and friendship in children at age 10 years with autism and TD. This aim generated two research questions, provided below, with their respective data analysis plans.

Question 1: To what extent do group and language ability contribute to peer competence, controlling for NVIQ, in children age 10 years with autism and TD?

Hypothesis: It was predicted that group and language together would account for a significant portion of the variance in peer competence, controlling for NVIQ.

Question 2: To what extent do group and language ability contribute to friendship quality, controlling for NVIQ, in children age 10 years with autism and TD?

Hypothesis: It was predicted that group and language together would account for a significant portion of the variance in friendship quality, controlling for NVIQ.

Prior to performing analyses, peer competence and friendship quality were examined for four children in the autism group who no longer met diagnostic criteria at age 10 years according to a blind assessor, to determine whether it was appropriate to include these children in the autism group. Friendship quality did not differ between the autism groups, but peer competence was significantly higher for children in the autism group who did not meet ASD criteria at age 10 years, $t(21)=-3.08$, $p<.05$, $d=1.67$. Children in the autism group without a current diagnosis at age 10 years had significantly lower peer competence than children with TD, $t(27)=2.59$, $p<.05$, $d=1.40$. Children without current diagnosis at age 10 years remained in the autism group because 1) they had a significant history of autism 2) the children in the autism group with and without a diagnosis were more similar to each other than to the TD group, 3) differences in peer competence and friendship quality between autism group (with and without diagnosis combined) and TD group were statistically significant.

A summary of data analyses for Questions 1 and 2 is presented in Table 5. Preliminary analyses indicated no significant interactions between predictors. To investigate whether group (autism or TD) and language contributed to peer competence and friendship outcomes for school-age children, two hierarchical multiple regression analyses were performed. For ease of

results interpretation, group was effect coded (1 for autism, -1 for TD). Effect coding changes the intercept term (b_0) of the model to the average score of the outcome rather than yielding the score for the group coded "0," as would be the case for dummy coding (E. Sanders, personal communication, February 22, 2016). To standardize scores within the sample, metrical predictors (NVIQ, VABS) were standardized with *z* scores, but outcomes were analyzed in their original units (E. Sanders, personal communication, February 22, 2016). For Question 1, NVIQ (DAS 10 years) was entered in the first step; group (autism/TD, effect coded 1, -1, respectively) and language (VABS 10 years) were entered simultaneously in the second step, and the dependent variable was peer competence (SSRS peer competence). For Question 2, NVIQ (DAS 10 years) was entered in the first step; group (autism, TD, effect coded 1, -1, respectively), and language (VABS 10 years) were entered simultaneously in the second step, and the dependent variable was friendship quality (FQS).

Table 5
IVs, DVs, and Numbers for Data Analysis, Research Questions 1&2

Research question	**IVs**	**DV**	**Control**	**n, complete data for analysis**	
1	Group (Autism, TD) Language (VABS *z*)	Peer Competence (SSRS raw)	NVIQ (DAS *z* score)	Autism 22	TD 25
2	Group (Autism, TD) Language (VABS *z*)	Friendship Quality (FQS raw)	NVIQ (DAS *z* score)	18	25
Note: all measures from age 10 years					

The second aim of this dissertation was to examine the longitudinal contribution of mutual responsiveness between children with autism at age 4 years and their parents to peer competence and friendship quality when children were age 10 years. This aim generated two research questions, provided below, with their respective data analysis plans.

Question 3: Does mutual responsiveness between parents and children with autism age 4 years predict peer competence at age 10 years, controlling for language at age 4 years?

Hypothesis: It was predicted that three subdomains of mutual responsiveness (Global Impressions, Micro Responsiveness, and Shared Control) together would predict peer competence at age 10 years, controlling for language at age 4 years.

Question 4: Does mutual responsiveness between parents and children with autism age 4 years predict friendship quality at age 10 years, controlling for language at age 4 years?

Hypothesis: It was predicted that three subdomains of mutual responsiveness (Global Impressions, Micro Responsiveness, and Shared Control) together would predict friendship quality at age 10 years, controlling for language at age 4 years.

A summary of data analyses for Questions 3 and 4 is presented in Table 6. Preliminary analyses indicated no significant interactions between predictors. To investigate the longitudinal contribution of parent/child interaction to peer competence and friendship outcomes for children with autism, two hierarchical multiple regression analyses were performed. Metrical predictors (VABS, four scores of mutual responsiveness) were standardized with *z* scores (E. Sanders, personal communication, February 22, 2016). For Question 3, language at age 4 years (VABS) was entered in the first step, mutual responsiveness *z* scores were entered simultaneously in the second step, and the dependent variable was peer competence (SSRS peer competence raw score). For Question 4, language at age 4 years (VABS) was entered in the first step, mutual responsiveness *z* scores were entered simultaneously in the second step, and the dependent variable was friendship quality (FQS mean raw score).

Table 6
IVs,DVs, and Numbers for Data Analysis, Research Questions 3&4

Research question	**IVs**	**DV**	**Control**
3	Global Impressions: Mean (*z* score)	Peer Competence (SSRS raw)	Language age 4 years (VABS *z score*)
	Micro Responsiveness: 1) Number of responsive bouts (*z* score) 2) Duration of responsive bouts (*z* score)		
	Shared Control: Ratio TC:PC Question+ Directive (*z* score)		
4	Global Impressions: Mean score (*z* score)	Friendship Quality (FQS mean raw)	Language age 4 years (VABS *z* score)
	Micro Responsiveness: 1) Number of responsive bouts (*z* score) 2) Duration of responsive bouts (*z* score)		
	Shared Control: Ratio TC:PC Question+ Directive (*z* score)		
Question 3 n=24; Question 4 n=19			

Assumptions. Normality, linearity, and homoscedasticity of residuals were examined for each model to ensure that linear regression model assumptions were tenable.

Power analysis. A power analysis using G*Power (Faul, Erdfelder, Buchner, & Lang, 2009) generated a priori sample size estimates for the analyses. Questions 1 and 2 have three predictors. With an alpha level of .05, and desired power of .80, a small effect size (f^2=*.15*) requires 550 subjects, a medium effect size (f^2=*.15*) requires 77 subjects, and a large effect size (f^2=*.15*) requires 36 subjects. Questions 3 and 4 have five predictors. With an alpha level of .05, and desired power of .80, a small effect size (f^2=*.15*) requires 647 subjects, a medium effect size (f^2=*.15*) requires 92 subjects, and a large effect size (f^2=*.15*) requires 43 subjects.

Anticipated effect sizes were difficult to estimate because few studies have investigated the link between mutual responsiveness and peer competence in children with autism. Thus far, none has investigated the link between mutual responsiveness and friendship quality in children with autism. Thus, preliminary data were analyzed (autism n=13; TD n=10) to assess feasibility

of the proposed analyses. For Questions 1 and 2, a multiple linear regression with standard predictor entry was conducted. Model results showed that the set of predictors (group and language) together accounted for a significant portion of variance in peer competence R^2 = 0.68 (adjusted R^2= 0.64), F (2, 19)=20.156, p<.001, and friendship R^2=0.40 (adjusted R^2 = 0.34), F (2, 19)=6.462, p<.01. For Questions 3 and 4, individual linear regressions were conducted (autism n=13) and showed that one domain of mutual responsiveness predicted friendship quality R^2=0.39 (adjusted R^2=0.34), F (1, 12) = 7.29, p<.05. These results indicated the proposed analyses were feasible.

Follow-up Analyses. In addition to planned analyses, a hierarchical multiple linear regression was performed with language at age 4 years as the first step independent variable, Shared Control as the second step independent variable, and peer competence as the dependent variable.

Results

Descriptive Statistics by Group

Means, standard deviations, ranges and number of participants with complete data for each measure are summarized in Table 7. These data are presented to describe the samples of children with autism and TD. Preliminary analyses via *t*- tests (2-tailed) revealed that children with autism at age 10 years had significantly lower scores than children with TD on measures of intellectual ability, NVIQ, language, peer competence, and friendship quality, and had significantly higher autism symptoms.

Table 7
Descriptive Statistics by Age

		Autism				TD				*df*
Age	Variable	*n*	Mean	*SD*	Range	*n*	Mean	*SD*	Range	
4	Language	25	78.04	19.04	47-109	--	--	--	--	
4	Dev. level	26	73.54	20.22	49-114	--	--	--	--	
4	Autism symptoms	26	7.11	2.00	3-10	--	--	--	--	
10	Intellectual ability***	22	83.14	28.02	30-128	25	118.44	14.35	93-158	30.39
10	Nonverbal IQ***	22	85.55	27.12	30-122	25	114.68	16.07	87-166	33.20
10	Language ***	23	76.30	19.60	29-110	25	104.96	10.88	82-127	33.75
10	Autism symptoms***	22	6.0	2.9	1-10	25	1.52	1	1-5	25.39
10	Peer competence***	23	9.7	3.7	3-17	25	17	2.36	12-20	36.71
10	Friendship quality***	18	3.5	.58	2.5-4.39	25	3.97	.43	2.91-4.74	29.92

*$p<.05$, **$p<.01$, ***$p<.001$,
Language=VABS Communication; Dev. Level=Mullen Scales of Early Learning Composite; Intellectual Ability=DAS GCA; Nonverbal IQ=DAS NVIQ; Autism symptoms=ADOS Peer competence=SSRS peer competence raw score; Friendship quality=FQS mean score;

Descriptive Information on Friendship in Children With Autism

The FII parent-report interview was developed for this dissertation to provide a consistent definition for a focus friend. Having a priori criteria for focus friends helped create a similar pool of friendships, facilitating accurate data analyses and interpretation of longitudinal and concurrent predictors of friendship quality. The FII also provided novel descriptive information about the characteristics of friends and friendships of school-aged children with ASD as

compared with a sample of typically developing school-aged children. Based on the FII, 73% (*n*=19/26) of children with autism had a reciprocal friend and 28% of children with autism did not have a friend, whereas 100% of children with TD had a reciprocal friend. Six of the seven children with autism who did not have a reciprocal friend had VABS Communication scores that placed their communication abilities in the "low" range (i.e. two standard deviations below the VABS Communication mean of 100), with Communication scores ranging from 29 to 65, although one child without a reciprocal friend had a VABS communication score of 84. However, six other children with autism and VABS communication scores in the "low" range, with scores ranging from 29-65, had at least one reciprocal friend. No parent from either group, ASD or TD, gave an example of a friend who was a first-degree relative (i.e., sibling or parent). Significantly fewer children with autism had a reciprocal friend compared to children with TD, Fisher's exact test, *p*=.004 (two-tailed). Of the children with autism who had a friend, 50% (n=9) of the friendships were of equal reciprocity, 38% (n=7) were unequal with the child with autism pursuing his or her friend more, and 11% (n=2) were unequal with the friend pursuing the child with autism more. All but one of the children with TD (96%) had friendships in which both children pursued the friendship equally, and 1 (4%) was unequal, with the child with TD reported to pursue the friendship more.

The FII did not specifically address whether friends were typically developing or had developmental disabilities. However, several parents described a rich variety of friends and relationships that included individuals with a range developmental differences. One child with autism, who had very low language skills, was best friends with another child whom the parent described as "on the spectrum." The participant's mother described the boys as "two peas in a pod," referring to their closeness and similar presentation of autism. In contrast, another child

with autism, who had language skills in the average range, had a best friend who was described as an "all-star athlete," a caring child, described as typically developing, who was one of the participant's "five best friends," who made sure the participant was included in their friend group's activities. One participant with autism reportedly enjoyed spending time with a 23-year-old woman her step-mother cared for, who reportedly also had special needs that were not specified. This relationship did not meet FII criteria because the child with autism and the young woman did not engage in play or identify one another as friends, but appeared to occasionally enjoy watching movies together. A parent of a different child with autism with low language ability described the friend acting as somewhat of a caregiver at times. The friendship met FII criteria and the child reportedly acted as a friend, but also as a sort of "babysitter" when the participant's mother had to run errands.

Parents reported that all children with autism and their friends had known each other for at least six months, and 27% had seen each other within one week of the FII (n=7). Children with TD had also all known their friends for at least six months, and 68% had seen their friends within one week of the FII (n=18). Shared interests were similar between autism and TD groups, with the most popular activity for both groups being video games and the second-most popular being outdoor play. See Table 8 below for a summary of findings from the FII.

Table 8
Friend Information Interview Results

	Autism* n=25	TD n=25
Child has a friend?		
Yes	18	25
No	7	0
Q1a. 1st-degree relative	0	0
Q2. Live in different house	25	25
Q4., Q5. Reciprocity		
Yes	18	25
No	0	0
Q6. Equal reciprocity?		
Equal	9	24
Friend pursues more	2	0
Child pursues more	7	1
Q8. Known longer than 6 months		
Yes	18	25
No	0	0
Q10. Seen in past 6 months		
>6 months	0	0
2-6 months	4	1
1 month	7	6
1 week	7	18
Q13., Q14. Number of shared interests		
0	1	0
1	1	0
2	16	25
Q. 13, Q. 14 Types of interests		
Video games	14	15
Outdoors	9	14
Pretend	4	9
TV	4	6

*One parent in the autism group did not complete the FII

Additional descriptive information on friendships was obtained by parent report on the Peer Social Contact Questionnaire (PSCQ). Parents described developmental status of their children's friends. Parents' descriptions of developmental status are provided to more deeply describe friendships, but a word of caution that the friends did not participate and their developmental status could not be independently confirmed. Describing the best or "focus"

friends of the 18 children with autism who had at least one reciprocal friend, five friends also reportedly had autism, zero reportedly had some other developmental disability, 11 were reportedly typically developing, and two friends were missing this information. Parents described many barriers to their children developing and maintaining friendships, including decreased interest in peers (*n*=7), stated interest, but difficulty reaching out to peers (*n*=8), behavioral concerns (e.g. aggression or "shutting down"), and limited access to peers (*n*=2). Two parents specified concerns seemingly related to autism, such as one child's "maniacal" adherence to school rules that limited access to peers, and another child's difficulty finding friends to share the same narrow and intense interests. Two children's parents noted concerns about victimization, reporting their children were at risk of being taken advantage of by children who seemed nice, but weren't their friends.

Aim 1: Examine Group and Language Contribution to Peer Competence and Friendship

Question 1: To what extent do group and language ability contribute to peer competence, controlling for NVIQ, in children age 10-12 years with autism and TD? Means, standard deviations, and zero-order correlations were examined among all five variables; the original variables of interest (group, language, NVIQ, and peer competence) and age, which was entered as a covariate because children with TD were significantly younger than children with autism (see Table 1). As shown in Table 9, all predictors were significantly correlated with peer competence. Higher NVIQ and language correlated with better peer competence (*rs*=.54, and .66, *ps* <.001, respectively). Group and age negatively correlated with peer competence (i.e. autism group and older children in both groups had lower peer competence; *rs*=-77 and -.31, respectively, *ps*<.001 and <.05, respectively). Predictors also were significantly correlated with each other: language and NVIQ (*r*=.74, *p*<.001), language and group (*r*=-.67, *p*<.001), and group

and NVIQ (r=-.56, p<.001), but the assumption of nonmulticollinearity was tenable, with VIF values under 10 (Wetherill, 1986 in Lomax, 2001; VIF NVIQ=2.34; VIF age=1.33; VIF group=2.29; VIF VABS=2.9).

Table 9

Question 1: Descriptives and Zero-Order Correlations

Outcome	*M*	*(SD)*	1.	2.	3.	4.	5.
1. Peer Comp	13.72	(4.58)	--				
Predictors							
2. Age	-.02	1.00	-.31*	--			
3. NVIQ	-0.01	(1.00)	.53***	-.17	--		
4. Group	-0.05	(1.01)	-.77***	.48***	-.56***	--	
5. Language	.04	(.98)	.66***	-.26*	.75***	-.67***	--

Note. n=49. Peer Comp= peer competence on SSRS (raw score); Age= participants' age in months (z score); NVIQ=Nonverbal IQ from DAS (z score); Group effect coded (autism=1, TD=-1); Language=VABS Communication (z score)

*p<.05 **p<.01 ***p<.001

A hierarchical multiple linear regression was performed with NVIQ and age entered simultaneously as the first step independent variable, group (autism/TD) and language entered simultaneously as the second step independent variable, and peer competence as the dependent variable. As shown in Table 10, Block 1, which included NVIQ and age, accounted for significant variation in peer competence, R^2=.33, p<.001. Block 2, which included group and language, accounted for significant variation in peer competence, R^2_{change}=.30, p<.001. Group was uniquely predictive of peer competence. With group effect coded (-1 for TD and 1 for autism), one unit of positive change in X (i.e. from mean of 0 to autism group [1]) indicated a decrease of 2.86 points on peer competence. In the context of all predictors (NVIQ, age, group, and language), NVIQ, age, and language did not contribute significantly to the regression model (ps>.05).

Table 10									
Question 1: Hierarchical Multiple Linear Regression for Peer Competence									
	Block 1				Block 2				
	R^2_{total}	R^2_{adj}	*B*	sr^2	R^2_{change}	R^2_{total}	R^2_{adj}	*b*	sr^2
Model fit	.33***	.30			.30***	.63***	.60		
Coefficients									
Intercept			13.71***					13.50***	
NVIQ			2.26***	0.24				-0.03	.00002
Age			-1.02	.05				.28	.002
Group								-2.86***	.17
Language								1.22	.02
Note. *n*=47. Block 1 *F*-change test *df*=2,44; Block 2 *df*=4, 42; NVIQ=Nonverbal IQ from DAS (*z* score); Age=participants' age in months (*z* score);(Group)=group, effect coded; Language=VABS Communication (*z* score).									
** p < .05, ** p < .01, *** p < .001.*									

Question 2: To what extent do group and language ability contribute to friendship quality, controlling for NVIQ, in children age 10-12 years with autism and TD? Means, standard deviations, and zero-order correlations were examined among all five variables: the original variables of interest (group, language, NVIQ, and friendship), and age, which was entered as a covariate because children with TD were significantly younger than children with autism (see Table 1). Predictors NVIQ, language, and group were significantly correlated with friendship quality, but age was not (r=.06, p=.35). Nonverbal IQ and language correlated with better friendship quality (rs=.32 and .52, ps <.05 and <.001, respectively), and group negatively correlated with friendship quality (i.e. autism group correlated with lower friendship quality) (r=-43, p<.01). The predictors were also significantly correlated with each other: age and group (r=.45, p<.01), language and NVIQ (r=.68, p<.001), language and group (r=-.64, p<.001), and group and NVIQ (r=-.53, p<.001), but the assumption of nonmulticollinearity was tenable with VIF values under 10 (Wetherill, 1986 in Lomax, 2001:VIF NVIQ=2.05; VIF age=1.3; VIF group=2.16; VIF VABS=2.46).

Table 11							
Question 2: Descriptives and Zero-Order Correlations							
Outcome	*M*	*(SD)*	1.	2.	3.	4.	5.
1. Friend quality	3.77	(.54)	--				
2. NVIQ	.12	(.91)	.32*	--			
3. Age	-.07	(1.03)	.06	-.09	--		
4. Group	-.16	(.99)	-.43**	-.53***	.45**	--	
5. Language	.14	(.93)	.52***	.68***	-.20	-.64***	--
Note. n=43. Friend quality= friendship quality on FQS (raw score); NVIQ=Nonverbal IQ from DAS (*z* score); Age=participants' age in months (*z* score); Group effect coded (autism=1, TD=-1)Language=VABS Communication (*z* score)							
*p<.05 **p<.01 ***p<.001							

A hierarchical multiple regression was performed with NVIQ and age entered simultaneously as the first step independent variable, group (autism/TD) and language entered simultaneously as the second step independent variable, and friendship quality as the dependent variable. As shown in Table 12, Block 1, which included NVIQ and age, accounted for significant variation in friendship quality, R^2=.11, p<.05. Block 2, which included group and language, accounted for significant variation in friendship quality, R^2_{change}=.25, p<.01. Language was uniquely predictive of friendship quality, and for every standard deviation increase in language, there was an expected increase of .28 points on friendship quality. In the context of the other predictors, NVIQ, age, and group did not contribute significantly to the regression model (*ps*>.05).

Table 12									
Question 2: Hierarchical Multiple Linear Regression for Friendship Quality									
	Block 1				Block 2				
	R^2 total	R^2 adj	*b*	sr^2	R^2 change	R^2 total	R^2 adj	*b*	sr^2
Model fit	.11*	.06			.25**	.36**	.29		
Coefficients									
Intercept			3.75***					3.73***	
NVIQ			.19*	.10*				-.10	.02
Age			.05	.008				.16	.06
Group								-.19	.05
Language								.28*	.09*
Note. n=43. Block 1 F-change test df=2,44; Block 2 df=4, 42; NVIQ=Nonverbal IQ from DAS (z score); Group)=group, effect coded; Language=VABS Communication (z score).									
* $p < .05$, ** $p < .01$, *** $p < .001$.									

Aim 2: Examine Mutual Responsiveness Contribution to Peer Competence and Friendship Quality

Question 3: Does mutual responsiveness between parents and children with autism age 4 years predict peer competence at age 10-12 years, controlling for language at age 4 years? Means, standard deviations, and zero-order correlations among all variables were evaluated (see Table 13) There were no significant correlations between the predictors and peer competence, but there was a nonsignificant trend of higher parent control (i.e. less Shared Control) being associated with lower peer competence (r=-.35, p=.053). The predictors were also significantly correlated with one another; higher Global Impressions significantly correlated with higher language scores (r=.60, p<.01), higher parent control significantly correlated with lower language (r=-.56, p<.01), a greater number of responsive bouts significantly correlated with higher Global Impressions (r=.51, p<.01), higher parent control significantly correlated with lower Global Impressions (r=-.55, p<.01), and higher parent control significantly correlated with fewer responsive bouts (r=-.46, p<.05). The assumption of nonmulticollinearity was tenable with VIF values under 10 (Wetherill, 1986 in Lomax, 2001: VIF VABS age 4 years: 1.84; VIF

Global Impressions: 1.95; VIF PEB duration: 1.08; VIF number of bouts: 1.52; VIF Shared Control: 1.76).

Table 13

Question 3: Descriptives and Zero-Order Correlations

Outcome	*M*	*(SD)*	1.	2.	3.	4.	5.	6.
1. Peer Comp	9.86	3.48	--					
Predictors								
2. Language	.13	.91	.25	--				
3. Global Impressions	.04	.89	.16	.60**	--			
4. PEB duration	-.07	.82	.11	-.15	-.08	--		
5. Number bouts	-.12	.95	.25	.35	.51**	.14	--	
6. Shared control	-.18	.89	-.35	-.56**	-.55**	.001	-.46*	--

Note. *n*=22. Peer Comp= peer competence on SSRS (raw score); Language=VABS Communication at age 4 years (z score); Global Impressions= Mean of Co-Imps (*z* score); PEB duration=duration of positive engagement behavior bouts in seconds (*z* score), Number bouts=the number of responsive bouts per interaction (*z* score), Shared control=ratio of shared control between parent and child (*z* score)

*p<.05 **p<.01 ***p<.001

A hierarchical linear regression was performed with language at age 4 years as the first step independent variable, mutual responsiveness scores entered simultaneously as the second step variable, and peer competence as the dependent variable**.** As shown in Table 14, Block 1, which included language at age 4 years, did not account for significant variation in peer competence, R^2=.06, p=.26. Block 2, which included Global Impressions, PEB duration, number of responsive bouts, and Shared Control did not account for significant variation in peer competence, R^2_{change}=.09, p=.77.

Table 14

Question 3: Hierarchical Multiple Linear Regression for Peer Competence

	Block 1				Block 2				
	R^2_{total}	R^2_{adj}	*B*	sr^2	R^2_{change}	R^2_{total}	R^2_{adj}	*b*	sr^2
Model fit	.06	.01			.09	.16	-.10		
Coefficients									
Intercept			9.73***					9.69	
Language			.95	.25				.49	.007
Global Impres.								-.48	.009
PEB duration								.44	.009
Number bouts								.42	.008
Shared Control								-.1.15	.05

Note. *n*=22. Block 1 *F*-change test (df)=1,20; Block 2 *df*=4, 16; Language=VABS Communication at age 4 years (*z* score); Global Impres.= Global impressions via mean of Co-Imps (*z* score); PEB duration=duration of positive engagement behavior bouts in seconds (*z* score), Number bouts=the number of responsive bouts per interaction (*z* score), Shared control=ratio of shared control between parent and child (*z* score)

** p < .05, ** p < .01, *** p < .001.*

Question 4: Does mutual responsiveness between parents and children with autism age 4 years predict friendship quality at age 10 years, controlling for language at age 4 years? Means, standard deviations, and zero-order correlations among all variables were evaluated (see Table 15). There were no significant correlations between the predictors and friendship quality. The predictors were significantly correlated with one another: higher Global Impressions were significantly correlated with higher language scores (r=.59, p<.01), higher parent control was significantly correlated with lower language (r=-.54, p<.05), a greater number of responsive bouts was significantly correlated with higher Global Impressions (r=.49, p<.05), higher parent control was significantly correlated with lower Global Impressions (r=-.56, p<.01), and higher parent control was significantly correlated with fewer responsive bouts (r=-.47, p<.05). The assumption of nonmulticollinearity was tenable with VIF values under 10 (Wetherill, 1986 in Lomax, 2001: VIF VABS age 4 years: 1.72; VIF Global Impressions: 2.03; VIF PEB duration: 1.11; VIF number of bouts: 1.48; VIF Shared Control: 1.74).

Table 15

Question 4: Descriptives and Zero-Order Correlations

Outcome	*M*	*(SD)*	1.	2.	3.	4.	5.	6.
1. Friend quality	3.46	.54	--					
Predictors								
2. Language	.21	.83	-.08	--				
3. Global Impres.	.20	.87	.18	.59**	--			
4. PEB duration	-.03	.83	.17	-.14	-.21	--		
5. Number bouts	-.07	1.03	.06	.39	.49*	.07	--	
6. Shared Control	-.18	.95	-.23	-.54*	-.56**	.001	-.47*	--

Note. *n*=22. Friend quality=friendship quality on FQS (raw score); Language=VABS Communication at age 4 years (z score); Global Impres.= Global impressions via mean of Co-Imps (z score); PEB duration=duration of positive engagement behavior bouts in seconds (z score), Number bouts=the number of responsive bouts per interaction (z score), Shared Control=ratio of shared control between parent and child (z score)

*p<.05 **p<.01 ***p<.001

A hierarchical multiple linear regression was performed with language at age 4 years as the first step independent variable, mutual responsiveness scores entered simultaneously as the second step variable, and friendship quality as the dependent variable. As shown in Table 16, Block 1, which included language at age 4 years, did not account for significant variation in friendship quality, R^2=.006, p=.75. Block 2, which included Global Impressions, PEB duration, number of responsive bouts, and Shared Control, did not account for significant variation in friendship quality, R^2_{change}=.17, p=.65.

Table 16

Question 4: Hierarchical multiple linear regression for friendship quality

	Block 1				Block 2				
	R^2_{total}	R^2_{adj}	*B*	sr^2	R^2_{change}	R^2_{total}	R^2_{adj}	*b*	sr^2
Model fit	.006	-.06			.17	.18	-.16		
Coefficients									
Intercept			3.47***					3.44***	
Language			-.05	-.08				-.23	.07
Global Impressions								.19	.05
PEB duration								.13	.03
Number bouts								-.05	.007
Shared Control								-.17	.05

Note. *n*=22. Block 1 *F*-change test (df)=1,20; Block 2 *df*=4, 16; Language=VABS Communication at age 4 years (z score); Global impressions=mean of Co-Imps (z score); PEB duration=duration of positive engagement behavior bouts in seconds (*z* score), Number bouts=the number of responsive bouts per interaction (*z* score), Shared control=ratio of shared control between parent and child (*z* score)

** p < .05, ** p < .01, *** p < .001.*

Follow-up Analyses

A nonsignificant trend correlating less parent control (i.e. more Shared Control) at age 4 years with higher peer competence at age 10 was detected (r=-.35, p=.053). To further investigate this relationship, a hierarchical multiple linear regression was performed with language at age 4 years as the first step independent variable, Shared Control as the second step variable, and peer competence as the dependent variable. As shown in Table 17, Block 1, which included language at age 4 years, did not account for significant variation in peer competence, R^2=.135, p=.08, f^2=.26. Block 2, which included Shared Control, did not account for significant variation in peer competence, R^2_{change}=.07, p=.08.

Table 17

Follow-up:Hierarchical Multiple Linear Regression for Peer Competence

	Block 1				Block 2				
	R^2_{total}	R^2_{adj}	*b*	sr^2	R^2_{change}	R^2_{total}	R^2_{adj}	*b*	sr^2
Model fit	.135	.09			.07	.21	.13		
Coefficients									
Intercept			9.51***						
Language			.37	.13				.15	.01
Shared Control								-.35	.07

Note. *n*=24. Block 1 *F*-change test *df*=1,22; Block 2 *df*=2, 21; Language=VABS Communication at age 4 years (*z* score Shared control=ratio of shared control between parent and child (*z* score)

** p < .05, ** p < .01, *** p < .001.*

Discussion

Overview

This dissertation investigated concurrent and longitudinal predictors of peer competence and friendship quality in children with autism and TD peers. Analyses indicated group and language concurrently predicted peer competence and friendship quality for children with autism and TD at age 10 years. Consistent with existing studies, children with autism without ID and LI demonstrated worse relationships with their peers than children with TD. Mutual responsiveness between parents and children with autism at age 4 years did not predict peer competence or friendship quality, but a non-significant trend was detected, indicating a potential relationship between Shared Control at age 4 years and peer competence at age 10 years. This dissertation made several novel contributions to existing literature. First, this dissertation was one of few studies to include participants with ID and LI. Second, longitudinal data were examined between ages 4 years and 10 years, which yielded predictions of peer competence and friendship quality six years after baseline. Comparatively, other studies longitudinally predicting peer competence have been much shorter. One study followed children with DD over two years (Guralnick et al., 2008), and the other followed children with autism over one year (Meek et al., 2012). Though one study longitudinally examined friendship features (e.g. whether friendships remained reciprocal throughout the year; Locke et al., 2013), no existing longitudinal studies were found that examined predictors of friendship quality in children with autism (i.e. specific descriptions of a friendship with a close friend). Third, to our knowledge, this dissertation is one of only two studies to measure friendship quality via parent report (Calder et al., 2013). This approach allowed inclusion of child participants with lower verbal ability, who could not complete a questionnaire that requires sophisticated receptive and expressive language, yielding a wealth of

information about their friendships. Finally, the Co-Imps and RACS were applied to characterize mutual responsiveness between preschool children with autism and their parents, the first study of which we are aware that used these coding systems with children with autism, extending previous studies that employed these coding systems to examine parent-child interactions (Dishion et al., 2012; Sitnick et al., 2014; Smith et al., 2013; Smith et al., 2014; VanRyzin & Dishion, 2012; Van Ryzin & Dishion, 2013).

Summary and Interpretation of Results

As expected, fewer children with autism had reciprocal friends than children with TD (73% and 100%, respectively). However, these percentages were much higher than previously reported in children with autism and TD (26% and 43%, respectively; Locke, et al., 2013). One reason for this difference may have been the use of parent report, which allowed assessment of friendships across multiple settings (home, neighborhood, school). Previous studies on friendships in ASD tend to be restricted to the school setting (e.g., Kasari et al., 2011; Locke, et al., 2013; Locke et al., 2010). This dissertation's findings indicated 21% (n=9) of all participants had friends with whom they did not attend school, but knew through their family or from organizations such as church. These friendships would have been missed using school-based assessment methods. Consistent with previous findings, children with autism were more likely to have friends who had autism than were children with TD (Locke et al., 2010).

Of the children who did not have a reciprocal friend (all with autism), language skills may have been an important factor. Children with autism without a reciprocal friend had mean VABS Communication scores 2 standard deviations below the mean (i.e. standard scores below 70). However, six children with autism who had at least one reciprocal friend also had mean VABS Communication scores 2 standard deviations below the mean. Thus, lower language may

have been a barrier to forming friendships for some children with autism, but it appeared to be possible for children with lower language skills to establish reciprocal friendships. This was a surprising finding, considering the importance placed on communication skills for developing peer relationships (Fujiki et al., 1999; Sigman et al., 1999), and indicates that children with autism built friendships with peers without relying on spoken language. Understanding their methods for making friends merits further investigation.

No age effect was detected for friendship quality, which was different from findings by Bauminger et al., (2008[b]). These differences may have been due to different methods; this dissertation employed parent report of friendship quality and Bauminger et al., (2008[b]) used direct observation of friendship-related behavior. Differences in observational methods may yield different friendship behaviors, with direct methods facilitating observations of overt friendship characteristics such as shared enjoyment with a friend, and nonobservtional methods (e.g. questionnaires such as the FQS) revealing more intimate and difficult to observe qualities such as how a child feels about his friend (Newcomb & Bagwell, 1995). Thus, it may not be that age differences were not present in our sample, but that they would have been more evident by directly observing interactions between children.

Support was found for hypothesis one, that group (autism/TD) and language (VABS at age 10 years) together would predict peer competence for children with autism and TD at age 10 years, controlling for NVIQ and age, and group uniquely predicted peer competence. Thus, being in the autism group was a better predictor of peer competence than the child's language ability. This was an unexpected and intriguing result. Although this regression only captured one point of development, according to previously-discussed developmental models, children in the autism group likely experienced worse social interactions throughout development, yielding worse

outcomes than their peers with TD, who experienced repeated positive social interactions. A preliminary analysis examined two groups within the autism group: those who met diagnostic criteria for autism at age 10 years, and those who did not. Children in the autism group without a diagnosis had significantly better peer competence scores than the children with a diagnosis, but their peer competence scores were significantly lower than children with TD. Thus, even though some children in the autism group no longer met criteria for autism, ostensibly demonstrating adequate ability to interact with their peers, their peer competence outcomes were not at the same level of their TD peers, indicating that history of an autism diagnosis, and likely more peer interactions that were negative throughout development compared to TD children, contributed to worse peer competence outcomes.

Support was found for hypothesis two, that group (autism/TD) and language (VABS at age 10 years) together would predict friendship quality for children with autism and TD at age 10 years, controlling for NVIQ and age, and language uniquely predicted friendship quality. Twelve children with autism had language scores within the average range. However, it appears that these children were not deploying their language effectively with peers in order to build friendships. This phenomenon has widely been documented by studies showing children with autism without ID or LI have worse friendship quality than IQ- and language-matched children with TD (Bauminger & Shulman, 2003; Bauminger & Kasari, 2000; Bauminger et al., 2008[b]; Bauminger et al., 2004).

As described previously, inspection of children's language scores and friendship outcomes revealed that six children with autism who had language scores in the low range reportedly had formed friendships that met a priori criteria. However, the unique contribution of language to friendship quality indicated that although children with lower language scores

established a friendship, their friendships were of lower quality. Furthermore, the unique contribution of language to friendship quality, and the fact that group did not uniquely contribute to friendship quality, indicates that language was important for children with TD as well as children with autism.

Examining hypotheses 1 and 2 together, I did not predict that different factors would uniquely contribute to peer competence and friendship, but it may be that this dissertation uncovered a heretofore undescribed phenomenon. Peer competence relies on actions such as entering peer groups and maintaining play, which arguably do not necessarily require good language skills. For example, a child can wordlessly enter a group activity or complete a puzzle with a peer using gestures or other compensatory communications. In contrast, high-quality friendships likely require sophisticated communication such as discussing shared interests and expressing feelings for a friend.

Conceptual frameworks also help to interpret the finding that different factors uniquely predicted peer competence and friendship. First, from a transactional perspective, it is likely that children with autism experience fewer high-quality social interactions throughout development due to their own social difficulties and that these interactions mutually affect the child and her environment. Thus, a child with autism emits fewer prosocial behaviors with peers, and experiences lower-quality social interactions, resulting in a depleted social environment. Repeated cycles yield worse peer competence. This interpretation is bolstered by the finding that children without a current diagnosis in the autism group had significantly worse peer competence than children with TD, indicating that despite no longer qualifying as having autism, their experiences throughout development put them on a different path from children with TD. A similar process of experiencing repeated cycles of interaction also are applicable for a child when

attempting to make friends, but perhaps once a child makes one friend, their personal social environment includes more positive social behaviors, and their developmental status is less of an issue. Indeed, children display better outcomes, including a greater sense of well-being and the ability to make more friends, by making only one friend (Hartup & Stevens, 1997). Although a child's developmental status may present an initial barrier to making friends, perhaps after making a friend, the more important factor is being able to deploy language to maintain a high-quality friendship.

Results of the first two questions indicate that children with a history of autism should receive continued support, even after making great progress. It is encouraging that children with autism experienced such growth, to the extent that some no longer met diagnostic criteria for autism, but their persistent social challenges indicated that providers must be wary of discharging children from their service, and should not assume that lower autism severity or good language skills leads to better peer relationships. Two assessment approaches employed in this dissertation could aid clinicians in detecting social difficulties with peers: using parent report and specifying peer-related social behaviors rather than broader social competence. If, after administering these assessments, a child still does not qualify for special education, it is advisable for clinicians to transition the child out of services gradually and with support systems in place. For example, it seems prudent to enlist the help of people within the child's social network, such as teachers, parents, peers and private therapists, to carefully monitor a child's peer interactions, providing specific behavioral targets (e.g. entering peer groups and resolving conflicts). Classroom teachers can foster more supportive social environments by talking about peer competence behaviors with all students, and by providing supports within the classroom, such as visuals of how to enter a game with peers.

If replicated, it appears language ability is critical to having higher-quality friendships. Clinicians, teachers, support staff, and parents should help children with autism make reciprocal friends, and support children's ability to use language to navigate friendships successfully. Specific language characteristics that enhance friendship quality are not yet known, but children with autism tend to use less intersubjective language to talk about how people feel or behave (Bauminger et al., 2004). Thus, encouraging more intersubjective language (e.g. "my friend and I feel happy because we built a fort") may help children build higher quality friendships. It may also be that a child's language abilities are not deployed adequately during interactions with their friends. Thus, clinicians should not assume that a child with adequate receptive and expressive language skills is using them effectively, and should observe or indirectly measure (e.g. via parent report) their interactions with friends and peers if possible. Children with autism who have average spoken language skills, (e.g. vocabulary and sentence structure) may restrict their language use to their circumscribed interests, requiring support to use language effectively with their friends to talk about each other's interests. The deployment of language with peers is also relevant for children with low verbal skills, who should have supports (e.g. buttons on their AAC device or visual supports on the playground) that facilitate social interactions with friends in addition to support for communicating about other everyday needs.

Support was not found for hypothesis three that mutual responsiveness between parents and children with autism at age 4 years would predict peer competence at age 10 years, controlling for language at age 4 years. This finding differed from extant literature in which children's interactive behaviors with parents predicted peer competence (Guralnick et al., 2008; Haven, et al., 2013; Meek et al., 2012). However, the previous studies examined the relationship between parent/child interactions and social competence no more than two years later, and the

second time point in this dissertation was six years later. Thus, it may be that the relationship between mutual responsiveness and peer competence is more difficult to observe as the child ages. In the context of the conceptual frameworks, parent/child interactions are vitally important, but interactions with many other social partners also are formative to a child's peer competence. By school age, a child will have interacted with many different social partners, and perhaps those interactions contribute more to peer competence by middle childhood than early parent/child interactions.

The unique contributions of parent- and peer-child interactions to peer competence in children with autism have not yet been studied. A trend toward a unique relationship was detected via a follow-up analysis that focused on Shared Control and peer competence. This regression also was not significant, but a power analysis with G*Power indicated that with the achieved effect size (f^2=.26), a sample of 41 participants would be sufficient to achieve significance with power of .80. More participants with autism who completed the earlier study at age 4 years are expected to complete the TAM study, thus future analyses may demonstrate a significant contribution of Shared Control to peer competence. If a future investigation reveals that Shared Control predicts peer competence six years later, it would indicate that a special, powerful relationship exists between parent-child interactions in early development and later peer-child interactions. Specifically, it would suggest that learning takes place during interactions between parent-child dyads with more Shared Control that directly contributes to a child's peer competence skills in later development, such as the ability to initiate and maintain play and resolve conflicts with peers. This finding could have great clinical impact, supporting approaches that encourage parents to act as play partners, rather than directors. Encouraging

Shared Control is especially important for parents of children with autism, who tend to be directive (Doussard-Roosevelt, et al., 2003).

Support was not found for hypothesis four, that mutual responsiveness between parents and children with autism at age 4 years would predict friendship quality at age 10 years, controlling for language at age 4 years. None of the predictors were directly or uniquely related to friendship quality. As with peer competence, it may be that parent-child mutual responsiveness becomes less influential over time. No studies to date have examined the longitudinal contribution of mutual responsiveness (or any aspect of parent/child interactions) to friendship quality, and thus, further investigation is necessary. Alternatively, it is possible that mutual responsiveness between children and parents relates to language development, which in turn contributes to friendship quality in later development. This assertion is supported by this dissertation's findings of significant correlations between mutual responsiveness (Global Impressions and Shared Control) and children's language at age 4 years, and is consistent with existing literature that demonstrated linkages between mutual responsiveness and language development (Haebig, McDuffie, & Weismer, 2013; Siller & Sigman, 2002; Siller & Sigman, 2008).

Correlations detected between mutual responsiveness and language in this dissertation were informative, but yield additional questions about the directionality of the relationship between mutual responsiveness and language. It may be that parents of children with better language felt more comfortable ceding some control of the play interaction, while parents of children with lower language felt the need to direct their children's behavior. This idea was supported by a study that found mothers who had children with and without autism were more directive of their children with autism (Doussard-Roosevelt, et al., 2003). It may also be that

parents who allowed children to take more control of interactions promoted language development and Global mutual responsiveness in their children. This explanation fits within the context of child-centered therapy approaches advocating following a child's interests, limiting directives and questions, and letting the child lead the interaction such as the ESDM approach (Rogers & Dawson, 2009), Enhanced Milieu Teaching (Hancock & Kaiser, 2006), and the Hanen Method (Pepper & Weitzman, 2004). Placing these results within the transactional model framework, it is likely that both the parent and the child influenced one another. Children with autism with better language were more able to verbally influence parents' behavior, which corresponded with parents responding to their children and allowing children to take more control of the interaction, (i.e. increasing Shared Control). Children with autism with worse language responded to parents' directions, which in turn reinforced parents' more directive behavior, and over time encouraged parents to continue controlling interactions (i.e. generating less Shared Control).

Language was included as a control variable in research questions 3 and 4 to clarify the relationships between mutual responsiveness and peer competence and friendship quality, assuming language would relate to children's mutual responsiveness behaviors. Surprisingly, language at age 4 years was not significantly correlated with either peer competence or friendship quality at age 10 years. However, language at age 10 years uniquely predicted friendship quality. Thus, VABS Communication scores from age 4 years and age 10 years differentially related to friendship quality. As previously discussed, it could be that mutual responsiveness contributed to language, which in turn contributed to friendship quality. In addition, children with autism changed a great deal between preschool and middle childhood, which may have prevented a linear relationship from developing between those time points. This

idea has partial support from a previous study following this cohort in which at age 6 years, children with autism made significant gains in intellectual ability following the ESDM intervention, and children in the ESDM treatment group had lower autism severity following treatment (Estes et al., 2015). This dissertation's approach would not have captured the intermediate changes in the children with autism.

Clinical Utility of Findings

A novel approach to measuring mutual responsiveness with the Co-Imps and RACS indicated potential for developing efficient yet detailed measures of mutual responsiveness for young children. First, 25 Co-Imps of Mutual Responsiveness yielded a high Cronbach's alpha, indicative of excellent internal consistency. This measure of mutual responsiveness may be useful in future studies and in clinical applications to examine parent-child interactions as it is more efficient than many more-detailed coding systems. In its current form, the Co-Imps require extensive reliability training, but it seems likely that a reliable questionnaire-format tool could be created based on the 25 selected items employed in this dissertation. This could have a substantial impact on the ability to reliably and efficiently measure parent-child interactions. Second, this is the first study of which we are aware to apply the RACS to children with autism. Given the heterogeneity of children with autism, it is necessary to richly describe their behaviors, both for illuminating possible subtypes and designing appropriately-targeted therapy. The RACS provides the means to do so. Finally, measuring Shared Control via child and parent questions and directives could be a straightforward method employed during low-structured play. This method allows measurement of both child and parent behaviors and has support in the extant literature among children with other DD, in which children's "influence attempts" included questions and directives toward parents (Guralnick et al., 2008). If feasible, measuring shared control in this manner could

apply to a variety of situations including research, parent coaching, training educators, and measuring change in interaction style over time. Thus, applications of the Co-Imps and RACS could improve characterization of children with autism, with the potential to lead to more accurate research practices and more appropriately-targeted therapy.

Limitations

One potential drawback of this study is that we relied exclusively on parent reports of peer competence and friendship quality. While parent report of peer competence is the convention, friendship quality usually is measured via child report. However, for this study, parent report was necessary to include children whose language skills would have limited their ability to complete interviews about their friendships. Parent report likely was more inclusive of friends from across multiple settings. As a result, we may have captured some friendships that other studies have not. Arguably, including these children is a unique strength of this dissertation, and makes an important contribution to the existing literature. Furthermore, parents' reports likely were valid because they were given clear criteria for friendships. One limitation of collecting data via parents during lab-based tasks was that we were not able to confirm the friendship with the child's identified "focus friend." Although it is possible that participants' parents did not accurately identify their children's reciprocal friendships (i.e. they identified non-reciprocal friendships as reciprocal), the FII was designed to ensure that only reciprocal friendships were analyzed. A previous study indicated that parents were likely to disagree with their children's identified friendships if they felt the friendships were not reciprocal (Calder et al., 2013). Thus, parents appear to be capable of detecting reciprocal friendships in their children. Furthermore, one of the criteria friendships had to meet was that the children met somewhere outside of pre-arranged groups, so in many cases friends had played at each other's houses or

community settings such as parks, allowing parents to observe their interactions and determine whether their relationships appeared to be reciprocal. The other limitation of collecting friendship data via parent report was that we were not able to confirm developmental status of the friend. In this study's sample, more parents of children with autism reported that their child's friend had a developmental disability than did the children with TD. Friend group makeup has been linked to friendship outcomes, with children in "mixed" groups, with one child with autism and another child with TD demonstrating better friendship outcomes than children with autism in "non-mixed" friendships with another child with autism (Bauminger et al., 2008[a]). However, a recent study indicated that children with autism benefitted from social interactions with other children with autism, although this result requires replication (Kasari et al., 2016). Without independently verifying developmental status of children's friends, we cannot confidently investigate differences in friendship quality based on the developmental status of the friend. This is a methodological consideration for future research.

Aspects of our sample also limited our ability to draw larger conclusions about our findings. First, our sample size was relatively small, with final numbers for analysis at n=23 for peer competence and n=18 for friendship quality for the autism group. This may have limited our statistical power for hypotheses 3 and 4, in which a power analysis indicated that the fewest number of subjects required if a large effect size were present would be 43. Additional children with autism who completed the study at age 4 years are in the process of completing the TAM study at age 10 years. The total number of participants with autism who completed the study at age 4 years was 45, and it is unlikely that 43 of them will return for the TAM study, but more children with autism completing the TAM study should increase the ability to detect significant relationships between mutual responsiveness at age 4 years and peer competence and friendship

quality at age 10 years. A smaller sample size of children with autism also means it is difficult to extend this study's findings to the broader population of children with autism. However, our inclusion of children with diverse presentations of autism makes our findings more applicable to the broader autism population. Also, participants were limited to those who could complete 5, in-person visits of approximately one and a half hours, including a four-hour diagnostic visit. This may have prevented some families from participating, such as those with less flexible work schedules. Participants were, on average, from highly-educated, affluent families within a constrained geographical location in city in which a major university is located. Socioeconomic factors have been shown to predict child outcomes (Dollaghan et al., 1999; Hoff, Laursen, & Bridges, 2012), and thus underlying socioeconomic variables may have unknowingly contributed to peer competence and friendship quality outcomes. Furthermore, this relatively homogeneous sample limits the ability to extend this study's findings to children with different socioeconomic and geographical backgrounds.

There may be latent factors influencing peer competence and friendship that we did not address. There are myriad contributors to complex social outcomes such as peer competence and friendship quality. In particular, executive functioning has been extensively studied in the autism population, and has been tied to social competence (Berger et al, 2002; McEvoy, Rogers, & Pennington, 1993). Executive functioning may not have been a factor for children with autism as early as age 4 years (Dawson et al, 2002), but children with TD demonstrate good cognitive flexibility around age 5 years (Zelazo et al., 2003), which could increase their ability to switch cognitive sets (e.g. change from thinking about completing a puzzle to thinking about playing a board game) within dynamic social contexts such as classrooms and playgrounds (Berger et al., 2003); thus, executive functioning could have contributed to peer competence and friendship

sometime between the time points we measured at 4 years and 10 years of age, and would be expected to challenge people with autism throughout development and into adulthood (Ozonoff et al., 2007). Another potential latent variable that we did not examine was the amount or type of therapy children with autism received, which conceivably could have contributed to peer competence and friendship quality. Amount of therapy likely did not contribute to peer competence and friendship quality, supported by evidence that this dissertation's participants with autism who also completed a previous study, did not demonstrate a link between number of treatment hours and later outcomes (Estes et al., 2015). However, significant differences were shown in outcomes based on the type of therapy within the autism group (ESDM versus community; Dawson et al., 2010; Estes et al., 2015), and could have contributed to peer competence and friendship quality at age 10. However, with a small number of participants in each treatment group (ESDM n=14, community n=12), we chose not to focus on potential treatment differences. Additional participants may increase statistical power to make this comparison possible.

Future directions

This dissertation analyzed data from a multi-time point study, revealing new questions about peer competence and friendships. First, some children with autism had low language scores but established at least one reciprocal friendship. This raised the question of how these children established and maintained a friendship without sophisticated language skills. Second, language uniquely contributed to friendship quality, but a remaining question is what specific aspects of language (e.g. receptive vocabulary, intersubjective language, or expressive syntax) were most important to friendship quality? Third, this study's results indicated that mutual responsiveness between parents and children with autism at age 4 years correlated with language

at age 4 years, and that language at age 10 years predicted friendship quality. Further investigation is required to better understand how these relationships unfold over a child's development, and whether mutual responsiveness indirectly supports later friendship quality. Finally, group uniquely predicted peer competence, including children in the autism group who no longer met diagnostic criteria for autism. Examining peer competence in these children again in the future would help illuminate the developmental trajectory of peer competence for children with a history of autism. It is anticipated that the participants with autism who completed the current study will be invited to participate in future studies, which should yield additional information on peer competence and friendships and their contributors in later development.

Rich information on friendship quality could be gained by including participants' "focus friends" as participants, serving three purposes. First, including identified focus friends would yield information on reciprocity of participants' friendships from the friends' perspectives, rather than relying solely on parent report, as was the case in this dissertation. Second, including focus friends would allow comparison of friendship quality scores between friends, revealing information on children with autism's insight into their own friendships. Finally, including focus friends as participants would ensure independent confirmation of their developmental status, which has been related to friendship quality (Bauminger et al., 2008[a]) and peer competence (Kasari et al., 2016). Although two lab-based studies included children with autism's friends as participants, the children with autism did not have ID or LI (Bauminger et al., 2008[a]; Bauminger et al., 2013), missing a large number of potential participants with autism, an issue that was addressed in this dissertation by including children with autism and ID and LI.

Many studies have investigated peer competence and friendship outcomes for children and adolescents with autism, but it would also be prudent to focus on these important social

outcomes for adults with autism. Although some investigations of peer competence and friendships for adults have been conducted (Carrington et al., 2003, McMahon et al., 2013; Orsmond et al., 2004), more studies are urgently needed. The applications of investigating peer competence and friendships in adults are wide, including building workplace relationships, functioning within romantic relationships, and enhancing quality of life through social connections. Many direct interventions are designed for children with autism, but fewer programs exist for adolescents and adults. Findings regarding the effectiveness of many adolescent programs have been inconclusive (e.g. social skills support group, LEGO® therapy, and Social Use of Language Program; McMahon et al., 2013), although other adolescent-focused interventions have shown promise (e.g. Skillstreaming and PEERS; McMahon et al., 2013; Mandelberg et al., 2014).

Summary

Results of this dissertation indicated that children in the autism group had lower peer competence and friendship quality than children with TD. Nearly one third of children with autism (n=7 of 26) did not have a focus friend at age 10 years, but all children with TD had a focus friend. At age 10 years, group and language significantly predicted peer competence and friendship quality. Mutual responsiveness between children with autism and their parents did not predict peer competence or friendship quality six years later. However, a trend toward significance was detected in the relationship between Shared Control at age 4 years and Peer Competence at age 10 years. If a future investigation with more statistical power detects a significant relationship, it would indicate that Shared Control is a powerful contributor to Peer Competence over the course of the child's development. This finding would support the use of

child-directed therapy techniques and teaching children with autism to be more proactive in social interactions via requests (e.g. “get the ball”) and questions (e.g. “can we make a pizza?”).

Another intriguing finding is the possibility that two related but distinct peer outcomes, peer competence and friendship quality, were predicted by different variables. Whether a child was in the autism group versus the TD group predicted peer competence, but not friendship quality. The importance of group to peer competence was further demonstrated by differential outcomes between children in the autism group who no longer met diagnostic criteria, but had significantly worse peer competence than children with TD. It appears that their developmental experiences generated fewer opportunities to practice peer-related social behaviors and led to worse peer competence than their TD peers. On the other hand, language ability predicted friendship quality, but not peer competence. It is possible that the participants in this study demonstrated some social abilities (e.g. entering peer groups and maintaining play) without sophisticated language, thus achieving peer competence, but required more advanced language skills to engage in activities that enhance friendship quality, such as discussing shared interests and talking about how a friend makes you feel. These were surprising findings and require replication, but may suggest different clinical intervention approaches for children with a history of autism and for evaluating and treating peer competence versus friendship behaviors. First, clinicians should be aware that children with a history of autism could suffer long-term impacts in terms of their everyday interactions with peers. Clinicians should be especially sensitive to ongoing social challenges of children with autism and should try to decrease clinical services gradually and involve a network of professionals, parents, and peers to support the child in their familiar social contexts. Second, clinicians should attend to language difficulties when interacting with friends, which may include using less intersubjective language and restricting

topics of conversation to specific interests not shared (or not as enthusiastically shared) by a child's friend.

This dissertation yielded previously undescribed contributions of group and language ability to peer competence and friendship quality for children with autism, and a potential longitudinal contributor of Shared Control. Results increased our understanding of experiences and skills that shape Peer Competence and friendship quality for children with autism, indicating that these related social outcomes may rely on different underlying skills, and an intriguing finding that language may be more influential for friendship quality than Peer Competence. These findings raised exciting, clinically-applicable directions for future research.

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Appendix A

Friendship Qualities Scale (Bukowski et al., 1994)

Question #	Question	5 Really true	4	3	2	1 Not true	0 Don't know
1	Your child and his/her friend spend all of their free time together.						
2	Your child's friend thinks of fun things for them to do together.						
3	Your child and his/her friend go to each other's houses after school and on weekends.						
4	Sometimes your child and his/her friend just sit around and talk about things like school, sports, and things they like.						
5	Your child can get into fights with his/her friend.						
6	Your child's friend can bug or annoy your child even if he/she asks the friend not to.						
7	Your child and his/her friend can argue a lot.						
8	Your child and his/her friend disagree about many things.						
9	If your child forgot lunch money or needed a little money, his/her friend would loan it to him/her.						
10	Your child's friend helps your child when having trouble with something.						
11	Your child's friend would help your child if he/she needed it.						
12	If other kids were bothering your child, your child's friend would help him/her.						
13	Your child's friend would stick up for your child if another kid was causing trouble for your child.						
14	If your child has a problem at school or at home, your child can talk to his/her friend about it.						
15	If there is something bothering your child, he/she can tell his/her friend						

Question #	Question	5 Really true	4	3	2	1 Not true	0 Don't know
	about it, even if it is something he/she cannot tell other people.						
16	If your child said he/she was sorry after having a fight with his/her friend, his/her friend would still stay mad at him/her.						
17	If your child's friend or your child do something that bothers the other one, they can make up easily						
18	If your child's friend and your child have a fight or argument, they can say "I'm sorry" and everything will be alright.						
19	If your child's friend had to move away, your child would miss him/her.						
20	Your child feels happy when with his/her friend.						
21	Your child thinks about his/her friend even when the friend is not around.						
22	When your child does a good job at something, his/her friend is happy for him/her.						
23	Sometimes your child's friend does things for your child, or makes your child feel special.						

Appendix B

RACS Codes Descriptions

RACS code	Description	Example
Directive (verbal)	Clear and firm commands for behavior change, requests for behavior change, or questions or statements regarding behavior change.	"Clean up now." "No, you do it."
Negative Directive (verbal)	Directive given with negative consequence contingent on compliance or some behavior change	"Clean up or you get a spanking."
Positive Structure (verbal)	Prompting, guiding, or encouraging the behavior of the partner. May involve choices. Can use playful, imaginative prompts for the child.	"Do you want to put the cars or the dinosaurs away first?" "If we clean up now, we can play bubbles later" "Let's make this the garage. We can drive the cars to put them away."
Positive Verbal (verbal)	Verbal expressions of approval of behavior, appearance, or conditions related to the family. Also includes apologies, thanks, compliments, or teasing with positive affect.	"Good job!" "I'm sorry I hurt your feelings" "Thanks"
Negative Verbal (verbal)	Disapproval of family member's behavior, appearance or state of conditions directly related to family. The behavior must be directly relevant to the initiator or other present family member.	"You're not cleaning up very fast" "You aren't doing that right." "That's not right."
Question (verbal)	Any verbal behavior in the form of a question AND contains an attempt to influence or change the behavior of the other family member.	"Do you wanna help?" "Should we put it back in the bucket?" "Which one do you want to play with?"
Talk (verbal)	General conversational verbal interaction including gossip, chit-	"High five!" "There you go."

RACS code	Description	Example
	chat, questions and answers about routine matters, acknowledgement of another's statement. Teaching or other verbal interaction not directly related to the task at hand (cannot be coded as directive or positive structure).	"What should we have for dinner tonight?" Child: "this?" Mom: "yeah."
Vocalization (verbal)	Verbal behavior that doesn't fall into other verbal code category. Attempts at verbal behavior that cannot be coded as talk. Does not include affective behavior such as laughter or crying. Participant may be trying to make sounds that approach words. Verbal tics and repetitive sounds are also vocalization.	"uh uh" ("up" or "more") "mamamama" ("more" or "mama")
No talk (off)	Lack of talk between partners for 10 seconds or more.	Talk is not occurring between partners
Ignore (affect)	Individual ceases to attend to what their partner is saying or doing.	Turn away from partner Not paying attention to bids for attention, rewards, or social interaction.
Orienting (affect)	An active affective code in which the participant is listening, tracking, and engaged in what the speaker is saying.	Head nods, other physical assenting behaviors. Body positioned toward speaker. Eye contact.
Positive Affect (affect)	Affect demonstrating happiness and surprise.	Smile. Happy eyes. Laughter.
Anger/Disgust (affect)	Physical characteristics include lowered brows and slight hint of tension in the jaw and clenched teeth. Also includes raised vocal quality.	Person displays facial expressions including eye rolls, narrowing eyes, wrinkling nose.
Neutral (affect)	"Dividing line" between negative and positive codes.	Voice is even and relaxed, person's resting facial expression is not emotional
Distress (affect)	Decrease in energy and passive, resigned countenance. Often displayed with low volume and	Crying, acting hopeless, whining, slow sighing, fidgeting, fearful face.

RACS code	Description	Example
	slowness of speech. It may resemble fear, whining or sadness.	
Positive Physical (physical)	Affectionate and/or extended positive contact between two people	Hugs, embraces, kisses, sitting with arm around person, high fives
Physical	Any physical contact between two people that is inherently neutral.	Holding child back to protect or ensure safety, holding child's arm to assist in a task, inadvertently hitting a parent during play
Negative Physical (physical)	Intrusive physical contact with another person	Light hitting, pinching, slapping, ear flicking
No Physical (off)	Absence of physical behavior	End of positive or neutral physical

Appendix C

Coder Impressions, *Selected Co-Imps for Global Impressions

01	Does the parent encourage positive child behavior with praise and/or incentives?
02	Does the parent use directives that seem specific and clear to the child?
03	Does the parent prompt the child to transitions and/or future requests for behavior change?
04	Does the parent set limits firmly without using aversive control techniques (i.e., yelling, anger, criticism, threats)?
05	Does the parent provide praise and rewards without regard to child's behavior (non-contingently)?
06	Does the parent give in to the child's negative moods or behaviors with treats and positive activities?
07	Does the parent seem to be avoidant or reluctant to set limits on the child, allowing the child to engage in misbehavior without responding?
08	Does the parent follow through with requests or directives to assure compliance and/or cooperation?
09*	Does the parent encourage the child to remain in the interaction (rather than wander away)?
10*	Is the parent appropriately contingent in responding to positive or compliant child behavior?
11*	Does the parent consistently respond to the child's interests or initiations?
12	Is the parent appropriately contingent in responding to negative or non-compliant child behavior?
13	Does the parent give the child choices for behavior change whenever possible?
14	Does the parent communicate to the child in calm, simple and clear terms?
15	Does the parent give understandable, age appropriate reasons for behavior change?
16*	Does the parent adjust or define the situation so as to assure the child's interest, success and comfort (e.g., making a game, reframing the activity, etc.)?
17	Does the parent redirect the child to more appropriate behavior if the child becomes off task, uncooperative or misbehaves?
18	Does the parent seem to be mindful of the child's behavior, whereabouts, activities and feelings?
19*	Does the parent follow the child's activity with his/her eyes?
20*	Does the parent respond appropriately to the child's initiations or interests?
21	Does the parent seem to have clearly established routines that are well understood and practiced by the child?
22	Does the parent effectively engage the child in the interaction?
23	Does the parent use verbal structuring to make the task manageable?
24	Does the parent seem 'tired-out', depressed, or inattentive to the child during the task?
25*	Does the parent's level of emotion match that of the child?
26	Does the parent display anger, frustration, and/or annoyance during activities?

27*	Does the parent seem to enjoy playing with the child?
28	Does the parent use physical discipline during the observation session?
29	Does the parent seem in firm control and in a leadership role with the child?
30	Does the parent show affection and/or love for the child during the observation session?
31	Does the parent hug, kiss, cuddle, tickle or otherwise touch the TC in a positive way during the session?
32	Does the parent actively ignore/reject the child?
33*	Does the parent comment on the child's activity?
34*	Does the parent orient his/her body to face the child?
35	Is the parent inventive or creative with their use of toys and ideas for play?
36*	Does the parent encourage the child to take turns?
37*	Does the parent willingly participate in activities chosen by the child?
38	Does the parent encourage the child to make eye contact?
39	Does the parent encourage the child to vocalize?
40*	Does the parent's pace match that of the child?
41*	Is the child compliant and cooperative with the parent's directives and requests?
42	Does the child seek out the parent, indicating reliance on the parent for reassurance and/or safety?
43*	Does the child appear to be aware of the parent's presence?
44	Does the child hug, kiss, cuddle, tickle or otherwise touch the parent in a positive way during the session?
45	Does the child seem afraid or avoidant of the parent?
46	Does the child react with physical aggression to the parent?
47	Does the child seem dysregulated and difficult to manage, unable to control his/her behavior and emotions?
48	Is the child easily frustrated?
49*	Does the child physically stay in the area of the activity?
50*	Does the child pay attention to the activities?
51	Does the child switch activities quickly (does the child seem to have a short attention span)?
52*	Is the child actively involved throughout the interaction (as opposed to passive)?
53*	Does the child imitate the parent's actions or activities on his/her own (without prompting)?
54*	Does the child attempt to involve the adult in his/her activities?
55*	Does the child make verbal or nonverbal requests of the parent?
56*	Does the child make spontaneous eye contact with the parent?
57*	Does the child vocalize in response to the parent?
58	Does the child seem happy during the interaction (laughing, smiling, acting content, etc)?
59*	Does the child exhibit reciprocal behavior (turn taking, conversing, singing, etc)?
60	Who seems to be in control or in the leadership position in this family?
61	Is there a clear sense of hierarchy between parents and children?
62*	Does the parent encourage or allow the child to direct the interactions?

Appendix D

Friend Information Interview

	Question
1.	*Is your child related to (NAME)?*
1a.	*If yes, how are they related? (1st/2nd degree relative)*
2	*Do they live in different houses?*
3.	*How old is your child's friend?*
4.	*Does your child consider _____ a friend?*
5.	*Does _____ consider your child a friend?*
6.	*Friendships range in reciprocity, with some kids equally seeking each other, while others are not as equal. Do your child and his/her friend equally pursue the friendship?*
7.	*How long has your child known this friend?*
8.	*(More than 6 months?)*
9.	*Is it a current friendship, meaning someone they have seen recently and that they play with regularly?*
10.	*When was the last time they saw each other?*
11.	*In an average week, about how often do they see each other outside of school for social purposes? (days/week)*
12.	*Where do the children meet?*
13.	*What do they like to do together?* Specify:_____
14.	*What do they talk about together?* Specify:_____
15	*How do they know each other?*
16	*How many friends does your child have, including best/focus friend?*