STUDENT ENGAGEMENT IN SELF-CONTAINED CLASSROOMS SERVING STUDENTS WITH AUTISM SPECTRUM DISORDERS

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ABSTRACT

JESSICA R. DYKSTRA: Student Engagement in Self-Contained Classrooms Serving Students with Autism Spectrum Disorders
(Under the direction of Linda R. Watson)

Given the rising prevalence rates of autism spectrum disorders (ASD), schools are serving an increasing number of students with ASD (Scull & Winkler, 2011). Researchers have highlighted active engagement as a critical component of effective interventions for students with ASD (National Research Council, 2001), yet there is limited research related to engagement in school-age children with ASD. Joint engagement, which reflects the social nature of engagement, is a known area of deficit in young children with ASD (Adamson, Bakeman, Deckner, & Romski, 2009) and may be an ideal construct for assessing the engagement of older students with ASD in the classroom.

This descriptive study was designed to examine the relationship of joint engagement with classroom ecological factors and student characteristics. The sample included 25 elementary and middle school students with ASD served in eight self-contained special education classrooms across three different school districts. Joint engagement was measured during typical classroom instruction in individual, small group, and large group sessions using live coding procedures. Data for the independent variables included the classroom ecological factors of group size, teachers' use of student

directed practices, teacher interaction style and teacher report of burnout, and the student characteristics of autism severity, expressive communication, and receptive vocabulary.

Mixed level modeling was used to examine relationships between joint engagement and the independent variables. Joint engagement was significantly related to group size, teachers' use of student-directed practices, students' autism severity, and students' expressive communication skills. There were no significant relationships of joint engagement with teacher interaction styles, teacher report of burnout, and students' receptive vocabulary skills. Additionally, the consistency of joint engagement as measured by within student variance was 38%, 66%, and 82% for large group, small group, and individual contexts, respectively. These findings have important implications for educational policies and practices and future research related to active engagement and effective interventions for students with ASD.

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CHAPTER 1

INTRODUCTION

Autism spectrum disorder (ASD) is a developmental disorder characterized by language deficits, difficulties with social skills, and the presence of repetitive and restrictive behaviors or interests (American Psychiatric Association, 2000). Individuals with ASD exhibit a range of symptoms across these developmental areas which impact their participation in everyday activities in life. Recent estimates indicate that approximately 1 in 88 children in the United States is diagnosed with ASD (Centers for Disease Control and Prevention, 2012), reflecting a prevalence that has grown at an alarming rate in the past decade.

Statement of the Problem

The increases in prevalence rates are paralleling increases of children with ASD in schools, as the number of students with a label of "autism" served in special education programs quadrupled from the 2000-2001 to the 2009-2010 school years (Scull & Winkler, 2011). In 2010, United States schools served nearly 420,000 students with a primary educational label of autism between the ages of 3 and 21, with over half of those students in the elementary and middle school age range (Data Accountability Center, 2011). In addition to growing numbers of children with ASD, there are increasing concerns about the outcomes for adolescents and adults with ASD. As a group, individuals with ASD tend to achieve limited independence as they move into adulthood, struggling with finding employment, establishing friendships and social networks, and

living independently (Beadle-Brown, Murphy, & Wing, 2006; Billstedt, Gillberg, & Gillberg, 2005; Howlin, Goode, Hutton, & Rutter, 2004). These poor outcomes have a financial impact on families of individuals with ASD and society as a whole (Ganz, 2007). In addition, individuals with ASD seem to have poorer outcomes compared to individuals with other disabilities (Esbensen, Bishop, Seltzer, Greenberg, & Taylor, 2010; Seltzer, Shattuck, Abbeduto, & Greenberg, 2004), reflecting a need for educational programs that are specifically designed to address the needs of individuals with ASD. Given the increasing prevalence of the disorder and the concerning track record of adult outcomes thus far, developing methods to serve older students with ASD in the educational system and improve outcomes among this population is a pressing concern.

Despite this growing population of children with ASD, research has largely focused on early diagnosis and intervention (Lounds Taylor et al., 2012). Consequently, relatively little is known about how to serve these children once they are school aged. In order to provide educational interventions that optimize outcomes for school-aged students with ASD, it is important that researchers examine student and classroom factors that impact the educational experiences of these students in the school environment. One potential influence on the educational outcomes of students with ASD is student engagement.

Engagement is acknowledged as a critical factor in learning and academic gains for children with and without disabilities (Greenwood, 1991; McWilliam, Trivette, & Dunst, 1985). Experts have recommended that children with ASD be actively engaged in meaningful activities for at least 25 hours per week (National Research Council, 2001), yet little is known about educational practices that will promote this “active

engagement". Given that engagement relates to the quality of education (McWilliam et al., 1985) and is predictive of children's later skills (Greenwood, Carta, & Atwater, 1991; Logan, Bakeman, & Keefe, 1997), measuring and understanding engagement is a necessary step in determining how to provide high quality, effective services for students with ASD.

Theoretical Foundations for Current Study

Researchers have long acknowledged that children are impacted by interactions within the environment. This contextual placement of learning or development is exemplified in Bronfenbrenner's ecological systems theory of development, which posits that each individual lives within a series of nested systems and develops through proximal processes, or interactions that occur within and between systems (Bronfenbrenner, 1994). In a school setting, the process of learning and development is impacted by the student, classroom environments, other people in the environment, and the proximal processes that occur between each of the parts of the ecological system. Given that engagement has been defined as developmentally and contextually appropriate participation in the environment (McWilliam et al., 1985), engagement is an ideal concept for exploring learning in schools through the lens of ecological systems theory.

The Importance of Engagement

Researchers have examined engagement for a variety of purposes, including studying the quality of childcare environments (McWilliam et al., 1985) and examining the impact of the educational environment on school-aged children (Greenwood et al., 1991). Additionally, researchers have established that engagement is predictive of later skills in children, including academic gains (Greenwood et al., 1991; Logan et al., 1997)

and language skills (Adamson et al., 2009). Thus, measuring student engagement may be a useful method for predicting educational outcomes of students and monitoring ongoing quality of educational programming.

Engagement and School Environments

The school environment plays an integral role in promoting student engagement. Studies have demonstrated relationships between engagement and teacher behaviors (McDonnell, Thorson, & McQuivey, 1998; McWilliam, Scarborough, & Kim, 2003), instructional strategies or activities (Hamilton, 2005; Marks, 2000; McWilliam et al., 1985), and classroom features (Kishida & Kemp, 2009; Logan et al., 1997; McDonnell et al., 1998; McWilliam & Bailey Jr., 1995). For example, frequency of teachers' academic interactions are related to higher levels of student engagement (McDonnell et al., 1998), and students with disabilities exhibit higher levels of engagement during one-to-one and small group instruction compared to whole group instruction (Logan et al., 1997; McDonnell et al., 1998). Additionally, teacher interaction styles and teacher burnout have been relate to other areas of classroom performance such as student language and academic acheivement (Girolametto & Weitzman, 2002; Jennings & Greenberg, 2009; Mirenda & Donnellan, 1986), and thus may be related to student engagement. The associations of engagement with teacher and classroom characteristics suggest student engagement is one measure that can tap into the quality of educational environments.

Engagement and Student Characteristics

Previous research also suggests that engagement is influenced by individual characteristics of the child. Both chronological age and developmental age have been linked to child engagement (Adamson, Bakeman, & Deckner, 2004; de Kruif &

McWilliam, 1999). Presence and type of disability also appear to impact levels of engagement in children (Adamson et al., 2009; McWilliam & Bailey Jr., 1995; Ruble & Robson, 2007). Identifying relationships between student engagement and characteristics, and identifying student engagement profiles may provide valuable information for making individualized decisions regarding educational placements, goals, and intervention strategies to optimize student outcomes.

Engagement in School-Aged Children with ASD

Despite relatively extensive research in engagement, few studies have examined the engagement of school-aged children with ASD. Kamps and colleagues explored the relationship between student engagement of children with ASD and naturally occurring instruction in a variety of classrooms (Kamps, Leonard, Dugan, Boland, & Greenwood, 1991). Small group instruction, frequent teacher interactions, and individualized sets of materials were associated with higher levels of engagement, which was quantified through academic responding. In the second phase of the study, professional development that targeted increasing teachers' use of some strategies showed promising effects on student performance in single-case design studies. Other single-case design studies have also demonstrated increased engagement for students with ASD through the addition of music and visual interactive materials in small group instruction (Carnahan, Musti-Rao, & Bailey, 2009), the use of child choice in play routines (Reinhartsen, Garfinkle, & Wolery, 2002), the use of structured teaching during independent play (Mavropoulou, Papadopoulou, & Kakana, 2011), and the implementation of cooperative learning groups in general education settings (Dugan et al., 1995). This limited research suggests instructional strategies and groupings may impact engagement for students with ASD.

Joint Engagement in Children with ASD

One limitation of previous research on school-age children with ASD, as well as many of the studies of children with other disabilities, is that engagement was primarily quantified by focusing on academic responding or on-task behaviors. Although this is one important aspect of classroom engagement, it fails to capture other facets of engagement that may be more affected in ASD, namely joint engagement. Joint engagement is the ability to interact with materials and people simultaneously, and requires coordination of attention between others and the environment. This concept of engagement highlights the social, transactional nature of learning in school environments.

The ability to engage jointly emerges in the first 18 months of life in typically developing children (Bakeman & Adamson, 1984). However, 30-month old children with ASD show less engagement than younger typical children and age-matched peers with Down syndrome (Adamson et al., 2009). Importantly, joint engagement is linked to later language abilities (Adamson et al., 2004; Adamson et al., 2009), which in turn relate to adult outcomes for individuals with ASD (Howlin et al., 2004). In intervention research, joint engagement has proven to be sensitive to change targeting early communication and play skills in younger children with ASD (Kasari, Paparella, Freeman, & Jahromi, 2008). Thus, focusing on joint engagement captures aspects of participation in educational environments that are important to learning, but may be particularly challenging for students with ASD.

Purpose

The *objective of this study* is to examine students' joint engagement in the classroom, and to investigate the associations of joint engagement with classroom

ecological factors and student characteristics of individuals with ASD. The study marks the first known attempt to examine the relationship between joint engagement and student, teacher, and classroom characteristics for school-age children with ASD in classroom settings.

The *long-term goal* of this research is to use an understanding of student engagement to develop effective classroom practices and individualized instruction to improve outcomes for students with ASD. Characterizing the nature of and influences on joint engagement in classrooms will have practical significance for educators, researchers, and other stakeholders in the fields of ASD and education. First, determining the relationship of teacher and instructional factors with the joint engagement of students with ASD will guide professional development efforts and offer information in the translation of interventions for educational settings. Second, ascertaining features of educational environments related to joint engagement will allow stakeholders to advocate for policies and funding to support the implementation of optimal practices in classrooms serving students with ASD. Finally, identifying student characteristics that are associated with joint engagement in classroom settings will aid in the development of differentiated intervention strategies and goals to increase individual engagement. Ultimately, the results of the proposed study will inform educational practices for students with ASD, identify potential avenues for improving educational outcomes for this population, and guide future research in this area.

Research Aims

This study is designed to explore classroom ecological factors and student characteristics that may be related to engagement in naturally occurring classroom

activities for students with ASD. A secondary goal of the study is to examine the consistency of joint engagement in students with ASD. The specific aims and corresponding hypotheses of this study are as follows:

Research Aim 1: Examine the relationship between classroom ecological factors and student engagement during typical classroom activities. The working hypotheses for this aim are (1a) student engagement will be inversely associated with the group size during activities, (1b) student engagement will be positively associated with teachers' use of student-directed practices during activities, (1c) student engagement will be positively associated with positive teacher interaction styles in the classroom, and (1d) student engagement will be inversely associated with teacher report of job burnout.

Research Aim 2: Examine the relationship between student characteristics and student engagement during typical classroom activities. The working hypothesis for this aim are (2a) student engagement will be inversely associated with autism severity, (2b) student engagement will be positively associated with level of expressive communication, and (2c) student engagement will be positively associated with receptive vocabulary skills.

Research Aim 3: Examine the consistency of engagement for individual students during typical classroom activities. This will be examined in three contexts: individual, small group, and large group instruction. The working hypotheses for this aim are (3a) student engagement will be strongly correlated within group contexts and (3b) student engagement will be moderately correlated across group contexts.

Summary

Evidence suggests that active engagement is a critical component of effective interventions for individuals with ASD, yet there is limited research about how to achieve, or even measure active engagement in school-aged children with ASD. The purpose of this study is to examine the relationship of engagement with classroom features and student characteristics in order to elucidate environmental and student factors that impact the educational experiences of students with ASD. Using ecological systems theory as a foundation, this study will focus specifically on joint engagement, which highlights the transactional nature of learning in classroom ecologies. Successful completion of this study will advance understanding of the impact of classroom ecologies and student characteristics on joint engagement and inform methodological strategies for measuring joint engagement in future classroom-based research for students with ASD. Given the rising number of individuals with ASD in school systems, developing a foundational understanding of the the engagement of students with ASD and the impact of educational environments and student characteristics is a crucial step in working towards improved educational outcomes for this population of students.

CHAPTER 2

BACKGROUND

Autism spectrum disorder (ASD) is estimated to occur in 1 out of 88 individuals (Centers for Disease Control and Prevention, 2012). It is a developmental disorder characterized by deficits in language, social difficulties, and repetitive and restrictive behaviors and/or interests (American Psychiatric Association, 2000). Although the presentation of ASD varies greatly across individuals, these core areas of difficulty impact many facets of development in individuals with ASD including social reciprocity and awareness, communication, executive functioning and cognition, adaptive functioning, and behavior and emotional regulation, all of which can impact an individual's experiences and success in daily life (American Psychiatric Association, 2000; American Speech-Language-Hearing Association, 2006). For school-age individuals with ASD, these core deficits could influence many areas important to educational experiences including peer relationships, academic achievement, communication, and successful navigation of the school environment.

In line with increases of prevalence rates for ASD, schools have seen increases in the number of students receiving special education services with an educational label of autism (Scull & Winkler, 2011). In one decade, schools in the United States saw a fourfold increase in the number of students with autism served in public schools, ballooning to over 375,000 students by the end of the 2009-2010 school year according to one study (Scull & Winkler, 2011). Compounding the impact of the rising number of

students with ASD is the fact that professionals are underprepared to work with these students, who have unique and complex educational needs compared to students with many other disabilities (Scheuermann, Webber, Boutot, & Goodwin, 2003; Schwartz & Drager, 2008; Simpson, 2004). To date, many of the research efforts in intervention have focused on young children, leaving major gaps in research for school-aged students with ASD (Lounds Taylor et al., 2012). However, key advocacy and research organizations have acknowledged the need for research in school-aged children and adults with ASD by creating strategic plans and soliciting requests for applications to specifically address interventions for older individuals with ASD (e.g., Autism Speaks, Interagency Autism Coordinating Committee, Institute for Education Sciences, National Institutes of Health).

This research gap is even more alarming given the outcome research for adolescents and adults with ASD. Several research teams followed individuals with ASD into their adult years and noted generally poor outcomes across this population (Beadle-Brown et al., 2006; Billstedt et al., 2005; Howlin et al., 2004). On the whole, individuals with ASD have small, but continued improvements in communication (Seltzer et al., 2003), repetitive behaviors and restrictive interests (McGovern & Sigman, 2005; Seltzer et al., 2003), self-care skills (Beadle-Brown et al., 2006), and adaptive behaviors (McGovern & Sigman, 2005). Despite these positive changes in skills and behaviors through adolescents and adulthood on average, some individuals with ASD do not make clear improvements and even have setbacks in these years (Seltzer et al., 2004). Adults with ASD tend to have difficulty maintaining close friendships (Howlin et al., 2004; Orsmond, Krauss, & Seltzer, 2004) and finding full-time employment (Seltzer et al., 2004). Additionally, studies have found that very few adults with ASD live independently

(Beadle-Brown et al., 2006; Howlin et al., 2004). Additionally, adolescents and adults with ASD have notably poorer outcomes compared to their peers with other disabilities, characterized by less independence, fewer social opportunities, and more behavioral difficulties (Anderson, Oti, Lord, & Welch, 2009; Esbensen et al., 2010). Overall, there seem to be some improvements in skills for adolescents and adults with ASD (Taylor & Seltzer, 2010), but these improvements have not translated to real-life outcomes. It is important, then, to focus on educational programs for school-aged children with ASD in order to implement effective interventions to improve adolescent and adult outcomes.

Active engagement has been highlighted as a critical feature of effective interventions for individuals with ASD (National Research Council, 2001). Therefore, finding ways to assess and improve engagement are key steps in developing and evaluating interventions for school-aged children with ASD. Engagement has been defined as "developmentally appropriate participation," and, by its participatory nature, takes into account both the individual and the environment. As such, developmental and learning theories that take both the individual and the environment into account are ideal when researching the concept of engagement.

Ecological Systems Theory

Ecological systems theory emerged in the 1970s as a response to the highly-controlled research in developmental psychology (Bronfenbrenner, 1994). The theory proposes that humans live within in a series of nested environments, and that human development occurs through ongoing and complex interactions, called proximal processes, which occur between the individual and the environments. In addition, the proximal processes that impact a specific developmental outcome vary based on

characteristics of the individual, characteristics of the environment, and the nature of the developmental outcome itself. Thus, the process, person, and context interact in complex ways to produce developmental outcomes, and it is important to observe developmental phenomena within the natural environment.

Ecological systems theory has been widely applied in educational research. Within this framework, individual students are situated in a classroom environment, interacting with people, objects, and symbols within that environment, and developing or learning within the environment. Student characteristics, environmental characteristics, and the interactions between the student and the environment (i.e., proximal processes) are thought to impact the developmental outcomes of the student. Indeed, ecological systems theory has been identified as a useful framework for examining important issues in schools such as academic achievement (Eamon, 2005; Engle & Black, 2008), student behavior (Urdan, Midgley, & Anderman, 1998), inclusion (Odom et al., 1996), literacy (Pancsofar & Vernon-Feagans, 2006), and use of technology (Staples, Pugach, & Himes, 2005). Ecological systems theory has also been used as a foundation for measuring and studying engagement in school environments (Greenwood et al., 1991). In line with ecological systems theory, the current study will examine the engagement of students with ASD in relations to student characteristics, as well as ecological factors, including instructional strategies, teacher behaviors, and classroom groupings.

Engagement

Engagement has been studied in relation to educational environments, classroom quality, and student participation over several decades. At the most basic level, engagement refers to children's participation in their environment (McWilliam et al.,

1985). As theories and methodologies have progressed, the concept and measurement of engagement has evolved, resulting in refined definitions, as well as a variety of tools to capture student engagement. Despite the many transformations in definitions and alternatives in tools, engagement remains a valued variable in educational research and practice for its utility as a descriptor, predictor, and outcome variable.

Measurement of Engagement

The concept of engagement has been utilized in research in many different ways and for many different purposes. These various conceptualizations and purposes have resulted in differences, including measuring engagement at the classroom level versus student level, measuring distinctive types and levels of engagement (e.g., cognitive versus social engagement), and measuring engagement as a trait (i.e., global engagement) versus a state (i.e., observed engagement).

Some of the earliest studies used engagement as a measure of environmental quality or program effectiveness. This idea of measuring engagement was innovative at the time and provided much new information, but the researchers used what might now be considered rather rudimentary methods for measuring engagement. One of the early studies examined children with disabilities in institutional settings by recording the stimulation (i.e., experiences), interactions (i.e., actions), and activity (i.e., participation; Cataldo & Risley, 1974). The measure was designed for use as an assessment of the quality of the environments these children were a part of on a daily basis, and was helpful in making decisions about how children spent time in residential settings. A later study measured engagement to look at childcare environments (McWilliam et al., 1985). The researchers used partial interval coding on videotapes collected in the classroom to code

the percentage of children present who were engaged during a particular activity. Engagement was defined as a dichotomous variable, so each child was coded either unengaged or engaged. This measurement system for engagement allowed researchers to compare engagement of children across different types of preschool classrooms and classroom activities. Using classroom level measures of engagement and a dichotomous definition of engagement was an informative, yet simple measurement system for the purposes of evaluating educational programs. However, researchers were also interested in looking at individual children and more nuanced levels of engagement.

Subsequent studies by McWilliam and colleagues focused on the engagement of individual children, refining measurement systems to assess specific levels and types of engagement (de Kruif & McWilliam, 1999; McWilliam & Bailey Jr., 1995; McWilliam et al., 2003). Similar to earlier studies by this research team, these measures used video coding to assess engagement. They began by looking at the focus of engagement (e.g., adults, peers, materials, nonengaged), as well as dichotomous levels within the different focus areas of engagement (e.g., interactive vs. attentional; McWilliam & Bailey Jr., 1995). As this measurement system continued to evolve, two levels were transformed into six (de Kruif & McWilliam, 1999) and seven (McWilliam et al., 2003) levels of engagement to reflect differing cognitive levels of engagement. Importantly, these different levels of engagement were designed to correspond to different learning opportunities. For example, a child who is watching another child put together a puzzle versus a child who is problem solving to put together a difficult puzzle on his/her own, are having different learning experiences, which may ultimately impact child outcomes.

The increasingly complex coding system was an important advancement in measurement, allowing researchers to examine engagement across a hierarchy of levels.

Other researchers have developed ecobehavioral observation systems to assess engagement such as the Code for Instructional Structure and Student Academic Response (CISSAR; Stanley & Greenwood, 1981), the Code for Active Student Participation and Engagement (CASPER-III; Tsao, Odom, & Brown, 2001), and the Ecobehavioral System for the Complex Assessment of Student Environments (ESCAPE; Carta, Greenwood, & Atwater, 1985). These systems were developed as a direct result of the ecological systems theory, with capabilities for simultaneous assessment of student and teacher behaviors as well as environmental factors. Ecobehavioral coding has been used to study the engagement of students with disabilities in relation to teacher behaviors and classroom features (Hamilton, 2005; Kamps et al., 1991; Wallace, Anderson, Bartholomay, & Hupp, 2002). However, these systems focus on rather narrow types of engagement. The CISSAR focuses on behaviors during academic programming for measuring student engagement (e.g., academic response, task participation, competing behaviors), whereas the ESCAPE and CASPER-III focus on social interactions (e.g., negative social behavior directed to typically developing peer, social behavior directed to adult, social behavior from a peer with disabilities). Additionally, the systems are complex, with large numbers of categories and variables with student behavior representing just a small portion of those variables. For example, the ESCAPE has 92 variables across 12 different categories (Hamilton, 2005). The sheer number of coded behaviors necessitates the use of partial interval coding, so the behaviors are observed for short periods of time (e.g., 2 seconds), and then recorded during the remaining part of the

interval (e.g., 28 seconds). Therefore, the actual time observing the students and environment are often very short even during relatively long observations (e.g., 120 seconds of observed behavior over an hour-long observation). Ecobehavioral assessment is a valuable form of measurement in the field of engagement, but can be difficult to use as it is resource-intensive, requiring extensive training and long observation times for effective use.

Although research moved towards increasingly complex measures of engagement with methodological and technological advancements, there were also attempts to re-simplify the collection of engagement data in order to make it more feasible for practitioners and researchers. One research team focused on task engagement, measuring if students were actively or passively engaged in the classroom (Kishida & Kemp, 2006; Kishida, Kemp, & Carter, 2008). McWilliam, who had been instrumental in the development of some of the more complex systems, and Casey used rating systems for several categories of engagement to scale back the intensity of data collection for practitioners with their Scale for Teachers' Assessment of Routine Engagement (STARE; Casey & McWilliam, 2007). Ruble and Robson (2007) used a unique conceptualization of engagement by examining the compliance and congruence of student behaviors, which focused on capturing if students were doing what they were supposed to be doing in the classroom. While these measurements are useful due to their simple nature, and the capacity to broadly and efficiently examine student engagement, the tools may miss other valuable information about the quality (e.g., developmental levels) or quantity (e.g., duration) of engagement.

Although most of the research has focused on direct observation of engagement (which might be considered a *state* of engagement), there is a small body of research that has examined engagement as a *trait*, using teacher or parent report tools to tap into a child's underlying capacity for engagement. McWilliam developed the Children's Engagement Questionnaire (CEQ; McWilliam, 1991), a caregiver report tool to assess the trait of engagement. The 32-item tool uses a 4-point rating system and provides four factors for child engagement: competence, persistence, undifferentiated behavior, and attention. Although these factors roughly correspond to several of the categories in McWilliam's observational measure for states of engagement (E-Qual; McWilliam & de Kruif, 1998), the factors and corresponding observed behaviors had primarily low to moderate correlations between the two methods (de Kruif & McWilliam, 1999). In fact, only one engagement state, undifferentiated behaviors, had strong correlations across observed and global engagement. This study supports the notion that engagement can be conceptualized as both a state and trait, and that children's performance (i.e., observed engagement) may not always match their general capacity for engagement (i.e., global engagement).

Joint engagement

One conceptualization of engagement that may be particularly useful in looking at students with ASD is joint engagement. Joint engagement is the active involvement and coordination of attention between objects and people in the environment (Bakeman & Adamson, 1984), and as such highlights the social aspect of engagement. The ability to engage in a triadic interaction (i.e., self-other-object) is a key developmental milestone for early learning (Adamson et al., 2004). For example, an infant who looks at a novel

object or an event that has just occurred and then looks back at his mother, who in turn labels the object or describes the event, is being exposed to language from an adult in the environment that relates to the infant's focus of attention. Although these learning opportunities become more complex as children develop, they are still asked to learn through these periods of joint engagement – whether it is a preschooler participating in circle time and learning the days of the week or a 3rd grader listening to her teacher read a book about Ancient Egypt and learning new vocabulary. Joint engagement arguably plays an important role in learning across the entire lifespan.

Joint engagement was initially explored in a longitudinal study of typically developing infants (Bakeman & Adamson, 1984). The two cohorts in the original study were followed from 6 to 15 months and 9 to 18 months, with observations scheduled every 3 months. At each time point, the infants were observed in play situations across three different conditions: with the infant's mother, with another infant, and alone. The recorded observations were coded for six different engagement states: unengaged, onlooking, persons, objects, passive joint (labeled supported joint in subsequent studies) and coordinated joint engagement (see Table 2.1 for definitions). This initial study documented the development of joint engagement in late infancy and the importance of adult-infant interactions for achieving higher engagement states.

Adamson, Bakeman, and colleagues furthered their work on joint engagement by examining subsequent stages of development in joint engagement from 18 to 30 months of age (Adamson et al., 2004) and examining joint engagement in children with ASD and Down syndrome (Adamson et al., 2009). Both studies were longitudinal in nature, with children engaging in a series of semi-structured communicative contexts with their

parents. The data were collected at 3-month intervals from around 18 to 30 months of age for the typically developing children and from around 30 to 42 months of age from the children with ASD and Down syndrome. The researchers coded engagement states similar to the earlier study, but expanded the codes to include non-symbol-infused and symbol-infused episodes of person, object, supported joint (formerly called passive joint) and coordinated joint engagement. Symbol-infused episodes were engagement states that included some type of symbolic representation such as high level pretend play or verbal language. The amount of time spent in the more advanced symbol-infused joint engagement states was found to be related to concurrent language ability and predictive of later language ability (Adamson et al., 2004). In a follow-up study, children with ASD had significantly lower proportions of time spent in coordinated joint engagement compared to their same-age peers with Down syndrome and younger typically developing children (Adamson et al., 2009). Symbol-infused joint engagement was predictive of later language abilities in children with ASD. Thus, joint engagement appears to be an important developmental measure and may tap into specific deficits in children with ASD.

Since Bakeman and Adamson's seminal work on joint engagement, researchers have used the concept of joint engagement in a broad range of studies including work on the development of affect (Striano & Bertin, 2005), the impact of adult interactions (Bigelow et al., 2010), and parent-mediated interventions (Girolametto, Verbey, & Tannock, 1994). Importantly, joint engagement has been used successfully as an outcome measure for intervention studies with preschoolers with ASD (Kaale, Smith, & Sponheim, 2011; Kasari, Freeman, & Paparella, 2006; Kasari, Gulsrud, Wong, Kwon, &

Locke, 2010; Kasari et al., 2008). Additionally, the joint engagement coding system has been used live in classroom settings with preschoolers with ASD (Wong & Kasari, 2012). Based on the collective body of research, joint engagement is influenced by early language abilities, predictive of later language abilities, and especially impaired in children with ASD. As a measure, the joint engagement coding system has been effectively used across a wide variety of descriptive and experimental studies.

Table 2.1. Definitions of engagement states.

Engagement State	Definition
Unengaged	Child exhibits no apparent engagement with a specific person or object
Onlooking	Child watches another person who is engaged in an activity, intently observing the person or the objects the person is manipulating
Object only	Child explores, plays with, or uses object(s) on his/her own, other people are not influencing the child's actions with the object(s)
Person only	Child interactions with another person and objects are not part of the interaction
Supported joint	Child and other person engage in same activity with the person influencing the activity but the child not acknowledging the other person
Coordinated joint	Child and other person engage in the same activity and the child coordinates attention to objects and people in an alternating or integrated manner

Consistency of engagement

An important consideration for observational measures is the consistency or stability of the measure, and the number of repeated measures required to attain an accurate measurement of a behavior or phenomena (Yoder & Symons, 2010). Across the studies for observational measures of engagement, researchers working in classrooms

have used observations as short as 5 minutes (Wong & Kasari, 2012) up to several hours (Kamps et al., 1991; Logan et al., 1997) with numbers of observations ranging from two per child (Kamps et al., 1991) to well over 10 per child (McDonnell et al., 1998; Wong & Kasari, 2012). However, there is limited information about ideal lengths or number of observations for capturing student engagement. In one study that focused on this issue, three observers coded four 15-minute observations for each of 47 children using a coding system that had five different levels of engagement and four different types of engagement (McWilliam & Ware, 1994). The researchers conducted generalizability and decision analyses, designed to assess the minimum number of observations and coders needed to achieve consistency in the measure. The conclusions suggested that coders accounted for very little of the variance and were reliable. But, the sessions accounted for a great deal of variance, suggesting differences between sessions were resulting in decreased reliability or validity. The decision study revealed that researchers would need to collect between 5 and 40 observations per participant in order to achieve reliability of .80 depending on the level and type of engagement. Although this study is related to a specific coding system and specific methodology, the results highlight the importance of examining the consistency of a measure. As researchers continue to explore observational methods for measuring engagement, considering the reliability and stability of these measures across observations will be an important part of developing appropriate protocols for engagement measures for use in descriptive studies, longitudinal research, and intervention studies.

Summary of Engagement

Engagement, or participation in the environment, has proven to be a valuable measure in developmental and educational research. Although researchers have both conceptualized and measured engagement in a variety of ways, the concept of joint engagement could be especially relevant for students with ASD. It is a known area of difficulty for young children with ASD, and it is linked to language learning, which is an important part of the educational experience for school-aged children. However, there are no known studies that measure joint engagement in children with ASD beyond the preschool years. The current study focuses on measuring joint engagement in school-aged children with ASD in the classroom setting.

Engagement and Classroom Ecological Factors

Engagement is a measure that captures the transactional nature of learning environments, with both individual and environmental factors impacting the engagement of a student. One large study noted that 8 to 12 % of the variance in student engagement in elementary, middle, and high schools occurs at the classroom level, implicating specific classroom or teacher characteristics (Marks, 2000). As noted above, the measurement of engagement developed around the idea of measuring program effectiveness; thus, much research has focused on how educational environments are related to engagement. Some key aspects of the educational environment are classroom features and teacher factors, such as instructional groupings and strategies, interactions and attitudes.

Classroom Features

Classroom features such as types of groupings and group size during instruction have been studied in relation to child and student engagement (Kamps et al., 1991; Kishida & Kemp, 2009; Logan et al., 1997; McWilliam & Bailey Jr., 1995; Ruble & Robson, 2007), but this review focuses specifically on instructional group size because of its replicated support for its relevance for students with disabilities. In a study of 29 elementary students with disabilities included in general education classrooms, students demonstrated engagement 23% of the time in whole-class activities, whereas, the mean percentage of engagement ranged from 42 to 50% in small group and individual instruction (Logan et al., 1997). McDonnell and colleagues (1998) measured the academic engagement of six students with severe disabilities across 15 to 22 observations over a period of 5 months. They noted that academic responding, their indicator for engagement, was positively correlated with the amount of one-to-one instruction and independent work, but negatively correlated with the amount of whole group instruction. Another study noted increased engagement in small group sessions compared to whole group sessions for elementary students with disabilities, though this was based heavily on informal observations conducted after the more formalized ecobehavioral assessments so the methods preclude definitive results (Kamps et al., 1991). There is evidence among elementary students with disabilities that engagement is related to the number of students present during instruction, and seems to be lower in large group instructional settings.

Several studies related to classroom features have focused specifically on children with ASD. Ruble and Robinson (2007) compared elementary school students with ASD and Down syndrome, and noted that children with ASD exhibited high amounts of

compliant behavior (i.e., alignment with behavioral expectations), but low degrees of congruent behavior (i.e., alignment with academic expectations) in large group settings as well as independent work. So, although the students may have been exhibiting appropriate behaviors and appeared on task, their academic participation was not matching up with teacher expectations for that task. They also found that students with ASD performed optimally in small group settings, with the highest combination of compliant and congruent behavior. Interestingly, the students in this study struggled with compliance the most in one-on-one settings.

Another study examined the engagement of preschool-aged children with ASD who attended both segregated and inclusive childcare settings, focusing on active and passive engagement and non-engagement (Kishida & Kemp, 2009). The study noted small to moderate, non-significant effects for engagement, with higher engagement in segregated settings compared to inclusive settings. Notably, the student to adult ratios differed between the settings, with a lower student to adult ratio in the segregated settings. It is possible that the group size and ratios impacted engagement, since this was not isolated from the structure (segregated vs. inclusive) of the classroom.

An experimental study examined the use of cooperative learning groups for two children with ASD accessing the general curriculum (Dugan et al., 1995). Although this study explored a specific technique, the technique was also explicitly related to group size. The cooperative learning groups involved splitting the class into small groups of students and students taking active roles in the learning within those groups. The ABAB single-case design study showed that academic performance improved and that academic engagement was much higher for both the students with ASD and their peers in the

cooperative learning group condition than the baseline condition of whole class instruction. The students spent more time actively participating and less time passively attending in the cooperative learning groups compared to the whole class instruction and lectures. Collectively, these studies suggest that different group sizes and instructional practices that directly relate to group size, impact the engagement of students with ASD.

Instructional and Teacher Factors

Instructional and teacher factors including teaching methods, teacher behaviors, and teacher attitudes, are malleable features in the educational environment, and thus are important ecological features to consider when examining engagement. Although there is a broad research base in this area, this section focuses on instructional practices and strategies, and teacher interactions and attitudes, variables that are specifically relevant for the current project.

Instructional practices and strategies. In general, instruction and activities with a focus on child- or student-directed practices seem to have a positive impact on engagement. While in group settings, young children with typical development and mild to moderate developmental disabilities demonstrated more participatory engagement (i.e., active engagement) when they were addressed individually by the teacher, compared to higher levels of attentional engagement (i.e., passive engagement) when they were addressed as a whole group (McWilliam et al., 2003). This suggests that focusing on individual students even within the group context may have a positive influence on engagement. This finding is similar in elementary students with disabilities, in that engagement, as measured by academic responses, was higher when the focus was on the target student in any given instructional grouping (large group, small group, or

individual; Logan et al., 1997; McDonnell et al., 1998). Additionally, evidence from one study suggests that proximity of the teacher impacts student engagement (Conroy, Asmus, Ladwig, Sellers, & Valcante, 2004). Child engagement and adult proximity were coded during observations of six elementary school students with ASD, and five of the six students showed significantly more engagement during times when the teacher was in close proximity to the target student. A general level of focus on or even proximity to the target student could be considered some of the most basic indices of child-directed practices and seem to positively impact engagement.

There are many studies that have looked at the type of instruction or activity in relation to engagement. For elementary, middle, and high school students, authentic instructional work as measured by student report, as opposed to "meaningless, low level work", was associated with higher levels of student engagement in the classroom (Marks, 2000, p. 157). The same study also noted different levels of engagement across the content areas of math and social studies in elementary and high school. For 24 elementary students with disabilities being served in six different self-contained classrooms, the levels of engagement also differed across activities within a given classroom (Kamps et al., 1991). Interestingly, these differences were not consistent across classrooms. For example, language activities resulted in the highest level of engagement in one class yet the lowest level of engagement in another class. Although these differences in content areas were not explored further in either of the studies, it is reasonable to consider that differences in types of instruction and activities associated with content areas may have contributed to the differences.

Kamps and colleagues (1991) also explored relationships between specific types of instructional tasks and engagement, noting that engagement was higher in tasks involving paper and pencil or other media compared to discussion tasks. Following the ecobehavioral assessments of engagement, informal observations suggested higher levels of engagement with other instructional variables including access to individualized materials, shortened rotations of media and concept presentation, random order of response (i.e., not going in same order around the table or room), and choral responding. As part of the same study, the researchers also completed several single-case design studies in the same classrooms to examine the impact of using these interventions that showed changes in student engagement. However, several interventions were implemented concurrently in each classroom so it is difficult to determine which student-directed instructional features were responsible for any evident changes in student engagement.

There are several studies that have looked at the impact of specific instructional practices on engagement in children or adults with ASD. Two studies focused specifically on the impact of choice-making on engagement (Reinhartsen et al., 2002; Watanabe & Sturmey, 2003). One study focused on very young children with ASD, examining the differences between child choice and teacher-selected conditions in play interactions between three 2-year-olds with ASD and their teachers (Reinhartsen et al., 2002). In the child choice condition, the child was allowed to select one of two toys; whereas the teacher offered a single toy to the child in the teacher-selected condition. In the single-case, alternating treatment design study all three participants demonstrated higher levels of engagement with the toy in the child choice condition, highlighting the

positive impact of offering choices on child engagement. The other study looked at the impact of individual choice on engagement during work tasks for adults with ASD at an adult services program (Watanabe & Sturmey, 2003). The work tasks were the same across the choice and non-choice conditions, but the choice condition allowed the participants to build their own schedule and the non-choice condition involved assigned schedules. Based on visual analysis of the multiple-baseline single-case design study, two of the three adult participants showed clear improvement in engagement as measured by on-task behavior in the choice condition compared to the non-choice condition. In addition, all three participants had higher average engagement in the choice condition. Based on these studies, it appears providing some level of choice during activities improves engagement for individuals with ASD.

Several other studies have examined the use of teaching strategies designed to promote engagement in independent work or play tasks (Massey & Wheeler, 2000; Mavropoulou et al., 2011; Morrison, Sainato, Benchaaban, & Endo, 2002; O'Reilly, Sigafoos, Lancioni, Edrisinha, & Andrews, 2005). Three of the studies examined the use of activity schedules using single-case design studies. The use of activity schedules resulted in increased task engagement for one preschooler with ASD across 3 tasks in a multiple-baseline across task design (Massey & Wheeler, 2000) and increased active engagement for a 12-year-old with severe ASD in an ABAB single-case design (O'Reilly et al., 2005). A multiple-baseline across participants study showed the use of activity schedules and reinforcement resulted in increased on-task behavior during independent play for four preschoolers with ASD (Morrison et al., 2002). Another study used structured teaching in play activities for two 7-year-old boys with ASD during

independent work time in an ABAB single-case design (Mavropoulou et al., 2011). There were mixed results, with improvements in engagement for one participant, but no clear change for the other participant. Collectively, these studies suggest that using specific instructional strategies (i.e., activity schedules, structured teaching) could improve engagement during activities related to academics and play. Notably, these studies primarily defined engagement as on-task behavior and focused on engagement during independent activities rather than instructional time with a teacher. While increasing engagement in these types of activities is important, it neglects the more social aspects of engagement that are also characteristic of classroom instruction.

Finally, one study focused on the incorporation of materials and music in academic instruction (Carnahan et al., 2009). The single-case design study looked at the use of interactive book reading, and interactive book reading combined with music in comparison to standard literacy instruction in the classroom for six elementary students with ASD. The researchers noted improved engagement based on visual analysis for several of the students in the interactive book reading and music condition as well as increased mean engagement in the same condition across all participants. Based on the authors' conclusions, using interactive materials combined with music during book reading activities is more effective than instruction without interactive materials and instruction. Overall, the results were mixed, but the use of interactive materials and music, which could be considered more student-directed in nature, may impact engagement in some students with ASD. However, all students were in a single classroom, so implementation was not staggered and therefore the replication across students was not controlled.

In summary, the use of student-directed practices appears to have positive impacts on the engagement individuals across a wide age span in children with typical development, as well as individuals with developmental disabilities including ASD. Specific student-directed practices with potential relationships to engagement include the consideration of student interest (e.g., student choice), usage of materials (e.g., interactive materials, individual materials for students), and specific instructional strategies or supports (e.g., structured teaching, activity schedules).

Teacher interactions and attitudes. Interactions between adults and children are very powerful and have been associated with many important aspects of development including cognition, language development, and social-emotional development (Hart & Risley, 1992; Phillips, McCartney, & Scarr, 1987). Several studies have looked at the impact of adult interactions on child engagement. One study looked at the impact of adult interactions on the engagement of infants from 9 to 17 months of age (Lussier, Crimmons, & Alberti, 1994). The researchers utilized the joint engagement coding scheme (Adamson, Bakeman, Russell, & Deckner, 1998) to examine infants behaviors in three contrived conditions with an unfamiliar adult and toys in a clinic room. The three conditions were (a) contingent, in which the adult used child-directed and warm interactions; (b) unresponsive, in which the adult did not initiate or respond to interactions with the infant; and (c) directive, in which the adult interacted with the infant but provided more directives rather than following the child's lead. There was significantly more time in passive joint engagement (i.e., supported joint engagement) in the contingent condition, significantly more time unengaged and in object engagement in the unresponsive condition, and significantly more time in watching (i.e., onlooking) in

the directive condition. These patterns seem to indicate that different styles of adult interaction impact joint engagement in very young children, with contingent styles eliciting higher levels of engagement.

Educational researchers have explored the relationships between adult or teacher interactions and child or student engagement. In one study, adult interactions within a childcare environment had a stronger association with observed levels of engagement than chronological age, developmental age, or child global engagement (McWilliam et al., 2003). In particular, the adults' elaborations, a non-directive form of interaction, were strongly related to both attentional and participatory engagement. Another study measured the engagement of 49 toddlers and preschoolers with developmental disabilities during free-play and instructional interactions with their teachers (Mahoney & Wheeden, 1999). Multiple regression analyses indicated that teacher interaction styles accounted for a significant amount of the variance in both the quality and frequency of child engagement. Child-oriented or responsive styles were positively correlated with initiations. Interestingly, social involvement (one measure of engagement used in the study) was negatively correlated with responsive behaviors but positively correlated with performance orientation, which tended to be more directive in nature. These studies suggest that teacher interaction style plays a role in child engagement during the early childhood years for children with disabilities, with a tendency for responsive interactions to increase engagement.

Teacher interactions were shown to impact the engagement of elementary students with disabilities in two studies that used ecobehavioral assessment to measure engagement and teacher factors, focusing on academic responding as the measure of

engagement (Kamps et al., 1991; McDonnell et al., 1998). Classroom management and discipline-related interactions, which are more directive in nature, were associated with lower levels of engagement, whereas academic-related interactions were associated with higher levels of engagement. Other studies have focused more broadly on interactions within the school environment. For example, Marks (2000) found that students' perceptions of a positive school environment and classroom supports significantly impacted school engagement in elementary, middle, and high school students. Based on these few studies, it seems that student engagement in the school-age years is associated with teacher interaction styles, and perhaps the classroom climates created by those interaction styles.

Although the research base related to teacher factors and engagement is somewhat small, adult and teacher factors, such as interaction style and feelings of job burnout, have been tied to other areas of child development and educational outcomes. Girolametto and colleagues conducted studies that examined teacher interaction styles and child language in toddlers and preschoolers with and without disabilities across different activities in day care settings (Girolametto, Hoaken, Weitzman, & van Lieshout, 2000; Girolametto & Weitzman, 2002; Girolametto, Weitzman, van Lieshout, & Duff, 2000). They noted that teacher behaviors that were responsive in nature had positive correlations with a variety of child language measures such as number of utterances, number of different words, and number of multiword utterances (Girolametto & Weitzman, 2002). In contrast, teacher behaviors that were directive in nature were significantly negatively correlated with child language production (Girolametto, Weitzman, et al., 2000). Additionally, teachers seemed to use more directive interactions

with children who had developmental disabilities (Girolametto, Hoaken, et al., 2000). An experimental study that focused on 12 older children, six with ASD and six with cognitive impairment, also examined language production of the child participants in relation to adult interaction styles (Mirenda & Donnellan, 1986). Each child interacted with the same six unfamiliar adults, three of whom used directive interaction styles and three of whom used facilitative interaction styles. The participants exhibited significantly more topic initiations, comments, and questions when interacting with the adults with the facilitative interaction styles. In sum, this research suggests that adult interaction styles impacts the language production of younger and older children with disabilities.

A great deal of research has focused on the impact of classroom climate on student behaviors and outcomes. One measure thought to be related to classroom climate is the social-emotional competence of teachers. Jennings and Greenberg (2009) proposed a model and offered an extensive literature review that highlighted the impact of the social-emotional competence of teachers on classroom climate and student outcomes. The authors acknowledged that teacher social-emotional competence may have differential impacts across contexts and ages, and noted that it may "especially important to developing warm and supportive teacher-student relationships and effective SEL [social and emotional learning] in the self-contained classrooms of pre-K through elementary school…" (Jennings & Greenberg, 2009, p. 493). Evidence indicates that social-emotional factors impact student outcomes. For example, one study showed that relational negativity between teachers and students in kindergarten was predictive of student behavioral and academic outcomes in the early elementary years (Hamre & Pianta, 2001). The relational negativity continued to predict behavioral outcomes through

8th grade, though this was mediated by earlier behavioral performance. It seems that teacher-student relationships, which are exemplified in teacher-student interactions, have some impact on behavioral and academic performance in the school years.

Teacher burnout has also been studied in relation to social-emotional climate, with research suggesting that burnout is related to teacher-student relationships (Yoon, 2002), classroom climate (Byrne, 1994), and teacher's social-emotional competence (Goddard, Hoy, & Hoy, 2004). Notably, teacher burnout has been particularly problematic among teachers in special education (Wisniewski & Gargiulo, 1997). Thus, teacher burnout may be a salient measure for tapping into many of these social-emotional factors in classrooms, which may be particularly important in self-contained classrooms and special education.

Summary of Ecological Factors and Engagement

Engagement is related to a variety of ecological factors in the environment, including group size, instructional practices, and teachers' interactions with students. Additionally, measures that tap into classroom climate, including teacher interaction style and teacher burnout, are related to other student behaviors and outcomes such as language production and social-emotional development. It is reasonable to believe that these teacher characteristics may also be linked with student engagement. Although these ecological factors have been tied to engagement or related developmental areas in several studies, very little of this research uses the concept of joint engagement. The current study contributes to this body of research by examining the relationship between joint engagement in elementary and middle school students with ASD and four ecological

factors: group size, student-directed instructional practices, teacher interaction styles, and teacher burnout.

Engagement and Student Characteristics

Although engagement has been linked to environmental factors, it has also been studied in relation to the individual, looking specifically at child or student characteristics that impact engagement. Indeed, a study of self-reported student engagement at the elementary, middle, and high school levels across 24 schools, 149 classrooms, and over 3,600 students found that over 80% of the variation in engagement occurs at the level of the student (Marks, 2000). Though self-reported engagement may differ from observed engagement, the level of variation at the student level is striking and clearly worthy of attention in research.

Researchers targeting early development and the early childhood age have posited that as children mature they have an increased capacity for engagement. Both cognitive (de Kruif & McWilliam, 1999) and social (Adamson et al., 2004) forms of engagement have been conceptualized as developmental hierarchies. In these bodies of research, two of the common areas of focus when examining individual characteristics that influence engagement are developmental abilities and type of disability.

Developmental Abilities

Researchers have long been interested in exploring the development of engagement. Since engagement is considered "developmentally appropriate participation", there are a range of behaviors necessary for engagement in the early years. Researchers have linked age to the development of visual attention (Colombo, 2001), smiling and laughter (Sroufe & Waters, 1976), dyadic interactions (Feldman &

Eidelman, 2004; Tronick & Cohn, 1989), and object play (McCune, 1995), all of which could be considered precursors to or prerequisites for engagement in the preschool years and beyond.

McWilliam and colleagues (1985) noted their interest in exploring engagement at the individual level, tapping into the impact of individual factors by examining engagement in children of different ages within child care settings, as well as in children with developmental disabilities (de Kruif & McWilliam, 1999; McWilliam & Bailey Jr., 1995; McWilliam et al., 2003). In one study, the researchers used the E-Qual-III engagement coding system to focus on hierarchical levels of cognitive engagement (e.g., non-engagement, attention, participation, persistence; de Kruif & McWilliam, 1999). The researchers coded child engagement for 62 children between 9 and 63 months of age during structured and unstructured times with the teacher, as well as meal times with the teacher. They also examined global engagement using the Child Engagement Questionnaire, which tapped into teachers' perceptions of each child's capacity for engagement. Bivariate correlations suggested that developmental age was strongly negatively correlated with global undifferentiated behavior, and moderately negatively correlated with both observed non-engagement and observed undifferentiated behavior. Developmental age was found to have moderate positive correlations with observed participation and global competence, which captured capacity for high level engagement. In addition, canonical correlation analysis revealed that developmental age was a large contributor in the first canonical function, which accounted for 70% of the variance in multivariate relationships between global engagement, observed engagement and

developmental age. Thus, it appears that developmental age plays a major role in cognitive engagement in children through the preschool years.

Bakeman and Adamson (1984) also examined engagement across developmental stages, using the joint engagement coding system. These studies used longitudinal designs, measuring engagement in two cohorts of 14 children every three months, from 6 to 15 months in the first cohort and 9 to 18 months in the second cohort. Their research supported clear developmental progress in joint engagement across infancy, as these very young children were observed in free play alone, with peers, and with their mothers. The infants showed significant linear trends with less unengaged behavior and more coordinated joint engagement over the course of development in both the peer and mother conditions.

Subsequent research showed continued developmental change in the toddler years, when children demonstrated an increased ability to engage in more advanced levels of joint engagement across the 18 to 30 month age range (Adamson et al., 2004). In this study, 56 children participated in a semi-structured protocol with a caregiver, which was repeated every 3 months during from ages 18 to 30 months. The researchers looked particularly at symbol-infused engagement states to capture the transition into the language learning period of development, in which children are beginning to understand and use symbolic representations such as words. All of the engagement states showed significant changes over time, with increases in symbol-infused supported and coordinated joint engagement and decreases in non-engagement, single engagement, and non-symbol-infused joint engagement. This study offers further evidence for the link between engagement and developmental age.

In addition to the impact of age in typically developing children, language abilities also appear to play a role in joint engagement (Adamson et al., 2004). In the same study, Adamson and colleagues used the MacArthur Communicative Development Inventory (Fenson et al., 1993) and the receptive and expressive language sub-tests of the Mullen Scales for Early Learning (Mullen, 1995) to divide the children into early, middle, and late language onset groups. Notably, growth over time in symbol-infused supported joint engagement was significantly higher in the early language onset group than in the middle and late language onset groups. Thus, language ability appears to have some impact on the growth trajectory of joint engagement in young children.

Other factors that have been examined in relation to engagement are the presence and severity of a disability. In a study with 32 children with typical development and 16 children with developmental disabilities in the same childcare center, the disability status of the child impacted engagement with adults, peers, and materials (McWilliam & Bailey Jr., 1995). Children with disabilities in this inclusive setting spent less time engaged in interactions with adults, and less time in higher levels of engagement with materials in the classroom. Additionally, older children with disabilities appeared to exhibit more attentional (i.e., passive) engagement with peers than did their typically developing peers.

Beyond the mere presence of a disability, there is a possibility that level of disability may impact engagement. Logan and colleagues (1997) used ecobehavioral assessment to examine engagement in children with moderate, severe, and profound disabilities in elementary school classrooms. There were significant differences in the amount of engagement in facilitating contexts for children with severe and profound disabilities compared to their peers with moderate disabilities, though these differences

were not significant once the researchers computed odds ratios that controlled for the overall amount of engagement. Based on these studies, it appears that the presence of disability has an impact on student engagement and the level of disability may have some associations with student engagement, though these associations are less clear in the research.

Types of Disability

Although developmental age has been clearly linked to engagement, researchers have also demonstrated differences in patterns of engagement across children with different types of disabilities. Much of the research that has explicitly looked at types of disability has focused on children with Down syndrome and/or children with ASD (Adamson et al., 2009; Hamilton, 2005; Ruble & Robson, 2007). Since both Down syndrome and ASD have been well-studied across different developmental areas, researchers have examined hypotheses that relate to these specific deficits and expected differences in engagement related to the well-studied characteristics of individuals within each of these populations.

Adamson and colleagues furthered their studies on the development of joint engagement by examining engagement using the same semi-structured protocol with caregivers in children with Down syndrome and ASD between the ages of 30 and 42 months (Adamson et al., 2009). These data were compared to the typically developing children from the previous study (Adamson et al., 2004), who were observed from 18 to 30 months of age. The diagnostic group had significant associations with the states of unengaged, object engagement, and coordinated joint engagement. The children with ASD spent significantly less time in coordinated joint engagement, and significantly

more time unengaged and in object engagement than both the peers with Down syndrome and the younger cohort of children with typical development. The trajectories for engagement across time in children with ASD did not differ significantly from their peers with Down syndrome, though their trajectories were less steep than the younger children with typical development for symbol-infused engagement (i.e., states that included some level of symbolic representation). Thus, children with ASD appear to have consistently lower levels of joint engagement compared to children with Down syndrome and younger typically-developing children.

A smaller study examined the engagement of four students with ASD and four students with Down syndrome in elementary school settings (Ruble & Robson, 2007). The data were collected during 2-hour observations in the students' classrooms during typical classroom routines. This study examined engagement in a unique way, measuring congruent and non-congruent behaviors, as well as compliant and non-compliant behaviors of the students during classroom instruction. Children with ASD produced 63% more compliant, but non-congruent engagement codes than their peers with Down syndrome. This suggests that children with ASD may appear to be engaged based on their compliant behavior (i.e., appropriate in responding to behavioral expectations), but are not actually participating in the way that is expected during academic activities. The study, however, was very small, focusing on descriptive data rather than statistical comparisons, so the results, though interesting, should be interpreted cautiously. In sum, there is evidence on differences in engagement among children with ASD from a developmental perspective, and emerging indications that the engagement of children with ASD in schools may differ from peers with other disabilities.

Summary of Student Characteristics and Engagement

Across a variety of studies, engagement has been linked to age and developmental abilities. Other studies have noted that engagement differs based on the presence, severity, and type of disability. Clearly, engagement is impacted by child characteristics. However, much of this research has been conducted with young children, with very little research examining the relationships of these individual characteristics for school-aged children with ASD. None of the research related to older children has used joint engagement as the concept for measuring engagement. It seems likely that student characteristics would be related to joint engagement for school-aged children with ASD, but it is unclear exactly how these student characteristics will impact joint engagement in the classroom setting.

Summary

With the prevalence rates of ASD on the rise, schools are serving a growing number of students with this disorder (Scull & Winkler, 2011). The National Research Council has identified "active engagement" as a key ingredient for effective interventions for children with ASD (National Research Council, 2001), yet there are not clear methods for measuring active engagement. Studies in younger children have highlighted the importance of joint engagement in relation to language learning (Adamson et al., 2004), and studies that have measured joint engagement in young children with ASD have noted deficits in this important developmental area compared to children with typical development and children with Down syndrome (Adamson et al., 2009). Thus, joint engagement appears to be a good measure for capturing behaviors that are important to learning and tend to be difficult for children with ASD. The current study is the first

known study to examine joint engagement of elementary and middle school children with ASD in the classroom setting.

Even when considering a broader definition of engagement, limited research has focused on school-aged children with ASD. Some studies have identified instructional practices that are related to academic responding and on-task behavior (Carnahan et al., 2009; Kamps et al., 1991; Mavropoulou et al., 2011; Morrison et al., 2002; O'Reilly et al., 2005; Ruble & Robson, 2007). However, the research related to engagement for the age group remains sparse, and little is known about the relationship of student or teacher characteristics to engagement in the classroom. Given the state of the research, the goal of the current study is to examine joint engagement of school-age children with ASD in the classroom setting in relation to ecological and student variables.

CHAPTER 3

METHODS

This descriptive study was designed to explore classroom ecological factors and student characteristics that may be related to engagement of students with ASD in naturally occurring classroom activities. A secondary goal of the study is to examine the consistency of joint engagement measures in individuals with ASD. Prior to initiation of the study, research approval was obtained from the Institutional Review Board at the University of North Carolina at Chapel Hill. The study included several phases of research, including recruitment and ascertainment, classroom observations, student assessments, student observations, and teacher assessments, which will be described in detail below.

Recruitment and Ascertainment

The recruitment process had several phases, including recruiting school districts, then classrooms and teachers, and finally, students. Because the study needed to be conducted in school settings, the first phase of recruitment involved getting approval to conduct research at the level of the school district. The researcher contacted administrative staff in six different school districts. Each district had different processes in order to apply for research approval, but all districts required some form of written application. In addition, one district asked for a meeting, and another district asked for a phone conference. Three of the school districts declined to participate in the research and three school districts agreed to recruit classrooms.

Following research approval, the school district personnel contacted principals and teachers serving in self-contained classrooms (i.e., classrooms that served only students with an identified disability) serving 8 to 12 year old students with ASD. In one district, the classrooms were recruited from a public separate day school, a school that only served children with disabilities. At this school, the researcher was in contact with the lead teacher who recruited five classrooms for participation. For the other two districts, the researcher was given the email addresses of teachers who were interested in obtaining more information about the study. In the second school district, both teachers who were contacted agreed to participate, for a total of two classrooms. In the third district, the researcher received the email addresses of four teachers. One teacher declined to participate due to an impending maternity leave and two teachers did not respond to the recruitment emails. One teacher agreed to participate, so one classroom was enrolled from the final school district. Consent forms and demographic forms were completed by each of the teachers who agreed to participate. Additionally, consent forms and demographic forms were completed for many of the teaching assistants across the eight classrooms. Since teaching assistants were not observed directly for the study, consent was not required for classroom participation. In total, eight classrooms were recruited from three different school districts.

Once a classroom was recruited, the researcher distributed consent packets to the classroom teacher and instructed the teacher to send the consent packets home with all students in the class with an educational label of autism. The packets contained two consent forms (one to be returned with the consent packet and one for the parents to keep), a demographic information form, and the Social Responsiveness Scale (SRS;

Constantino & Gruber, 2005), which was used as a measure to confirm the educational label of autism and assess autism symptom severity.

Consent packets were returned to the classroom teacher and collected by the researcher. The teachers sent reminders to complete the consent packet to parents at their own discretion in efforts to recruit students for the study. The researcher received consent packets from 25 students across the eight classrooms. Due to incomplete SRS forms from caregivers, teachers completed the SRS for four students (described in detail in the Student Assessments section). All 25 students whose parents returned consent packets met criteria for ASD on the SRS, based on either parent or teacher report, and were enrolled in the study.

Participants

Teachers and students from eight self-contained classrooms participated in the study. Each classroom had a primary teacher and two teaching assistants. The classrooms served between six and ten students. Since five of the classrooms were in a separate school for students with disabilities, all of the students from that school were served exclusively in a self-contained classroom. The other three classrooms were in elementary schools, and at least some students in each class were included in some activities with general education classrooms. Based on observations and informal conversations, all of the classrooms used an eclectic approach, combining aspects of structured teaching and applied behavioral analysis, among other methods, in their teaching.

Teacher Participants

Each of the eight classrooms had one primary teacher, all of whom consented to participate in the study. In addition, across the eight classrooms there were 13 teaching

assistants who consented to participate in the study, for a total of 21 teacher participants. Each of the teacher participants filled out a demographic form with information about gender, race, and ethnicity (see Table 3.1). The classroom teachers were all women, which is reflective of the general make-up of special education teachers in the United States. The teaching assistants were a more diverse group of individuals than the classroom teachers.

Table 3.1. Demographic information for teacher participants.

	Teachers		Teaching Assistants	
	N	%	N	%
Gender				
Male	0	0%	2	15.4%
Female	8	100%	11	84.6%
Race				
Black/African-American	1	12.5%	7	53.8%
White	7	87.5%	6	46.2%
Ethnicity				
Hispanic	0	0%	0	0%
Non-Hispanic	8	100%	11	84.6%
Not reported	0	0%	2	15.4%

In addition to demographic information, the researcher also collected information about the teachers' previous professional experiences. The teachers and teaching assistants had a range of levels of experience in school settings, with children with disabilities, and with children with ASD (see Table 3.2). Notably, all of the teachers had at least three years of experience working with children with ASD, although one teacher was relatively new to working in the school setting. Most of the teaching assistants also had three or more years of experience working with students with ASDs.

Table 3.2. Classroom staffs' levels of experience.

Years of experience	In a school setting		With children with educational disabilities		With children with ASDs	
	Teacher	TA[a]	Teacher	TA	Teacher	TA
0-2 yrs.	1 12.5%	1 8%	0 0%	1 8%	0 0%	2 15%
3-5 yrs.	2 25%	4 30%	1 12.5%	2 15%	2 25%	3 23%
6-10 yrs.	1 12.5%	3 23%	2 25%	3 23%	4 50%	4 30%
11+ yrs.	4 50%	4 30%	5 62.5%	7 54%	2 25%	4 30%

Note: TA = teaching assistant
[a] Data was missing from one teaching assistant

Student Participants

There were a total of 25 participants in the current study. The participants ranged from 8 to 12 years old at the time of recruitment, with three 8-year olds, seven 9-year olds, nine 10-year olds, five 11-year olds, and one 12-year old. Demographic information related to gender, race and ethnicity is reported in Table 3.3. The disparity between the number of male and female student participants was slightly greater than expected among individuals with ASD.

Table 3.3. Demographic information for student participants.

Gender	N	%	Race	N	%	Ethnicity	N	%
Male	23	92%	Asian	1	4%	Hispanic	5	20%
Female	2	8%	Black/African-American	8	32%	Non-Hispanic	20	80%
			White	14	56%			
			Multi-racial	1	4%			
			Other	1	4%			

Caregivers were also asked to provide information about their child's disability and concomitant diagnoses on the demographics form. Twenty-three students' caregivers reported a primary diagnosis of ASD with three of those caregivers reporting a secondary diagnosis of developmental delay. The remaining two students were reported to have a diagnosis of pervasive developmental disorder in one case, and developmental delay and "other" in the second case. However, all students had an educational label of autism and met the cut-off criteria on the SRS to confirm the label of autism. Three caregivers reported uncorrected hearing or visual impairments and one caregiver reported an uncontrolled seizure disorder. No caregivers reported history of traumatic brain injuries or genetic disorders related to ASD for their children.

Caregivers provided information about their levels of education. There was a wide range of educational levels across the caregivers, and the percentages were roughly reflective of the levels of education in the general population of adults in North Carolina (United States Census Bureau, 2012). Out of the 25 sets of caregivers, there were no responses for three mothers and eleven fathers. See Table 3.4 for detailed information about the educational levels of the caregivers of the student participants.

Table 3.4. Caregiver levels of education.

	Mothers		Fathers	
Level of education	N	%	N	%
< 12 years	3	12%	3	12%
High school or GED	5	20%	4	16%
Some college or technical (1-2 yrs)	4	16%	3	12%
College or technical (3-4 yrs)	5	20%	0	0%
Graduate or professional school	5	20%	4	16%
Not reported	3	12%	11	44%

Procedures

Once teachers and students were enrolled in the study, the researcher conducted a series of observations and assessments to gather data for the study. First, teachers were observed in three 20-minute sessions to assess teacher interaction styles. Then, students participated in two assessments outside of the classroom to assess expressive communication and receptive vocabulary. Next, students were observed for six 5-minute segments to measure joint engagement during regular classroom instruction. Finally, teachers completed a questionnaire regarding their attitude towards work. Data were collected across several months at each of the schools.

Classroom Observation

The Caregiver Interaction Scale (CIS; Arnett, 1989) was used to measure teacher interaction style. This 26-item measure uses a four-point rating scale (not at all true, somewhat true, quite a bit true, very much true), and provides four different subscale scores: positive interaction (10 items), punitive (9 items), permissive (3 items), and detached (4 items). The CIS has a split half reliability of .90 and a test-retest reliability of .84 (Arnett, 1989). Additionally, the CIS was found to be significantly and strongly correlated with other measures of global classroom quality, suggesting it is a valid measure (Sakai, Whitebook, Wishard, & Howes, 2003). The scale was originally developed for use in preschool classrooms, and has been used extensively in research studies as well as quality studies (National Association for the Educational of Young Children, 2005). Although the great majority of the work has been conducted at the preschool level, an adapted version of the CIS has been used in elementary school classrooms (Carl, 2007).

To establish reliability with the CIS, the primary researcher and research assistant used videos from preschool classrooms to practice coding and clarification of operational definitions. The researchers had difficulty attaining reliability for exact matches at the item level during training, so a consensus coding procedure was used for the current study. The researcher and research assistant observed each of the sessions and rated the teachers separately on each item. Then, the two raters compared ratings on individual items, and came to consensus for all individual items that were scored differently by the two raters. Consensus coding has been used successfully by researchers conducting 20-minute observations for the CIS (P. Pierce, personal communication, May 17, 2011).

Teachers were observed in three 20-minute sessions to assess their interaction style during three different classroom routines: meal time, academic instruction, and circle time. Meal times included breakfast, lunch, or snack across the classrooms. Academic instruction observation occurred during reading or math for all eight classrooms. Circle time was generally a more interactive session, and included activities such as calendar, attendance, singing, and dancing across the classrooms. The three 20-minute observations occurred across at least two different school days in each classroom. During each of these observations, the researchers rated the teachers on the 26 items of the CIS and used the consensus procedure described above for final scoring. The researchers independently completed three observations in each of the eight participating classrooms for a total of 24 observations. On independent ratings, they had exact matches on 57% of the items, and were within 1-point on 88% of the items. Then, they met to decide on consensus ratings as described above, and the consensus ratings were used in all analyses.

Student Assessments

The researcher used a combination of parent and teacher report, structured assessments, and semi-structured protocols to obtain data to describe the participants. As noted above, parents or teachers completed the Social Responsivesness Scale to assess traits related to ASD. The students participated in a semi-structured communication sample with the researcher to assess expressive communication Additionally, researchers completed the Peabody Picture Vocabulary Test-4th edition (PPVT-4; Dunn & Dunn, 2007) with each student to assess receptive vocabulary ability.

Autism severity. The Social Responsiveness Scale (SRS; Constantino & Gruber, 2005) was sent home as part of the consent packet for parents to complete to confirm the educational label of autism and to provide a measure of autism severity. The SRS is a parent and teacher report measure with 65 items using a 4-point rating scale, and takes approximately 15-20 minutes to complete. It has been demonstrated to have high concurrent reliability with the Autism Diagnostic Interview – Revised (Constantino et al., 2003). The study used a cut-off score of 60 or above as inclusion criteria to confirm the educational label of autism. The estimated specificity from parent reports using a cut-off score of 60 or above is 84% (Constantino et al., 2007). This measure provides scale scores for various symptom domains. Unlike other tools, broad testing of the SRS has consistently resulted in a one-factor solution, suggesting it is measuring a single underlying construct (Constantino et al., 2003; Constantino & Todd, 2000). The SRS has been successfully used as a rapid quantitative measure for assessing social impairment in individuals with ASD and provides a continuous measure of severity (Constantino et al., 2007).

The caregivers of nine of the 25 participants left at least one question unanswered on the SRS, and one set of caregivers did not speak English fluently enough to complete the SRS. Experts involved with the creation and validation of the SRS have said that modal values can be used to score blank items for up to 10% of the SRS, or six or fewer blank items (C. Gruber, personal communication, September 29, 2011). Four of those nine forms contained only one or two missing answers, and therefore less than 10% of the items on the SRS. The modal values for the missing answers were used for these four participants. The remaining five forms contained more than six missing answers, which is above the 10% cut-off. Two of these five forms were missing answers for over half of the questions. The researcher decided that the form may have been difficult or painful for the parents given then number of blank answers, so the teachers were asked to complete the SRS for these two students. For the three other sets of caregivers whose response forms contained fewer than 10 missing answers, the researcher sent home a document with the unanswered questions. Two of the three caregivers returned the document and the answers were transcribed to the original SRS form. The final set of caregivers who received a form of the unanswered questions did not return the form and had nine missing answers, which is above the 10% item cut-off for using modal values. The teacher was asked to complete an SRS for that student. In total, teachers were asked to complete the SRS for four participants: two students whose parents left more than half of the answers blank, one student whose parents did not return the secondary probe for up to 10 missing answers, and one student whose parents did not speak fluent English. The teacher norms were used for computing the SRS scores for these four students.

Expressive communication. Each student also participated in a semi-structured communication sample. The semi-structured communication assessment contained eight tasks drawn from procedures used in previous research (i.e., Autism Diagnostic Observation Schedule; Lord, Rutter, DiLavore, & Risi, 1999; Attention-Following and Initiating Joint Attention Protocol; Watson, Baranek, & Poston, 2003) designed to elicit communicative behaviors. The eight tasks were coloring, tops/spinners, reading, bubbles, switch-activated or remote control toy, balloon, ball track, and snack (see Appendix A for detailed description of assessment). The assessment was conducted in a separate room at a table with the assessor sitting across from the student, and was video-recorded by a second researcher.

Each expressive communication assessment was coded for three forms of social-communication, social interaction, behavior regulation and joint attention, based on Bruner's hierarchy of early social-communication skills (Bruner, 1981). The coding system was adapted from the ASAP Social-Communication Coding System, which has been used to code social-communication behavior for a study with preschool children with ASD (Dykstra et al., in preparation). The previous study coded student behaviors demonstrated in the Autism Diagnostic Observation Schedule (ADOS), one of the assessments from which several tasks for the current assessment were drawn and was found to correlate significantly with expressive language measures. The social-communication coding system focuses primarily on non-verbal forms of communication, and targeted four social interaction behaviors, five behavior regulation behaviors, and seven joint attention behaviors (see Table 3.5 for detailed definitions).

Table 3.5. Definitions of social-communication behaviors.

Behavior	Definition
Social Interaction: Child communicates to get attention, or to maintain or initiate involvement in an activity	
Watches closely	The child and adult are engaged in a face-to-face interaction and the child watches the adult for at least 2-seconds in anticipation of the adult's contribution to the interaction
Shows wanting to continue	The child uses some type of action (e.g., gesture) or vocalization (e.g., sounds, words) to indicate that s/he wants the game/routine to continue
Initiates game/routine	The child starts a new game/routine or a game/routine that has been previously demonstrated during the assessment with at least 30 seconds between the initial demonstration and current initiation
Expands game/routine	The child changes a face-to-face game/routine by switching roles, including a different person (e.g., mother, teacher, camera person), or adding new actions or materials within the game/routine
Behavior Regulation: The child communicates in order to gain access to an object, get help with an object, get another person to perform an action, or to protest an object or action	
Reaches	The child uses an open-hand reach or opens and closes his/her hand repetitively
Contact gestures	The child uses a gesture that includes coming into contact with an object or person
Points	The child uses an isolated finger or thumb to point to an object
Other BR gestures	The child uses other distal or symbolic gestures which may include sign language or sign approximations, or depictive gestures
Vocalizations/ Verbalizations	The child uses vocalizations or verbalizations in the absence of a gesture
Joint Attention: The child initiates communicates in order to draw the adults attention to an object or event	
3-point gaze	The child looks at the object/event-adult-object/event or adult-

	object/event-adult in quick succession
Gives	The child gives an object to the adult
Shows	The child shows an object to the adult either by moving the object closer to the adult or re-orienting the object towards the adult
Touch point	The child touches an object with a single finger or thumb
Distal point	The child uses an isolated finger/thumb to point to an object/event
Other JA gestures	The child uses other distal or symbolic gestures which may include sign language or sign approximations, depictive gestures, or conventional gestures not included in any of the above categories
Vocalizations/ Verbalizations	The child uses vocalizations or verbalizations in the absence of a gesture

The primary researcher and a research assistant worked together to adapt operational definitions and examples in the coding system. Next, they used ADOS videos from previous studies to pilot the adapted coding system. Then, the coding system was finalized (see Appendix B for complete coding manual) and the researchers trained on additional ADOS videos in order to attain acceptable reliability. For the current study, the coders viewed the expressive communication assessments using DVD players on computers, and watched for instances of the targeted communicative behaviors. The coders recorded *types* of behaviors, coding only novel instances of a specific behavior used for a specific purpose, rather than *tokens* of behaviors (i.e., pure frequency counts). The coding system was designed to capture a range of communicative forms and functions, with less emphasis on repeated displays of a specific form and function of communication within one context of the assessment. Thus, a reach to request bubbles would only be coded once, even if the gesture was repeated, but a reach to request bubbles and a point to request bubbles would be coded as two different behaviors.

Likewise, a point to request a ball and a point to request a snack would also be coded as two different behaviors since the repeated form and function were used for different purposes. In addition to looking at gestures, coders also noted if the students paired the communicative behaviors with eye contact and vocalizations or verbalizations.

Following coding, the behaviors were each assigned a score. Communication forms and functions were weighted based on previous experience and research (Dykstra et al., in preparation). Additional points were given for behaviors that were paired with eye contact and/or vocalizations or verbalizations. The scores were summed to give sub-scores for social interaction, behavior regulation, and joint attention, as well as a total score for social-communication. See Appendix C for the coding and scoring sheet for the assessment.

The primary researcher coded all videos for the current study, and a research assistant coded seven randomly selected videos for reliability unknown to the primary researcher, which amounted to 28% of the assessments. The researcher used intraclass correlations (ICCs) between scores to estimate reliability. This method was chosen over behavior-by-behavior reliability because the scores were used in the final analyses and the individual communicative behaviors by students were low frequency in nature and likely would have resulted in overly conservative estimates of reliability. The ICC for the total social communication score was .92, which is considered acceptable in research (Shrout & Fleiss, 1979).

Receptive vocabulary. The Peabody Picture Vocabulary Test – 4th edition (PPVT-4; Dunn & Dunn, 2007) is a receptive vocabulary test validated for individuals from 2 ½ to 90 years old. For the PPVT-4, the administrator reads a single word and the

student points to one of four pictures on a page. This tool was specifically selected for the wide age range and non-verbal response requirements since it was anticipated that many students in the current study would perform well below age expectations and have difficulty with verbal response requirements. The PPVT-4 has a test-retest reliability of .93 (Dunn & Dunn, 2007). Additionally, many research studies with children with ASD have utilized this tool for measuring receptive vocabulary or language (Delinicolas & Young, 2007; Howlin et al., 2004; Kjelgaard & Tager-Flusberg, 2001; Lord & Schopler, 1989).

The PPVT-4 was administered to each student in a separate room within the school. One student participant was unable to complete the test items, so the researcher did not administer the full PPVT-4. Another student spoke Spanish as his first language, so the PPVT-4 was translated into Spanish for this student by a research assistant fluent in Spanish. The standard scores and age equivalent scores on the PPVT-4 both had floor effects in this sample, so the researcher used raw scores as the receptive vocabulary measure.

Student Observations

Once all data collection on student characteristics was complete, observations of students were conducted during typical classroom instruction while the primary teacher was serving as the instructor or co-instructor of the session. Students were observed for six 5-minute segments across at least two different school days. The observations were planned to be conducted during two one-to-one sessions, two small group sessions (i.e., 2-3 students) and two large group sessions (i.e., 4 or more students) when possible. However, many classrooms did not have regularly scheduled small group sessions, so

additional large group sessions were observed for students who did not participate in small group sessions. During each 5-minute observation, the researchers coded student joint engagement and classroom ecological features. These are described in detail below.

Joint engagement. Coders used a continuous time sampling procedure to record engagement states using definitions based on the joint engagement coding system (Adamson et al., 1998). The coding system included following six categories: unengaged, onlooking, object only, person only, supported joint engagement, and coordinated joint engagement (see Table 2.1 for definitions). The coders used PocketPCs with the Multi-Option Observation System for Experimental Studies (MOOSES; Tapp, Wehby, & Ellis, 1995) software to collect data live in classroom settings. The coding definitions and procedures were adapted for live coding in classrooms serving students with special needs. This coding system has been utilized successfully for live coding in preschool classroom settings (Wong & Kasari, 2012).

Prior to beginning the current study, the coders were trained in joint engagement coding for another research project assessing engagement in preschoolers with ASD. Coders received a 1 ½ to 2 hour training session, followed by coding practice using a combination of previously recorded and live 5-minute segments. The coders achieved reliability of at least 80% agreement before coding for the current study.

The coders scheduled times with the classroom teacher to conduct 5-minute continuous observations during regular classroom instruction. Students were observed during individual, small group, or large group academic instruction, for six different sessions. One student moved from her current placement prior to completion of the six observations, so only three observations were completed for that student.

For the purposes of the current study, coordinated joint engagement was used as the engagement variable of primary interest. This is the highest level of engagement, and indicates that the student is alternating engagement between objects and people. This is in contrast to supported joint engagement, which involves another person influencing engagement but does not require student acknowledgement of the other person. Thus, coordinated joint engagement is more reflective of students' abilities to engage, rather than supported joint engagement, which is more reflective of the teachers' efforts to engage the students.

Reliability was collected for 30 observations of engagement, which was just over 20% of the sessions. Percent agreement during the observations averaged .80. The percent agreement in coordinated joint engagement, used as the dependent variable in all analyses testing the study hypotheses, was .90 between the two coders. In addition to calculating the overall reliability, the researcher calculated ICCs on the amount of time spent in each of the six engagement categories, because these durational variables were used in the analyses. The ICCs were at or above .80 for four of the six engagement categories, including an ICC of .95 for coordinated joint engagement. Onlooking had an ICC of .75 and supported joint engagement had an ICC of .38. This low reliability for supported joint engagement was a concern, but this category was only examined descriptively and was not used for testing study hypotheses.

Classroom ecological factors. Immediately following each 5-minute observation session, the coders recorded information or ratings for targeted classroom ecological factors including group size, use of student-directed practices, number of peers present, and number of adults present (see Appendix D for the complete coding sheet). The

observation sessions were selected and coded based on group size. Individual sessions were sessions in which the teacher worked with the target child and no peers were present. Small group sessions involved two or three students including the target student, and large group sessions involved four or more students including the target student. Coders also recorded the highest number of peers and adult present during any point in the observation. Finally, coders responded to four multiple choice items regarding the teachers' use of student-directed practices; each item had four different response options. The items were related to student access to materials, student interest in materials, teachers' adaptation during the activity and response requirements during the activity. The items were selected based on previous research (e.g., Kamps et al., 1991) and experience related to instructional features that impact student engagement. The researcher developed operational definitions for each of the answers on the four items on the student-directed practices measure (see Appendix E). In addition to the more defined questions, there were also places to record a description of the activity and materials used during the activity.

As noted above, reliability data were collected for just over 20% of the observation sessions. For the number of peers present in the observation, the reliability coder omitted the number for five of the 30 observations. However, in the remaining 25 observations, the coders had perfect agreement for the number of peers present. Therefore, it seems reasonable to assume sufficient reliability for the number of peers present. For the 4-item student-directed practices measure, the ICC was .84 for the summed scores across the 30 observations. This is within the acceptable range for ICCs (Shrout & Fleiss, 1979).

Teacher Assessment

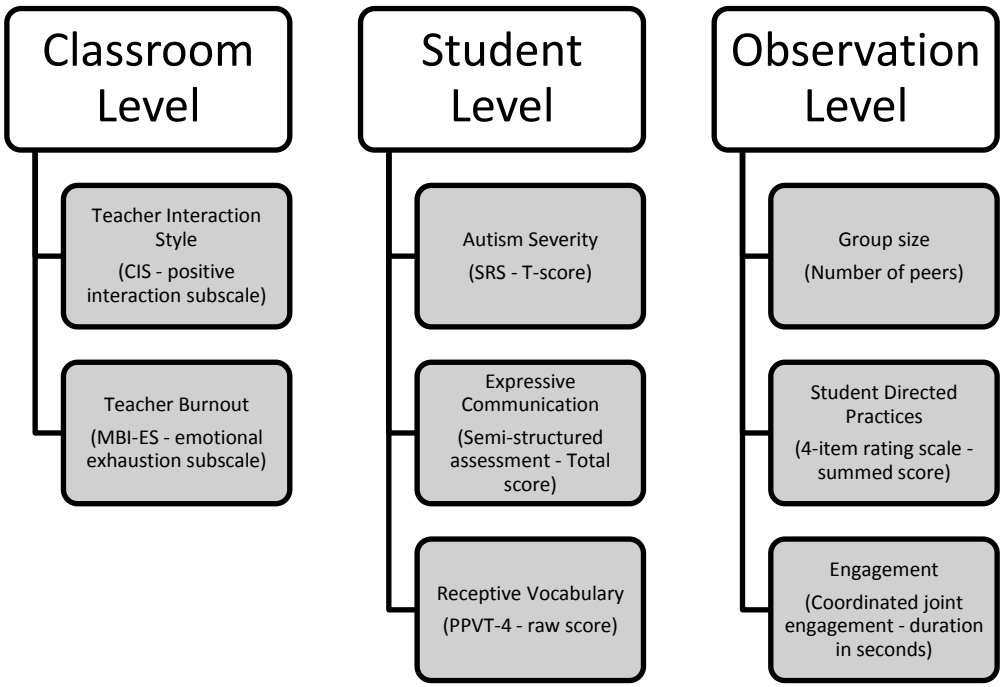
Following completion of all other measures, the primary teacher for each classroom was given the Maslach Burnout Inventory – Educators Survey (MBI-ES; Maslach, Jackson, & Schwab, 1996) This is a 22-item measure that assesses teachers' attitudes towards work across three different factors: emotional exhaustion (9 items), depersonalization (5 items), and personal achievement (8 items). Each item requires a rating between 0 and 6, with frequency descriptors of "never", "a few times a year or less", "once a month or less", "a few times a month", "once a week", "a few times a week", and "every day". The three factor solution has been confirmed by multiple studies, with reliability estimates ranging from .72 to .90 on each of the subscales (Gold, 1984; Iwanicki & Schwab, 1981). It has been widely used in educational research (Maslach, Jackson, & Leiter, 1996). For the current study, the emotional exhaustion scale was used as a measure of teacher burnout. This scale has items such as "I feel emotionally drained from my work" and "I feel frustrated by my job". In previous research, the emotional exhaustion scale had reliability estimates of .88 (Gold, 1984) and .90 (Iwanicki & Schwab, 1981).

Data Management and Analysis Plan

All raw data were double entered into two separate Microsoft Excel™ spreadsheets. Following data entry, the spreadsheet files were compared using Diff Doc™ software and all errors were corrected to create verified spreadsheets. Next, the spreadsheets were merged using the SAS® software Version 9.2 of the SAS system for Windows (SAS Institute Inc., 2012). Data for the current study was collected at three different levels: classroom, student, and observation (See Figure 3.1). Based on the

nested design of the study, the researcher used mixed level modeling for statistical analyses of the three research questions, with engagement being modeled as a function of different independent variables for each of the research questions. For the analyses for each research question, the researcher used the Bonferroni-Holm correction for multiple comparisons.

Figure 3.1. Levels of nested variables for study.



Summary

The current study focuses on the coordinated joint engagement of students with ASD in the classroom setting. The research aims are to examine: (1) the relationships between classroom ecological factors (i.e., group size, student-directed practices, teacher interaction style, teacher burnout) and student engagement, (2) the relationships between student characteristics (i.e., autism severity, expressive communication, receptive vocabulary) and engagement, and (3) the consistency of the measurement of student engagement across and within group contexts.

CHAPTER 4

RESULTS

Data were collected from students, teachers, and classrooms to examine the impact of student and classroom factors on students' joint engagement in the classroom. First, data were screened to assess the distributions of the data. Descriptive data for the independent variables are presented. In addition, the dependent variable, joint engagement, is described in detail to characterize engagement in self-contained classrooms among students with ASD. Planned statistical analyses were conducted for each research question in Statistical Package for the Social Sciences (SPSS) Statistics Version 19.0 (IBM Corp., 2010) using mixed level modeling to account for the nested design of the study.

Data Screening

Data were screened prior to analysis using a combination of visual inspection and analysis of descriptive statistics. The researcher examined the data for outliers, assessed the data assumptions for mixed level modeling, and explored the univariate descriptive statistics. Inspection of the data revealed three missing data points for joint engagement, one missing data point for the Peabody Picture Vocabulary Test – 4^{th} edition (PPVT-4), and no missing data for the remaining variables. The missing data points for joint engagement were from a single participant who moved to a different school during the study and the missing data point for the PPVT-4 was for a student who was unable to

complete the assessment. Mixed level modeling is designed to account for missing data so the results for both participants were kept in the data set for analyses.

Screening for Outliers

Data were screened for outliers using standardized scores (z-scores) for the dependent variable and all of the independent variables. A z-score of less than -3.29 or greater than 3.29 is considered a potential outlier. The z-scores for the dependent variable, coordinated joint engagement, ranged from -0.86 to 2.86.

The z-scores for classroom, student, and observation level independent variables were each assessed at the corresponding level. The z-scores for student directed practices ranged from -1.94 to 2.17, which is within the acceptable range. The z-scores for number of peers ranged from -1.10 to 3.49, with two z-scores falling in the range as potential outliers. These observations occurred for two different student participants in the same classroom when their class had combined with another class for instruction. Based on conversation with the classroom teacher, this was a common occurrence for this particular class. Since the goal of the study was to examine real-world instructional practices, these outliers were kept in the analyses.

All z-scores fell within the acceptable range for the student characteristics. The range of z-scores were -1.69 to 2.01 for autism severity (SRS T-score), -1.20 to 2.77 for the total expressive communication score, and -0.80 to 2.99 receptive vocabulary (PPVT-4 raw scores). Notably, there were also no outliers when the standard scores were examined for the PPVT-4. Finally, the z-scores for teacher interaction style (positive interaction on the CIS) and teacher report of burnout (emotional exhaustion on the MBI-

ES) ranged from -1.72 to 1.84 and -2.02 to 1.12 respectively, all within the acceptable range indicating no outliers.

Because the student characteristics were included in a single model, data were assessed for multivariate outliers among these three variables. Mahalanobis distances were calculated for a regression model with all three variables: autism severity, expressive communication, and receptive vocabulary. Tabachnick and Fidell (2007, p. 74) suggest a critical value using .001 for chi-square, which is 16.27 with three degrees of freedom for the three independent variables. The maximum Mahalanobis distance was 12.12, which is below the suggested cut-off. Thus, there appear to be no multivariate outliers among the student participants for the targeted characteristics.

Data Assumptions

Mixed level modeling uses similar data assumptions as other general linear model statistical procedures. The four main assumptions for general linear models are linear relationships between variables, normal distribution of the dependent variable, homogeneity of variance across groups, and independence of observations for the dependent variable. However, mixed level modeling addresses issues in homogeneity of variance and independence of observations through the nested design, and thus data screening was not necessary in regards to those two assumptions. The data were visually inspected using bivariate scatter plots to assess linear relationships between the dependent variable and each of the independent variables. Based on visual inspection, all relationships appeared to be linear in nature. Additionally, the bivariate scatter plots for each pair of student characteristics were examined since the student characteristics were

placed in a single model. All variables appeared to have linear, albeit weak, relationships with each other.

The descriptive data were examined to ensure normal distribution of the dependent variable. For the analyses, the dependent variable was the number of seconds in coordinated joint engagement. Coordinated joint engagement had a mean of 62.9 with a standard deviation of 72.9 across the 147 observations. Visual analysis of the data revealed a positively skewed distribution, with many zeros and low durations for coordinated joint engagement. However, the skewness was 1.3 and the kurtosis was 0.6, both within the acceptable range to meet assumptions for normality. When the data points for coordinated joint engagement were combined at the child level, the variable remained positively skewed (0.5), but the visual inspection suggested a relatively normal distribution. The dependent variable was not transformed for the analyses since there were a relatively large number of observations and the mixed level modeling is a robust procedure (C. Wiesen, personal communication, September 27, 2012).

Descriptive Statistics

The following section reviews the descriptive statistics for the independent and dependent variables. First, the section will examine data for the classroom ecological features. Next, the characteristics of the student participants will be described. The final section will describe the engagement of students with ASD in the classroom setting during academic instruction.

Classroom Ecological Features

The classroom ecological features included four variables: two variables that were collected at the observation level and two variables that were collected at the classroom

level. These variables targeted aspects of the educational environment from instructional features (observation level) and teacher behaviors (classroom level).

Group size and student-directed practices were measured for each 5-minute observation of student engagement, across a total of 147 observations. The metric for group size was originally intended to be categorical for individual, small group (i.e., 2-3 students), and large group (i.e., 4 or more students) contexts, with a plan to collect two observations per student in each context for a total of six observations. However, some classrooms did not use small group instruction so the researcher decided to maintain the total number of observations, and record the actual numbers of peers present. There was a mean of 1.7 peers (in addition to the target child) in the small group settings across 18 observations and 4.9 peers in the large group settings across 81 observations.

Student-directed practices were assessed using four researcher-developed items each with a 4-point scale (see Appendix D). The questions were designed to assess student access to materials, student interest in materials, teacher adaptation of activities, and activity response requirements. The 4-point scales were scored with "1" as the least student-directed practice and "4" as the most student-directed practice for a given question. The scores were summed to create an overall score for student-directed practices for each observation, with scores ranging from 4 to 16, as well as sub-scales for materials and activities with scores ranging from 2 to 8. The descriptive statistics for the student-directed practices across individual, small group, and large group contexts are presented in Table 4.1. Teachers tend to use more student-directed practices during individual sessions and less student-directed practices during large group sessions.

Additionally, access to materials seems to be a particularly strong area across this group of teachers compared to the other aspects of student-directed practices.

Table 4.1. Mean and standard deviation for student-directed practice scores across group settings.

	Materials			Activity			Total
	Access	Interest	Sum	Adaptation	Response	Sum	
Individual	3.8 (.4)	2.1 (.8)	5.9 (1.0)	2.9 (1.0)	2.4 (.5)	5.3 (1.3)	11.2 (1.9)
Small group	2.8 (1.1)	2.1 (.9)	4.9 (1.7)	2.4 (.9)	2.4 (1.0)	4.8 (1.5)	9.7 (3.1)
Large group	2.4 (1.0)	1.8 (.8)	4.2 (1.3)	1.8 (.6)	1.9 (.7)	3.7 (1.1)	7.9 (2.1)
Average	2.9 (1.1)	1.9 (.8)	4.8 (1.5)	2.3 (.9)	2.1 (.7)	4.4 (1.4)	9.2 (2.7)

Note: Access = student access to materials; Interest = student interest in materials; Adaptation = adaptation of activity/task by teacher; Response = response requirements of activity/task

Teacher interaction style and teacher burnout were measured for the classroom teacher in each of the eight classrooms, resulting in classroom level variables. The Caregiver Interaction Scale (CIS; Arnett, 1989) was administered in three different settings for each teacher, academic instruction, circle time, and meal time. The CIS provides scores four distinct factors: positive interaction, punitive, permissiveness, and detached behaviors. The possible scores on the subscales were 10 to 40 points for positive interaction, 9 to 36 points for punitive, 3 to 12 points for permissiveness, and 4 to 16 points for detached behaviors. See Table 4.2 for descriptive statistics within and across contexts. Overall, teachers were more positive and less detached during the academic and circle time settings in comparison to meal times. There was little variability in the permissiveness factor overall, but the other three factors had a relatively broad

ranges of scores. The sum of the positive interaction factor scores across the three settings are used in the analysis for addressing this research question.

Table 4.2. Descriptive statistics for four factors of the CIS across settings.

		Academic	Circle time	Meal time	Total
Positive interaction	Mean	29.5	29.6	26.5	85.6
	SD	4.3	5.8	6.1	14.3
	Range	22 - 36	20 - 39	19 - 37	61 - 112
Punitive	Mean	14.5	13.6	15.1	43.3
	SD	4.1	3.2	3.6	9.4
	Range	11 - 22	11 - 21	11 - 20	36 - 63
Permissive	Mean	7.25	7.4	7.9	22.5
	SD	0.9	0.9	0.8	0.9
	Range	6 - 8	6 - 9	7 - 9	21 - 24
Detached	Mean	5.5	5.9	8.5	19.9
	SD	2.0	2.4	3.5	6.4
	Range	4 - 10	4 - 10	4 - 14	12 - 31

The Maslach Burnout Inventory – Educator Survey (MBI-ES; Maslach, Jackson, & Schwab, 1996), a teacher report of job burnout, contains three subscales: emotional exhaustion, depersonalization, and personal achievement. For emotional exhaustion and depersonalization, higher scores are indicative of higher feelings of burnout; for personal accomplishment, lower scores are indicative of higher feelings of burnout. The descriptive statistics for the MBI-ES are in Table 4.3. For the teachers in this study, there was a fairly limited range of scores for the depersonalization factor, but the scores were more varied for the factors of emotional exhaustion and personal achievement. For the purposes of this study, the emotional exhaustion sub-score was used in the analyses.

Table 4.3. Descriptive statistics for three factors of the MBI-ES.

	Emotional exhaustion	Depersonalization	Personal achievement
Mean	21.5	3.1	39.0
SD	6.7	2.9	4.4
Range	8 – 29	0 – 8	32 – 47
Possible range	0 – 54	0 – 30	0 – 48

Student Characteristics

The student characteristics of autism severity, expressive communication, and receptive vocabulary, were assessed through caregiver or teacher report, a semi-structured assessment, and a standardized assessment. Since the student characteristics will be combined in a single model, the correlations of the variables were examined (see Table 4.4). None of the correlations was significant. Although this was somewhat surprising, the measures were specifically chosen to assess different developmental aspects of the students. The following section includes basic descriptive statistics for the specific scores for each measure that were used for analyses, as well as more detailed information about sub-components of the measures as appropriate.

Autism severity. As noted in the methods section, autism severity was measured through parent report when possible, and teacher report as needed using the Social Responsiveness Scale (SRS; Constantino & Gruber, 2005). The SRS provides separate normative data for parent and teacher report so the appropriate normative data were used for each student. The mean, standard deviation, and range for the scores are reported in Table 4.5. According to the standardized scores, there were five students in the mild to moderate range and 20 students in the severe range for autism symptomatology. Since the

students were all served in self-contained classroom, it is not surprising that many of the students exhibited severe symptoms related to ASD.

Table 4.4. Correlations between measures of student characteristics.

	1 Autism severity[a]	2 Expressive communication[b]	3 Receptive vocabulary[c]
1	-	-.11 p=.59	.10 p=.63
2		-	.34 p=.10
3			-

[a] T-score on the SRS
[b] Total score of the expressive communication assessment
[c] Raw score on the PPVT-4

Expressive communication. The expressive communication scores for social interaction, behavior regulation, and joint attention, as well as the total score, were derived from weighted scoring of the student behaviors that were coded from the videotaped semi-structured communication assessment. The descriptive statistics are reported in Table 4.5. Although the total expressive communication scores were used for the analyses, it is helpful to look at the specific behaviors from which the scores are derived (see Table 3.5 for detailed descriptions of behaviors).

There was a range of both numbers and functions of expressive communication behaviors across the participants. The mean number of initiations of different types of communicative behaviors was 17.4 behaviors; one student initiated a low of 5 types of communicative behaviors and one student initiated a high of 38 types of communicative behaviors during the semi-structured assessment. All of the students had at least one initiation of behavior regulation, and 21 of the students had at least one initiation of joint

attention. In contrast, only 12 students initiated at least one social interaction, which is likely a reflection of the assessment not eliciting social interactions in the procedures.

In addition, students also demonstrated different forms of communication. All 25 students demonstrated at least one proximal gesture for behavior regulation and 21 students demonstrated at least one distal gesture for behavior regulation. In contrast, 17 students demonstrated at least one proximal gesture for joint attention and only 12 students demonstrated at least one distal gesture for joint attention. Based on this more qualitative examination of the data, it appears the expressive communication assessment and scoring procedures were successful in capturing differences in communicative skill level and performance across the student participants.

Table 4.5. Descriptive statistics for child characteristics.

	SRS (n=25)	EC Weighted Scores (n=25)				PPVT-4 (n=24)	
	T-score	SI	BR	JA	Total	Raw	SS
Mean	84.7	3.1	29.8	19.5	52.4	32.3	30.2
SD	14.0	4.4	13.9	23.2	36.3	38.1	21.2
Range	61 – 113	0 – 16	9 – 64	0 – 89	9 – 153	2 – 146	20 – 99

Note: SRS = Social Responsiveness Scale; EC = Expressive Communication; PPVT-4 = Peabody Picture Vocabulary Test-4th edition; SI = Social Interaction; BR = Behavior Regulation; JA = Joint Attention; SS = Standard Score.

Receptive vocabulary. The receptive vocabulary scores were obtained from the Peabody Picture Vocabulary Test-4th edition (PPVT-4; Dunn & Dunn, 2007). One student was not assessed on the PPVT-4 because he did not successfully complete the test items for the assessment. As expected, many of the students were well below age expectations. Out of the 24 students assessed, 14 of the students had a standard score of 20 (lowest possible standard score), and 10 of the students had an age-equivalent of less

than 24 months, which indicated that there were floor effects in this group of participants. The floor effects on the standard scores were anticipated, but the floor effects of the age-equivalent scores were somewhat less expected. As a result, the raw scores for the PPVT-4 were used for analyses. The descriptive statistics are reported in Table 4.5.

Student Engagement

The coding of student engagement (Adamson et al., 1998) measured the duration in each of the six engagement states: unengaged, onlooking, object only engagement, person only engagement, supported joint engagement, and coordinated joint engagement

Table 4.6. Descriptive statistics for joint engagement observations.

	Mean in sec. (SD)	Mean percent	Min-Max in sec.	Skewness	Kurtosis
Non-engagement	177.7 (92.1)	59.2%	7 – 300	-0.4	-1.2
Unengaged	125.8 (86.3)	41.9%	5 – 292	0.2	-1.2
Onlooking	51.9 (60.8)	17.3%	0 – 228	1.5	1.3
Single engagement	47.3 (53.5)	15.8%	0 – 226	1.4	1.5
Object	36.8 (52.9)	12.3%	0 – 226	1.7	2.4
Person	10.5 (18.7)	3.5%	0 – 96	2.3	5.6
Joint engagement	75.0 (75.6)	25.0%	0 – 271	0.4	-0.1
Supported joint	12.1 (23.4)	4.0%	0 – 142	2.8	9.5
Coordinated joint	62.9 (72.9)	21.0%	0 – 271	1.3	0.6

(see Table 4.6 for descriptive statistics). On average, students spent just over 40% of the time, with over half of that time coming in the form of joint engagement.

Unsurprisingly, patterns of student engagement varied systematically across the different categories of group size (see Table 4.7). Active engagement increased from 20% during large group settings, to around 37% during small group sessions, and to nearly 75% during individual sessions. Students had the highest amounts of unengaged behaviors and lowest amounts of joint engagement in large groups, and the lowest amounts of unengaged behaviors and highest amounts of joint engagement during individual sessions.

Table 4.7. Comparison of percentages in engagement states across group contexts.

	Mean			Minimum – Maximum		
	1:1 n=48	SG n=18	LG n=81	1:1 n=48	SG n=18	LG n=81
UE	20.0%	44.6%	54.3%	2 – 70%	4 – 95%	3 – 97%
OL	5.3%	18.2%	24.4%	0 – 24%	0 – 72%	0 – 76%
OBJ	22.2%	8.9%	7.1%	0 – 75%	0 – 46%	0 – 67%
PER	2.3%	2.4%	4.4%	0 – 17%	0 – 29%	0 – 32%
SJE	8.4%	2.8%	1.7%	0 – 47%	0 – 17%	0 – 18%
CJE	42.1%	23.1%	8.0%	0 – 90%	0 – 68%	0 – 42%

Note: UE = unengaged; OL = onlooking; OBJ = object only engagement; PER = person only engagement; SJE = supported joint engagement; CJE = coordinated joint engagement; 1:1 = individual sessions; SG = small group sessions (2-3 students); LG = large group sessions (4 or more students)

Analyses of Research Questions

The analyses utilized mixed level modeling to account for the nesting of observations within students, and the nesting of students within classrooms. Student was

set as a random effect and classroom was set as a fixed effect. Because students were treated as a random effect, each student is considered a random sample from the population of individuals with ASD who could have been placed in a given classroom. However, the classrooms were treated as a fixed effect, meaning the classrooms in the study will be considered the population for this exploratory study. The dependent variable, coordinated joint engagement, was measured multiple times for each student, so all analyses were conducted at the level of the observation. The Bonferroni-Holm correction was used for planned analyses to account for multiple comparisons within each of the research questions (Holm, 1979).

Relationships between Joint Engagement and Classroom Ecological Features

For the first research aim, coordinated joint engagement was modeled as a function of group size, use of student-directed strategies, teacher interaction style, and level of teacher burnout. Independent variables were analyzed individually to examine the impact of each of the classroom ecological factors on student engagement, thus there were four different mixed level models for this research aim.

Observation level variables. Both group size and student-directed practices were collected for each 5-minute observation. Due to differences in use of instructional groupings across the classrooms in the study, there were 48 individual observations, 18 small group observations, and 81 large group observations. As a result of these unexpected differences in instructional groups as well as differences in class sizes, the number of peers present during the observation was used for group size in the analyses. For student-directed practices, the summed scores of the four item researcher-developed measure were used for analyses. Results for the observational level variables are in Table

4.8. The *F* and *p* values for the factor effect indicate whether the independent variable was significantly related to coordinated joint engagement. Due to planned analyses of four variables across the classroom ecological factors, the acceptable *p*-values for significance were .0125, .017, .025, and .05 when the results are considered from the lowest to highest *p*-values (Holm, 1979). The *F* and *p* values for the fixed factor of classroom indicate whether the classroom had a significant effect on the model. Since students were considered a random factor, the parameter estimate (β) is the estimated difference in seconds of coordinated joint engagement for a one point change in each of the independent variables, with the positive or negative value delineating the directionality of the estimated differences.

Table 4.8. Mixed model results for relationship between coordinated joint engagement and observation level classroom ecological features.

	Factor effect		Classroom effect		Estimate
Factors	*F*	*p*	*F*	*p*	*β*
Group size	**87.2**	**<.001**	1.3	.322	-15.7
Student-directed practices	**113.1**	**<.001**	1.0	.480	18.4

There was a significant relationship when coordinated joint engagement was modeled as a function of group size. Classroom did not have a significant effect in the model. The negative parameter estimate suggests that for each additional peer present during the observation, the student would have an estimated reduction of 16 seconds of joint engagement during a 5-minute (or 300-second) observation. Thus, if a student in a classroom of six students went from an individual session (i.e., no peers) to a whole group session (i.e., five peers), it is estimated that the student would be in coordinated

joint engagement for over 75 fewer seconds in a 300-second group session. This is equivalent to a 25% difference in duration at the highest engagement state.

There was also a significant relationship when coordinated joint engagement was modeled as a function of student-directed practices. Similar to model for group size, classroom did not have a significant effect in this model. The parameter estimate indicates that for each one point increase in the student-directed practices measure, students would have an estimated increase of 18 seconds of coordinated joint engagement. If teachers improved their use student-directed practices by one level on each of the four items (see Appendix D for items and levels), it is estimated that a student would be at the highest level of joint engagement for an additional 72 seconds, which is over 20% of the total observation time.

Classroom level variables. Because teacher interaction style and teacher burnout were measured for each classroom teacher, there were only seven available degrees of freedom. Thus, when each of these variables was introduced to the model, there were six remaining degrees of freedom. For the analyses, the data were transformed using the SAS® software Version 9.2 of the SAS system for Windows (SAS Institute Inc., 2012) such that the remaining six classroom effects were made orthogonal to the independent variable. Because there was one teacher per classroom, the classrooms were accounted for in the independent variables and it was not necessary to include classroom as fixed effect. Students were still included as a random effect for these analyses. The results for the classroom level analyses are in Table 4.9. Teacher interaction style and teacher burnout were part of the classroom ecological factors analyses, so Bonferroni-Holm corrected *p*-values noted in the previous section apply to these analyses.

For the analysis of teacher interaction style, coordinated joint engagement was modeled as a function of positive teacher interaction. The positive interaction scores of the CIS across each of the three settings (i.e., academic, circle time, meal time) were summed to create a single variable for positive teacher interaction. Positive teacher interaction style was not significantly related to coordinated joint engagement. Coordinated joint engagement was modeled as a function of teacher emotional exhaustion for analysis for teacher burnout. The emotional exhaustion score of the MBI-ES was used for the analyses for the teacher burnout measure. Emotional exhaustion did not have a significant relationship to student engagement.

Table 4.9. Mixed model results for relationship between joint engagement and teacher level classroom ecological features.

	Factor effect		Estimate
	F	*p*	*β*
Teacher interaction style	0.2	.656	-0.3
Teacher burnout	0.6	.441	-1.1

Relationships between Joint Engagement and Student Characteristics

For the second research aim, joint engagement was modeled as a function of autism severity, expressive communication, and receptive vocabulary. The student characteristics were analyzed in a single model to examine the relationship of these variables with coordinated joint engagement (see Table 4.10). Students were considered a random effect and classrooms were modeled as a fixed effect. The parameter estimate (β) for a given independent variable is the estimated difference in the dependent variable, coordinated joint engagement, for a difference of one in the independent variable. The *p*-value ($p = .076$) indicates that classrooms were not significantly related to coordinated

joint engagement in this model. Similar to the first research aim, the Bonferroni-Holm correction procedure was used to account for multiple analyses, so *p*-values of .017, .025, and .05 were considered significant when ordering the values from lowest to highest (Holm, 1979).

Table 4.10. Mixed model results for relationship between joint engagement and child characteristics.

	Factor effect		Classroom effect		Estimate
Factors	*F*	*p*	*F*	*p*	*β*
Autism severity	**5.5**	**.020**	1.9	.076	-1.1
Expressive communication	**7.7**	**.006**	1.9	.076	0.6
Receptive vocabulary	0.4	.504	1.9	.076	0.2

Autism severity. Autism severity was significantly related to the amount of coordinated joint engagement. The negative value of the parameter estimate is indicative of a negative relationship, such that students with higher scores on the SRS (i.e., more severe autism symptoms) tend to have lower durations of coordinated joint engagement in the classroom. The parameter estimate shows that students who score one point higher on the SRS would have at estimated difference of -1.1 seconds in coordinated joint engagement. Thus, students who score one standard deviation higher on the SRS (i.e., 10 points) would have an estimated difference of 11 fewer seconds of coordinated joint engagement during a 5-minute (300 second) observation.

Expressive Communication. The expressive communication scores were also significantly related to coordinated joint engagement. Based on the parameter estimate,

students who scored 1 point higher on the expressive communication would have an estimated difference of 0.6 seconds of coordinated joint engagement during the 300-second observation of student engagement in the classroom. Thus, for each additional contact gesture or distal gesture in behavior regulation with eye contact and vocalization, a student would have an estimated 1.8 or 2.4 more seconds of coordinated joint engagement, respectively. Students who were scored for one additional contact gesture or distal gesture for joint attention with eye contact and vocalizations would have an estimated 3 and 3.6 more seconds of coordinated joint engagement, respectively.

Receptive Vocabulary. Based on the results from the mixed level modeling, receptive vocabulary was not significantly related to the coordinated joint engagement of students during classroom instruction. As would be expected based on the non-significant result, the parameter estimate was very low.

Consistency of Joint Engagement

Finally, the third research aim examined the consistency of the measure of student joint engagement. For these analyses, coordinated joint engagement was entered as the dependent variable and student was entered as a random effect. The classroom was not entered as a fixed effect because the purpose of the research question was to examine the consistency of joint engagement in students independent of any other factors. The analyses were conducted with all of the observations, and then separately for the individual, small group, and large group observations (see Table 4.11). This statistical procedure is the mixed level modeling equivalent of computing correlations across the observations. The student effect was significant for the analyses that included all of the observations. In the follow-up analyses, the student effect was significant for the

individual observations. Using the *p*-values for the Bonferroni-Holm correction (.017, .025, and .05), the student effect was not significant for the small or large group observations (Holm, 1979). Notably, there were only 18 small group observations and only 5 students with two observations in small group settings.

Table 4.11. Consistency of coordinated joint engagement by group context using co-variance ratios.

	Student effect		Covariance parameters		
Context	Wald Z	*p*	Residual	Intercept	% of variance within student
All	**2.0**	**.042**	4282.9	1053.0	19.7%
Individual	**3.0**	**.002**	1312.7	5899.4	81.8%
Small group	1.8	.072	1288.6	2525.1	66.2%
Large group	2.1	.037	460.8	275.9	37.5%

When examining the covariance parameters, the intercept is the amount of variance within student and the residual is the amount of variance among students. Therefore, the ratio of the intercept to the sum of the residual and the intercept is the proportion of the variance accounted for within student out of the total variance. The percentages of within student variance differed systematically by group context; overall within student variance was the highest for individual sessions and the lowest for large group sessions (See Table 4.11). When examining all of the observations together (individual, small group, and large group), just under 20% of the variance was accounted for at the level of the student.

Summary

In the current study, the coordinated joint engagement of students with ASD during academic instruction was associated with group size and teachers' use of student-

directed practices during instruction. In addition to classroom ecological features, two student characteristics were related to classroom engagement, autism severity and expressive communication. However, students' receptive vocabulary skills were not related to their engagement in the classroom. There were also no significant associations of teacher interaction style and teacher report of burnout with students' engagement in the classroom. Finally, students' demonstration of coordinated joint engagement is strongly correlated in individual sessions but more limited in consistency in larger group settings and across all settings.

CHAPTER 5

DISCUSSION

This study sought to address several key gaps in the literature related to classroom engagement of elementary and middle school students with ASD. The research aims were to examine (1) the relationship of joint engagement with classroom ecological features, (2) the relationship of joint engagement with student characteristics, and (3) the consistency of joint engagement in students across repeated measures. The results from the descriptive statistics and mixed level models will be discussed in relation to educational practices and policies, and future research.

Engagement in the Classroom

Given that active engagement is a critical component of effective interventions for students with ASD (National Research Council, 2001), it is important to examine the amount of time students spend actively engaged during classroom instruction. This study was unique compared to other research related to engagement in school-aged children with ASD because it examined joint engagement, which highlights the social nature of classroom engagement. Additionally, the coding system used continuous coding which captures the duration of states of engagement, in contrast to previous studies that used various types of interval coding. Overall, the students were actively engaged around 40% of the time, and were in states of passive or non-engagement for around 60% of the time. This was similar to studies of elementary school students with significant disabilities that looked at academic responding, in which the students were engaged around 36% (Logan

et al., 1997) and 30% (McDonnell et al., 1998) of the time. In preschool students with ASD, one study found that active engagement was around 45% during structured activities and 56% during unstructured activities in special education classrooms (Wong & Kasari, 2012). Another study of preschool children with ASD in self-contained settings found that students were actively engaged over 65% of the time (Kishida & Kemp, 2009), which is notably higher than the current study. Given that active engagement is higher in both of these studies, it is possible that the structure (e.g., activity centers) and instruction and expectations (e.g., play-based instruction) of classrooms during the preschool years promote more active engagement. It is important to consider how elementary and middle school classrooms serving students with ASD can include more learning opportunities that promote active engagement.

Descriptively, it is interesting to note that there was very little object, person, and supported joint engagement in the small group and large group instructional settings in the current study. Object engagement was more common in one-to-one settings when students generally had greater access to instructional materials, but person engagement was still very rare even in the one-to-one sessions. The limited person engagement may be reflective of the fact that observations were conducted during academic instruction, and thus often included the use of academic materials which could elicit more joint engagement. Nevertheless, given the limited social-communication abilities of many of the student participants and the importance of dyadic interactions for achieving higher levels of communication (Bakeman & Adamson, 1984), these person interactions may still be valuable for this population of students.

Finally, although much of the focus was on the mean duration of engagement states across the 147 student observations, it is important to note that there was a great amount of variability in the amount of time spent in various engagement states across students. For example, when summing the engagement states across all six observations, students ranged from a low of 19 seconds to a high of 15 minutes and 22 seconds in coordinated joint engagement over the 30 minutes of observation. Across all observations, active engagement ranged from a low of around 6 minutes to a high of around 21 minutes. These descriptive data help to begin to characterize the engagement during academic instruction for elementary and middle school students with ASD receiving services in self-contained classrooms.

Engagement and Classroom Ecological Variables

Addressing the first aim, the findings of this study provide support for the relationships between classroom ecological factors and student engagement. Classroom ecological variables have been linked to engagement in studies focused on academic responding and on-task behavior, but no previously published studies have examined the relationship of joint engagement with classroom ecological variables in elementary and middle school students. The hypothesis that student engagement would be significantly related to group size was supported, with larger group sizes associated with lower levels of coordinated joint engagement. This is similar to other studies that examined academic responses in elementary students with severe disabilities, which also found lower levels of engagement in larger group settings (Logan et al., 1997; McDonnell et al., 1998). Interestingly, one study found small group settings (dyads and triads), rather than individual or large group instruction, to be optimal settings for engagement for four

students with ASD (Ruble & Robson, 2007). Since the current study used mixed level modeling, it is not possible to look at non-linear relationships or assess optimal group size. However, based on visual analysis, there did not appear to be a non-linear relationship between engagement and group size.

The large, negative parameter estimate indicated an inverse relationship between engagement and group size with an estimated 16 second decrease in coordinated joint engagement during a 5-minute observation for each student added to the number of students in the group. When considered at the level of a school day, the differences could be quite large. For example, if a student has four hours of instructional time (240 minutes), this would result in almost 13 fewer minutes of time in coordinated joint attention for each student added to the instructional grouping over those 4 hours of instruction. Looked at in a different way, a student in a classroom of eight students would spend an estimated 11 additional minutes in coordinated joint engagement during an individual session compared to a whole class session during a 30-minute instructional period.

Notably, the descriptive statistics showed that the amount of time spent in the different levels of engagement differed greatly by instructional groupings. In the large group instruction, students spent an average of approximately 54% of their time unengaged, compared to only 20% of their time unengaged during one-to-one instruction. Anecdotally, students were often looking around the classroom or engaging in repetitive or stereotyped motor behaviors during periods of unengaged behaviors. Students also engaged in maladaptive behaviors at times. Students had some level of active engagement (i.e., object, person, supported joint, or coordinated joint) for 21% and 37%

in large and small group instruction, but around 75% during one-to-one sessions. Logan and colleagues noted similar differences between whole class and one-to-one instruction for students with moderate to profound disabilities in general educational settings, though the students had nearly equal amounts of academic engagement in small group and one-to-one instruction (Logan et al., 1997). In contrast, another study that examined academic engagement of students with severe disabilities in general education classrooms reported similar levels of engagement across large group, small group, and one-to-one instruction, with averages between 28 and 30% across instructional groupings (McDonnell et al., 1998). One important consideration when examining engagement across group sizes is the student-teacher ratio, as well as the amount and type of support the teachers are providing. This was not examined in previous studies and was not formally analyzed in the current study. From informal classroom observations in the current study, there were often several adults present during large group instruction, but the instructional involvement of those adults varied greatly between classrooms and even individual observations. For example, some of the teaching assistants helped support the students' engagement throughout the session, providing prompts related to academic materials or engaging other students as the teacher focused on a target student. In contrast, other teaching assistants' supports were related almost exclusively to behavior such as appropriately sitting at the table or reducing maladaptive behaviors. Based on the results, group size has a significant impact on students' duration of coordinated joint engagement during academic instruction, but further exploration of the impact of student-teacher ratios and involvement of teaching assistants is warranted.

The hypothesis that student engagement would be positively associated with teachers' use of student-directed practices during activities was also supported by the data. The student-directed practices measure focused on students' access to materials, students' interest in materials, teachers' adaptations of activities and tasks for the individual students, and response requirements during the activity (see Appendix D for measure). Based on the parameter estimate, there would be an estimated 18 second increase in coordinated joint engagement over a 300-second observation for a one point difference in student-directed practices. This translates to an increase of 6% of the proportion of time spent in coordinated joint engagement with each additional point on the rating scale for student-directed practices. However, it is important to note that the measure is a composite of several different student-directed instructional practices, and it is unclear if some of these practices may have more of an influence on engagement than other practices. Future research should examine the impact of specific practices.

There were no significant findings for the hypotheses that student engagement would be positively associated with positive teacher interaction styles in the classroom and inversely associated with teacher report of job burnout. Due to the low number of classrooms in the study and the limited number of students in each classroom, the power to detect significant differences for either of these variables was very limited.

Teacher interaction style was assessed across three different settings for 20-minutes in each setting. This measure was collected very early in the data collection process at each school. This situation raises the possibility of a Hawthorne effect, in which teachers performed differently due to the observers in the classroom. For the current study, the interaction styles were assessed at the classroom level. Based on

informal observations, teachers did appear to interact differently across students, so it may be useful to assess teacher interaction with specific students. Studies reporting significant results related to adult interaction style have generally used different methods than the current study. Some studies have used adults with intentionally disparate styles of interaction (Mirenda & Donnellan, 1986) or have coached adults as confederates to use specific interaction styles (Lussier et al., 1994). Other studies have gathered more detailed information, recording specific interactive behaviors rather than using global ratings of interaction (Girolametto, Hoaken, et al., 2000; Girolametto & Weitzman, 2002; Girolametto, Weitzman, et al., 2000; McWilliam et al., 2003). Therefore, it may also be important to measure discrete behaviors in future studies.

The teacher burnout was measured using a self-report tool. The researcher made the decision to collect this information at the end of the data collection process to ensure that the rating did not unintentionally or subconsciously impact teachers' behaviors during the study. However, this also may have resulted in less honest responses in some cases, given that the researcher had become more familiar with the teachers over the course of the study. Based on the informal observations of the researcher, some of the most enthusiastic teachers reported the highest levels of exhaustion; whereas teachers who seemed more frustrated or negative often scored low on the emotional exhaustion scale. In future studies, it may be valuable to either distribute this Maslach Burnout Inventory –Educator Survey at the beginning of data collection or include additional measures that may also tap into teacher burnout, or a related variable such as social-emotional competence of the teacher or classroom climate.

In sum, the current study suggests group size and the use of student-directed practices are significantly related to students' joint engagement during academic instruction. The parameter estimates point to relationships with a great deal of practical significance, since relatively small changes in group size and student-directed practices are estimated to result in rather large differences in coordinated joint engagement. Both teacher interaction style and teacher report of burnout were not found to be significantly associated with student engagement in the current study.

Engagement and Student Characteristics

The second research aim was to examine the relationship between student engagement in the classroom setting and three student characteristics: autism severity, expressive communication, and receptive vocabulary. As hypothesized, student engagement in the classroom was significantly associated with autism severity, as measured by parent or teacher report on the Social Responsiveness Scale (SRS). The negative relationship indicates that lower levels of coordinated joint engagement are associated with higher levels of autism severity. Although this is the first study to examine autism severity in relation to engagement, the results are consistent with a study that found classroom engagement to be negatively related to the severity of intellectual disability of a student (Logan et al., 1997). The relationship in the current study was statistically significant, but the parameter estimate is rather small, with an estimated decrease of 1 second in coordinated joint engagement for every additional point on the SRS T-score. Thus, across the range of T-scores for the sample in this study, the T-score of the student with the highest (most severe) SRS score would be estimated to be associated with a total decrease of 52 seconds in coordinated joint engagement compared

to the study with the lowest SRS score. One interpretation of this finding is that autism severity has only a small, albeit significant, association with students' coordinated joint engagement. Another possibility is that the SRS may not be a particularly informative tool when considering engagement in the classroom setting.

Related to this second possibility, one major concern is the inconsistency in parent and teacher report. Although there are separate established norms for parents and teachers, and the appropriate normative data were used when calculating the T-scores, the researcher noted some scores that seemed odd based on behavioral observation of the students. For example, one of the most social students in the study actually received the highest score (i.e., most severe score) on the SRS based on parent report. Although some studies on the SRS found teacher and parent ratings to be correlated (Constantino et al., 2003), more recent studies have noted inconsistencies between parent and teacher ratings (Kanne, Abbacchi, & Constantino, 2009). In future studies, it may be helpful to either have the teachers complete the SRS to help with informant consistency or to use a measure for autism severity that is less subjective. Few tools to assess severity of ASD are available, especially for students in this age group and range of functioning, and each has some potential limitations. For example, the Autism Diagnostic Observation Schedule (Lord et al., 1999) has a severity metric (Gotham, Pickles, & Lord, 2009), but it is only on a 10 point scale and may not provide the range of scores needed to detect differences in this population.

The hypothesis that student engagement would be positively associated with level of expressive communication was supported by the results. Higher scores on the expressive communication assessment were associated with higher amounts of

coordinated joint engagement in the classroom setting. The expressive communication assessment included high-interest activities designed to elicit communicative attempts. Thus, students' communication in the highly motivating context of this assessment may reflect their capacity for social engagement. Other studies in school-aged children with ASD have not examined relationships between engagement and expressive communication or language, although concurrent language abilities have been linked to joint engagement in toddlers with ASD (Adamson et al., 2004). It is important to note that the measure for the current study focused on communication initiations across early communication functions, and did not tap into aspects of expressive language such as vocabulary or grammar.

Despite the significant results, the parameter estimate for expressive communication and engagement was low with an estimated difference of 0.6 seconds for each point on the expressive communication score. The standard deviation on the expressive communication measure was 36.3 points. So, a one standard deviation difference in scores as measured in this group of students would result in an estimated difference of around 22 seconds in coordinated joint engagement over a 5-minute observation block. Therefore, a student who scores one standard deviation higher than another student would have an estimated 7% difference (i.e., 22 seconds) in the percentage of time spent in coordinated joint engagement. Another way to look at this is by considering individual gestures. The highest possible score for a single gesture is six points (e.g., distal point for joint attention with eye contact and vocalizations), which would create an estimated difference of 3.6 seconds, or a little over 1% of the total observation time. So, even if a student exhibited five additional gestures at the highest

point total, there would be an estimated 18-second, or 6%, difference in the amount of coordinated joint engagement over the course of a 5-minute observation. In sum, the relationship between joint engagement and expressive communication is statistically significant, but the magnitude of the relationship may have somewhat limited clinical significance.

Student engagement was not significantly associated with receptive vocabulary skills as measured by the Peabody Picture Vocabulary Test – 4th edition (PPVT-4). One potential problem was the rather limited range of abilities for receptive vocabulary, aside from a few students. The PPVT-4 is designed for use across a wide range of ages, and has been used as a measure in many studies of school-aged individuals with significant cognitive disabilities. However, nearly 60% of the students in this study had a standard score of 20, and 40% of the students had age-equivalents of less than 24 months, which represent the floor of the assessment for each of the metrics. The researcher elected to use raw scores in order to supply a larger range of scores, but this tool still may not have been sensitive enough to capture differences among the students. Another possible explanation is that receptive vocabulary is not associated with engagement in school-age students. Based on informal observations, there were certainly students with higher language abilities who struggled with classroom engagement, so this latter explanation is a realistic possibility.

The PPVT-4 has been found to correlate highly with cognitive ability (Liss et al., 2001; McCulloch & Joshi, 2001). Other studies that have examined the engagement of students with disabilities found the level of cognitive impairment to be associated with classroom engagement (Logan et al., 1997). If the receptive vocabulary is considered a

proxy for cognitive ability, and engagement is not associated with receptive vocabulary in this population of students, then it is possible that cognitive abilities would not be indicative of the likelihood of coordinated joint engagement in the classroom in this population.

Based on results from this study, coordinated joint engagement appears to be related to some student characteristics. Autism severity and expressive communication are associated with students' joint engagement during classroom instruction across different group settings, but receptive vocabulary was not significantly related to classroom engagement. The magnitudes of the associations with autism severity and expressive communication are not particularly strong, but it may be useful to examine the relationships of these variables within a narrower context, such as focusing on student engagement in only individual or large group sessions. One of the ultimate goals of this line of research is to identify different profiles of students with ASD and understand how these profiles may impact educational needs and outcomes for these students. Determining the associations between student engagement in the classrooms and student profiles is a helpful starting point in this quest.

Stability of Engagement

The final research aim was to evaluate the consistency or stability of the measurement of joint engagement of students with ASD on the 5-minute observations both within a specific group setting (individual, small group, large group) and across all observations. The hypotheses that student engagement would be strongly related within group settings and moderately related across group settings were partially confirmed. When looking at the percent of variance accounted for at the student level across all

observations, the random student effect was significant; however, based on the covariance parameters only 20% of the variance was accounted for at the student level. The follow-up tests revealed a pattern across the individual, small group, and large group settings, with the highest percent of variance accounted for at the student level in individual sessions and the lowest percent of variance in the large group sessions. However, with the Bonferroni-Holm correction, the student effect was only significant for the individual setting. The mixed level modeling procedures used for these analyses function as intraclass correlation calculations, because the analyses focus on the ratio of within participant variance to total variance. The correlations between observations were strong for individual and small group settings with ICCs of .80 and .70 respectively, but only moderate for large group settings with an ICC of .39. All of the students had two large group observations and 24 of the 25 students had two individual observations; however, only 5 students had two observations in a small group setting so those results should be interpreted very cautiously. In sum, there is a significant student effect across all settings, but the repeated measures of student engagement are most consistent in the individual setting.

Limitations

There were several notable limitations of the current study. First, the sample size was relatively small with only 25 student participants and 8 teacher participants. This impacted the power for detecting significant associations, especially for the classroom level variables of teacher interaction style and teacher burnout. Additionally, since the analyses used classrooms as a fixed effect, this study can only make claims about these

specific classrooms. However, it is important to note that the classrooms were from three different school districts and were a rather diverse sample.

Second, several of the measures were either adapted or created for the purposes of the current study. The administration for the expressive communication assessment was adapted from two other assessments. The coding system for this assessment was also adapted from a different study. The researcher made the decision to measure expressive communication in this way due to the lack of established assessments that could provide information about non-verbal and verbal communication abilities for students with limited expressive language at older chronological ages. Despite some support for the utility of the assessment based on the significant correlations between the expressive communication scores on this assessment and coordinated engagement, many aspects of students' expressive communication were not captured, and those unmeasured aspects may be associated with variability in coordinated joint engagement. The four-item student-directed practices tool also was created for the purposes of this project. Similar to the expressive communication measure, after extensive reviews of the literature, no tools were identified to assess student-directed practices for this population of students appropriate for the study design. Thus, the researcher developed the tool based on existing research and had several professionals familiar with classroom practices informally review the tool. Given these tools were adapted or created for this study, no information on the validity of the expressive communication measure or the student-directed practices measure for this population of students exists beyond the indirect evidence in this study from the findings that they were related in the predicted directions to student engagement.

Also related to measurement, there were a few issues with the standardized measures for autism severity (SRS) and receptive vocabulary (PPVT-4). Several students' parents did not complete the SRS; thus, the teacher scores were used for four students resulting in inconsistent use of parent versus teacher report across participants. Since the study was small, all scores were included in the analyses to maintain as much power as possible. Additionally, based on the overall ability of students in the study, the raw scores were used for the PPVT-4. Ten of the raw scores fell below the age-equivalent of 24 months, which is below the range of this measure, so those scores may not be valid. Additionally, one student was given the assessment in Spanish based on teacher recommendations. So, the scores for receptive vocabulary may have some validity issues.

Finally, the primary researcher served as the coder and assessor for all of the measures utilized in the study, potentially introducing some bias into the study. Countering this possible limitation, estimates of inter-observer reliability between the primary researcher and observers who were blind to the hypotheses of the study were acceptable for engagement, student-directed practices, group size, and expressive communication. Consensus coding was used for teacher interaction styles, which likely attenuated the potential for bias. Additionally, many of the independent variables did not have significant relationships with joint engagement. In sum, the potential for biases was addressed to the greatest degree possible within the constraints of this study.

Implications

Despite these limitations, the study offers valuable information for educational practices and policies, as well as future research related to students with ASD. Although experts have emphasized active engagement of students with ASD, the descriptive

information indicates that the students in this study were actively engaged only about 40% of the time. If considered over the course of a standard school week, these students may be actively engaged approximately 12 hours out of a 30 hour school week. Moreover, the observations were conducted during academic instruction, excluding times such as lunch, recess, arrival, and dismissal, so this average of 40% active engagement may actually overestimate student engagement. Additionally, Ruble and Robson found that even when students with ASD exhibit compliance in their engagement, their behavior may not be congruent with what is expected during a given educational activity (Ruble & Robson, 2007). This suggests that even during times of engagement, students with ASD may not be accessing learning opportunities in the same way as their peers. It is important to continue to seek ways to improve and increase the engagement of students with ASD in classroom settings.

An encouraging finding was the large impact of classroom ecological factors such as group size and student-directed practices on engagement. Given these factors are related to teacher behaviors and instructional strategies, there is great potential for change. This change could be accomplished through professional development to inform and coach educators in strategies and allocation of resources that support student engagement. First, it is important to work with teachers to improve their understanding and use of strategies that promote active engagement. Training could be provided on the use of materials, for example interactive stories, which have been found to improve engagement in elementary school students with ASD (Carnahan et al., 2009). This move towards teaching strategies that promote more active engagement is not unique to ASD or

special education, so it may be possible to draw from research on students of other ages, with other disability types, or from general education.

Second, it is important to devote resources towards the paraprofessionals working with students with ASD. Months of observations in these classrooms revealed stark differences in the roles of paraprofessional. In some classrooms, the paraprofessionals were used as co-teachers, running small groups or providing clear instructional support during whole class sessions. In other classrooms, the paraprofessionals took on a more passive role, with limited interaction with students outside of behavioral prompts and discipline. Thus, a more favorable student-teacher ratio does not necessarily translate to more instructional support. Previous research has acknowledged the difficulty of preparing paraprofessionals to work with students with disabilities (Giangreco, Suter, & Doyle, 2010). The paraprofessionals may have limited training related to students with ASD and evidence-based practices. Given the unique and complex learning needs of students with ASD, offering continuing education to paraprofessionals working with this population is important. In special education, the paraprofessionals have the potential to serve a major role in promoting active engagement through the provision of student-directed practices. However, researchers, educators, and policymakers must continue to work together to find solutions to the challenges of personnel preparation for paraprofessionals.

The student characteristics of autism severity and expressive communication were related to joint engagement. These characteristics may be important to examine when considering the level of supports and types of strategies students need to achieve joint engagement in the classroom setting. However, some students did not fit this pattern. For

example, the student who had the second lowest score on the expressive communication assessment was within the top third of students for coordinated joint engagement during individual sessions. This student, who exhibits a high engagement-low communication profile, may need more intensive instruction targeting early forms and functions of communication, since it seems that he actively participates in the classroom but may not be initiating communication that would elicit additional learning opportunities. Continuing to assess and explore student profiles can help to determine relative strengths and weaknesses when establishing intervention goals and strategies for school-age students with ASD.

A somewhat unexpected finding was the lack of relationship between student engagement in the classroom setting and receptive vocabulary ability. Student placements often seem to be based largely on cognitive abilities. Students who are accessing alternative curriculum may be placed in more restrictive settings, whereas students who have higher cognitive abilities may be placed in general education classrooms. However, it may also be important to examine closely examine student engagement. For example, students who exhibit high levels of engagement despite having more limited cognitive skills may do well in less restrictive settings. Likewise, students who have high academic skills levels but struggle with engagement may need more support for successful inclusion in general education classrooms.

Although the findings in this study speak to variables associated with coordinated joint engagement among students with ASD in their classrooms, neither this coding system or other engagement coding systems provide information about the quality of learning opportunities to which the students are being exposed. For example, a student

may engage in a coordinated way with the teacher when asked a question with only one response option. But these types of learning opportunities, while offering opportunities for high level engagement, do not necessarily promote progress in academic or adaptive skills. Based on observations in these classrooms and my own experiences, students with ASD in self-contained classrooms often participate in activities in independent work, individual instruction, and group instruction which are rote and repetitive without much opportunity for new learning. Although these activities may promote some level of active engagement, it is important to acknowledge that active engagement does not always reflect the learning opportunities presented to students. Therefore, future studies should consider the quality of learning opportunities alongside the students' engagement during classroom activities.

Finally, this study has methodological implications for school-based research on student engagement, especially related to the measurement of joint engagement among students with ASD. With increased restrictiveness in school and research policies, videotaping in classroom settings is becoming more difficult. When measuring behaviors of students or teachers in authentic educational settings for research purposes, live coding is becoming more of a necessity than a choice. Overall, the coding system holds promise for use in research with older students with ASD in educational settings. If engagement is to be assessed or monitored regularly by educators in the classroom setting, however, the coding system likely would need to be simplified. Researchers could use strategies similar to those of Casey and McWilliam (2007) who developed a method for professionals in childcare settings to rapidly assess engagement across activities and settings. Engagement is a critical consideration in the education of students with ASD

and the results offer a starting point for moving forward in educational practices, policies, and research.

Future Research Directions

The results of this study build on existing evidence on classroom engagement in school-aged children with ASD with findings that smaller group sizes and student-directed practices impacted student joint engagement, aligning with and extending previous research that related similar classroom ecological features to on-task behaviors and academic responding among a similar population of students (Kamps et al., 1991). This line of research can be expanded in several ways, including evaluating methods for measuring engagement in school-aged students with ASD, assessing the effect of specific student-directed instructional practices, examining the impact of teacher interaction using a more highly-resolved tool, and exploring student profiles related to engagement.

Since this was the first study to use live joint engagement coding in elementary and middle school classroom serving children with ASD, using the coding system across more classrooms, students, and coders will be valuable in evaluating the measurement characteristics of this tool. It is important to further examine the stability of the measure and establish data collection procedures to optimize that stability. For example, how much should the student be observed (e.g., number and length of observations) or what setting characteristics should be held constant (e.g., interaction partner, group size, subject matter) to ensure a valid assessment of joint engagement. Assessing the tool's capacity for detecting change would also be valuable. This could be accomplished in the context of single-case design studies of interventions designed to promote engagement in students with ASD. Finally, previous studies have examined both global and observed

engagement (de Kruif & McWilliam, 1999), noting differences between a general impression of student engagement and engagement performance within a specific setting or activity. It would be helpful to have a global joint engagement scale that can assess students' broad capacity for engagement to help evaluate the environmental matches or mismatches for particular students.

Another area for future research is in the area of student-directed practices. Exploring the data from the current study to see if individual items seemed more strongly related to student engagement may be a helpful first step. Additionally, researchers should consider single-case design studies to explore causal relations between specific strategies and student engagement. Although this was partially addressed in previous research (Kamps et al., 1991), many of the single-case studies assessed the impact of multiple instructional strategies implemented concurrently, such that conclusions about the causal relation between any one strategy and engagement could not be reached. One possibility is to conduct multiple-baseline designs with phases to examine additive impacts of specific strategies. Finally, some existing research has examined the impact of specific strategies on engagement for students with ASD, for example, interactive reading (Carnahan et al., 2009) and cooperative learning groups (Dugan et al., 1995). It would be valuable to pursue a similar line of studies to look at other strategies, such as the inclusion of perseverative interests or the use of screen technology.

The lack of evidence for a relationship between teacher interaction style and student engagement in the current study warrants further examination for several reasons. First, the design was underpowered, so expanding the study to a larger number of classrooms and teachers is necessary in order to reach a more confident conclusion

regarding the presence or absence of a relationship. Second, the level of specificity in the Caregiver Interaction Scale, used to measure teacher interaction style, may be insufficient to address this question. Using a more highly-resolved measurement system, such as a tool that records the frequency of responsive or directive strategies, might be helpful. These tools have been used in research with younger students (Girolametto, Hoaken, et al., 2000; Girolametto & Weitzman, 2002; Girolametto, Weitzman, et al., 2000) but it will be necessary to consider adaptations needed for research in elementary and middle school settings.

Additionally, researchers should look at teacher interactions and student engagement in this population of students using ecological systems theory. For example, utilizing sequential analysis to code teacher behaviors and student engagement could be useful in determining specific teacher behaviors that are more often associated with higher or lower levels of engagement. Also, it would be valuable to look at longitudinal analysis of engagement to determine if the quality or quantity of interactions between teachers and students lead to changes in engagement over the course of a school year for this population of students. Future studies could use these types of designs to explore transactional relationships, or the proximal processes, effect student engagement with students with the most significant needs.

Finally, little is known about more specific profiles of students within the population of school-aged students with ASD with significant learning needs. The potential for non-responders in interventions seems particularly problematic in this population, and examining more detailed profiles may be helpful in individualizing approaches for interventions. A large study that assessed student characteristics such as

engagement, cognitive ability, receptive and expressive language skills, autism severity, and sensory and attentional characteristics in students with ASD with significant learning needs is an important step in considering educational environments and strategies that will maximize active engagement in the classroom for these students.

Summary

The results of this study suggest that both student characteristics and classroom ecological features are associated with the joint engagement of students with ASD being served in self-contained elementary and middle school classrooms. This is consistent with ecological systems theory, which suggests that student outcomes are influenced by students, their environment, and interactions with the environment. The results provide a great starting point for future research in measurement, intervention, and educational environments. Additionally, the results of this study and future related studies have implications for educational policies and practices, as well as professional development for special educators. It is critical for researchers to continue to study engagement in students with ASD in order to identify effective intervention strategies and ensure optimal outcomes for these individuals.

Appendix A. Expressive communication assessment.

Semi-structured Assessment for Expressive Communication

The examiner and child will be seated at the corner of the table, so that they are at a 90 degree angle from one another. Each of the following tasks will take approximately 3 to 5 minutes. In general, the goal of each task is for the child to initiate some form of communication. The examiner should wait and allow sufficient time for child initiations. If the child does not initiate, the examiner will move through a prompt hierarchy that may include positional, environmental, gestural, and verbal prompts.

Task	**Materials**	**Description**
Coloring	• Marker box • Paper • Markers • Decorative cylinder	The examiner places a box of markers between self and child. The examiner and child draw with markers. After a little while, the examiner takes a new marker from the box while at the same time placing a humorously-decorated plastic cylinder in the marker box and offers the box to the child. Give the child ***up to three opportunities*** to notice the unusual item in the box. This is achieved by having the child retrieve a new marker from the box three times during this activity. Provide prompts as needed.
Tops/Spinners	• Set of tops or helicopter spinners	The examiner will demonstrate play with tops/spinners that wind-up, release and spin. The examiner will establish a routine (e.g., "ready, set, go") to try to get the child to request. Then, the examiner will give the materials to the child, and wait to see if the child needs help to operate the tops/spinners. Give the child ***multiple opportunities over the course of 4-5 minutes***. Provide prompts as needed.
Reading	• Books and magazines with altered pages	The examiner brings out several books or magazines and offers them to the child. The child chooses one book to look at together with the examiner. Each book has four pages altered (scribbles on a page, an upside-down page, a torn page and a blank page). Let the child take the lead on looking through the book. If the child flips through the book quickly, the examiner can help the child to turn the pages one at a time. Provide prompts as needed.

Task	Materials	Description
Bubbles	• Bubble solution • Tray • Bubble gun	While the child is given a 2nd book to look at as a distraction, the examiner uses the bubble gun to blow bubbles near the child. ***Wait*** to see if the child initiates communication, and if not, ***repeat*** again. Next, the examiner ***places the bubble gun in front of the child, but maintains control of the bubble solution*** to see if the child will initiate communication to access the bubble solution. Continue the activity for ***4-5 minutes***. Provide prompts as needed.
Switch-activated or remote control toy	• Switch-activated or remote control toy	The examiner hands the child a distracter toy. The examiner reaches down to the activity box and *activates a toy* positioned at a 45 degree angle to the child. ***Pause 10 seconds, then activate the toy again*** to give the child a second opportunity to initiate communication if needed. Once the child notices the toy, ***wait to see if the child will request*** to play with the item. Provide prompts as needed.
Balloon	• Several balloons	The examiner dramatically ***blows up a balloon, and then counts to 3 and lets the balloon go*** so that it flies around the room. The examiner retrieves the balloon and ***repeats*** the balloon task. Once this has been done twice, ***wait to see if the child will retrieve the balloon and request*** the routine again. Continue the routine for ***4-5 minutes***. Provide prompts as needed.
Ball track	• Ball track • 3-4 balls that fit • 1-2 balls that do not fit	Position the ball track so the ball ends on the examiner's side of the table. The examiner ***hands the child several balls*** that can roll down the ball track, with the examiner collecting the ball each time. After several attempts, the examiner ***hands the child the balls that do not fit on the track***. Wait to see if the child notices and points out the ball that does not fit. Provide ***at least three opportunities.*** Provide prompts as needed.
Snack	• Two types of snack • Two containers • Napkin or plate	The examiner places small portion of each of the two snacks on a napkin or plate in front of the child. The remainder of each of the snacks will be in two sealed containers. The examiner will ***wait for the child to request*** the snack. If the child does not request the snack, ***move the containers around to make noise and wait again***. Continue snack for ***4-5 minutes***. Provide prompts as needed.

Appendix B. Social-Communication Coding Manual.

Social-Communication Coding Manual

Adapted for dissertation of Jessica Dykstra

Introduction

Purpose

The purpose of the coding system is to measure initiations of social-communication behaviors in children with autism.

Overview

The coding system was created to be utilized with an expressive communication measure adapted from the Autism Diagnostic Observation Scale (ADOS, Lord et al., 1999) and the Joint Attention Protocol (Watson et al., DATE). Coders will watch videos of children participating in the assessment, and code for targeted social communication behaviors.

Behavioral Categories

The behaviors occur in 3 large categories of social communication behaviors: social interaction, behavior regulation, and joint attention. See below for the specific behaviors within each category.

Initiation of **Social Interaction**	Initiation of **Behavior Regulation**	Initiation of **Joint Attention**
Watches closely	Reaches	3-point gaze
Shows wanting to continue	Contact gestures	Gives
Initiates game/ routine	Points	Shows
Expands game/ routine	Other BR gestures	Touch point
	Vocalizations/Verbalizations	Distal point
		Other JA gestures
		Vocalizations/Verbalizations

Coding Procedures

These are general instructions regarding the coding procedures:

1) Review the definitions of social-communication behaviors prior to coding.

2) All video coding must be completed within HIPAA and Human Subjects Protection guidelines.

3) Code from the start to the end of the video recording of each assessment.

4) Any given segment of a video should not be viewed more than three times when scoring one particular behavior.

General Rules

These are general rules for coding that apply across multiple categories:

1) IDENTIFYING BEHAVIORS. When coding a behavior, first consider the purpose of the communication – social interaction, behavior regulation, or joint attention. If the behavior serves one of the three targeted communicative functions, then determine if it meets the definition for one of the specific behaviors listed under the broad category.

2) BE CONSERVATIVE. If it is not clear that the communicative behavior is a higher level behavior, score as the lower level behavior (see examples below).

LOW	HIGH
Behavior regulation	Joint attention
Reach	Point
Shows wanting game/routine to continue	Initiates game/routine

Behavior regulation and joint attention may be especially difficult to differentiate.

Tips: If (1) an object is within reach, (2) the activity is still in progress, OR (3) the child has demonstrated that s/he has the ability to operate the object, it may be *joint attention*.

3) EYE CONTACT. Coding eye contact or directed gaze during video coding can be difficult. As such, there are three indications for eye contact: eye contact (EC), no eye contact (No), and not codeable (NC). It is important to be certain that the gaze is directed towards the communication partner's face, and not an object that is near the face. Below are some guidelines.
    a. Only code "eye contact" if at least some part of the communication partner's head/face is in camera view and object is away from the face. You may code "eye contact" even if adult is not looking.
    b. Code "not codeable" if

i. the head/face of the communication partner is off camera
ii. it is not possible to see if the child is looking at the face or the object
iii. the communication partner is moving or talking in a way that may draw the child's attention

c. Code "no eye contact" when the child is not making eye contact

4) VOCALIZATIONS VS. VERBALIZATIONS. Check vocalizations if the production is a sound. Check verbalizations if the production is a word or phrase, even if the word or phrase is not completely intelligible.

5) BEHAVIORS DIRECTED OFF-CAMERA. In video-coding, there may be reaches, points, or other gestures directed at objects, people, or events that are off-camera. If the child or adult verbalizes what they are referencing, or if the object or person comes into the view of the camera, use that modifier. However, if it is unclear what the child is referencing, use the "other" category in modifiers.

Operational Definitions of Social-Communication Behaviors

There are three broad categories for initiations of social communication: social interaction, requesting, and joint attention. Each broad category is defined, followed by descriptions of the specific behaviors under each category. Remember, behaviors must first meet the definition for a broad category before determining the specific behavior for coding.

Initiation of Social Interaction

Definition: Child communicates to get attention, or to maintain or initiate involvement in an activity.

The general idea of social interaction is that the child is engaged and enjoying the face-to-face, back and forth interaction, and communicates using eye contact, actions, gestures, and/or vocalizations/verbalizations. Social interactions may involve objects, but the main focus is on the interaction with the communication partner. The social interaction category includes four sub-categories.

Note: social interaction is not specifically elicited within this assessment, so be very conservative when coding in this category.

Watches closely: The child and adult are engaged in a face-to-face interaction and the child watches the adult for at least 2-seconds in anticipation of the adult's contribution to the interaction. This should only be coded if there is no higher level behavior for initiating social interaction (e.g. shows wanting to continue)

Examples:

- The adult pauses before letting the balloon go. The child watches the adult in anticipation of the adult letting the balloon go.

Non-examples:

- The adult brings out the ball track. The child watches as the adult sets the ball track up. This is not coded because the focus of the child is the toys and not the interaction with the adult.

Shows wanting to continue: The child and adult are engaged in a face-to-face game/routine, the adult pauses, and the child uses some type of action (e.g., gesture) or vocalization (e.g., sounds, words) to indicate that s/he wants the game/routine to continue. If it is in the context of a social game/routine, code as social interaction, not behavior regulation.

Examples:

- The penguin fell off the table, and the adult laughed. The child then sets up the penguin at the edge of the table again and presses the button, laughing as it falls off the table again.

Non-examples:

- The adult has the balloon blown up. He or she says, "Ready, set…" and the child adds, "Go!" This is not coded because the main focus of interaction is on the object. Even though this would be considered behavior regulation, it would not be coded as initiation of behavior regulation because it is prompted by the adult.

Initiates game/routine: The child initiates a face-to-face game/routine. It can be either a new game/routine or a game/routine that has been previously demonstrated during the assessment with at least 30 seconds between the initial demonstration and current initiation.

Examples:

- The child begins to sing a song and looks at the adult to engage the adult in the interaction.
- The child begins a celebratory routine after completing a task, saying "yay" and looking for the adult to join in.

Non-examples:

- After playing a tickle game, the adult says, "Let's play with the toys!" The child moves his hands towards the adult in a tickle motion. This is not coded because there was not an activity between the game and the initiation. Instead, code as *shows wanting to continue*.

Expands game/routine: The child changes a face-to-face game/routine by switching roles, including a different person (e.g., mother, teacher, camera person), or adding new actions or materials within the game/routine.

Examples:

- During the tickle game, the child switches roles and starts tickling the adult.

Non-examples:

- The child and adult are looking at the book. The child starts reading the book. This is not coded because it shows an expansion of activity, but not of social interaction.

Initiation of Behavior Regulation

Definition: The child communicates in order to gain access to an object, get help with an object, get another person to perform an action (with or without an object), or to protest an object or action.

The focus of behavior regulation is on the child communicating to get an object or action that s/he wants or needs or to avoid an object or activity. These communicative attempts will likely occur across many activities such as bubbles, balloon, and snack. The initiation of behavior regulation includes 5 sub-categories.

Regarding Adult Cues:
Initiation of requesting should be carefully considered if the behavior is prompted or cued. If the initiation occurs within 5 seconds of the prompt, do not code the behavior.

- *Following a visual cue* (e.g., an extended hand with an upturned palm and extended fingers prompting a "give" for help): **do not code** because this is considered a prompted behavior.
- *Following a direct verbal cue* (e.g., "Do you need help?", "Show me what you want.", "Should we do it again?"): **do not code** because this is considered a prompted behavior.
- *Following an indirect verbal cue* (e.g., "Hmm.", "Oh no – it's broken."): **code** if the child initiates one of the target behaviors.
- *When the adult draws attention to an object* (e.g., the adult shakes the containers of snacks without giving any other cues): **code** if the child initiates one of the target behaviors.

Reaches: The child uses an open-hand reach or opens and closes his/her hand repetitively to indicate wanting an object. If the reach ends in a grab or the child is attempting to grab the object, do not code the behavior. If the child pauses and retracts his or her hand slightly before reaching again and grabbing, the initial reach can be coded. In order to count a second reach within the same activity, the arm should go back to a neutral position (e.g., down at side of the body, on the table).

Examples:

- The child extends arms toward the container of cookies.
- The child opens and closes hands above head in the direction of the bubble gun.

Non-examples:

- The child reaches arms out to catch and pop bubbles. This is not coded because the child is popping the bubbles, not indicating that he/she wants them.
- The child reaches and grabs the container of cookies. This is not coded because contact was made at the end of the reach.
- The child reaches and then points to an object. This is not coded as a reach, but rather should be coded as a *point* because when two gestures are used within the same behavior, the higher level behavior should be coded.

*Note: if the adult is pulling an object away, carefully consider whether the child is reaching or grabbing

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Contact gestures: The child uses a gesture that include coming into contact with an object or person. This includes pulling/pushing the adult's hand, arm, or other body part towards an object in effort to gain access to the object or perform an action on the object, giving an object to the adult or moves an object towards the adult in order for the adult to perform an action on that object, tapping or banging on an object to indicate a request, or pushing an object away to protest.

Examples:

- The child pulls the adult's hand toward the penguin after it stops moving.
- The child gives the juice box to the adult when s/he isn't able to open it.
- The child taps on the snack container to request a specific snack.
- The child pushes the bubble gun away to indicate s/he is finished.

Non-examples:

- The child pulls adult's fingers aside in order to get a ball. This is not coded because the child is simply moving the adult's hand out of the way, not communicating for the adult to perform at action.
- The adult places his/her open hand in front of the child and the child then gives the balloon the adult. This is not coded because the movement of the adult's open hand in front of the child is considered a prompt.

Points: The child points to an object in order to gain access to that object or points to direct the adult's behavior. The gesture must be an isolated point with a finger or thumb.

Examples:

- Child sees the juice box across the table and points a finger at it.
- The child points and says "Go that way."

Non-examples:

- Child extends arm toward the bubble gun. This is not coded because the child did not make an isolated finger point. Instead, code as *reach* under *initiation of behavior regulation*.

Other BR Gestures: The child uses other distal or symbolic gestures in order to gain access to an object, get assistance, request or direct actions, or protest an activity or event. This may include sign language or sign approximations, depictive gestures, or conventional gestures not included in any of the above categories.

Examples:

- The child signs "more" to request more bubbles.
- The child signs "finished" to protest an activity.
- The child purses his/her lips and blows to request inflation of a balloon.

Non-examples:

- The child taps on the box to request a toy in the box. Instead, code as *contact gesture* under *initiation of behavior regulation*.

Vocalizations or Verbalizations Only: The child uses vocalizations or verbalizations in the absence of a gesture in order to gain access to an object, get assistance, request or direct actions, or protest an activity or event.

Examples:

- The child says "all done" to protest an activity.
- The child says "again" to request the balloon again.

Non-examples:

- The child gives the balloon to the adult and says "more". Instead, code as *contact gesture* under *initiation of behavior regulation*.

Initiation of Joint Attention

Definition: The child initiates communicates in order to draw the adults attention to an object or event.

The main idea of joint attention is that the child is communicating with another person for the sole purpose of sharing interest in an object or event. In the ADOS, this may occur when the child is exposed to a novel object or activity. The initiation of joint attention includes seven sub-categories.

Regarding Adult Cues:
Initiation of joint attention should be carefully considered if the behavior is modeled, prompted, or cued. If the initiation occurs within 5 seconds of the prompt, do not code the behavior.

- *Following specific modeling of a communicative behavior* (e.g., the adult and child are looking at a book and the adult points at pictures to elicit joint attention): do not code the first initiation if the child matches the adult's non-verbal behavior (e.g., pointing) within 5 seconds. After the child initiates once, any additional initiations can be scored.
- *Following a direct verbal cue* (e.g., "Tell me what you see" or "What do you see?") **do not code** because this is considered a prompted behavior.
- *Following an indirect verbal cue* (e.g., "Hmmm." or "Uh-oh") **code** if the child initiates one of the target behaviors.

3-point gaze: The child looks at the object/event-adult-object/event or adult-object/event-adult in quick succession in order to share interest in the object/event. If the child speaks during the 3-point gaze, code under *vocalizations or verbalizations only for joint attention*. Do not code if the point of focus in the middle of the 3-point gaze lasts for longer than 3 seconds. 3-point gaze can be coded if the adult is already attending to the item. Do not code of the adult is talking or moving.

Remember, the 3-point gaze should be about sharing interest, rather than simply observing or checking in with the adult.

Examples:

- The child looks at the penguin, then to the adult's face, then back to the penguin.
- The child colors on the paper, then looks from the adult, to the paper, and back to the adult.

Non-examples:

- The child looks at the penguin, then at the adult and the video recorder, then back to the rabbit. This is not coded because the child looked at the adult *and* video camera, which is not a 3-point gaze.
- The child looks at the marker box, watches the adult while s/he asks if the child needs a different color, then looks back at the marker box. This is not coded because the adult was speaking.

Gives: The child gives an object to the adult to share interest in the object. If the child does not release the object, but the object makes contact with the adult's body or clothing, code as a give. Do not code as initiation of joint attention if the adult performs some type of action with the object (code as initiation of behavior regulation).

Examples:

- The child is playing with the water snake from the marker box. S/he smiles, gives it to the adult, and then takes the toy right back.

Non-examples:

- The child is playing with the tops. S/he unsuccessfully tries to put a top on the spinner and then gives it to the adult. This is not coded because the child likely wants the adult to perform an action. Instead, code as *contact gesture* under *initiation of behavior regulation*.

Shows: The child shows an object to the adult to share interest in the object either by moving the object closer to the adult or re-orienting the object towards the adult. The "object" can be something on the child (e.g., clothing, elbow, cut on leg). Do not code if the child shows an object to the camera.

Examples:

- The child opens the marker box and sees the squeeze toy. Then, the child holds up the squeeze toy towards the adult.

Non-examples:

- The child is playing with the balloon. S/he flies it through the air as if the balloon is moving again. This is not coded because it is not clear that child is holding out the rocket to share interest in it with a communication partner.

Touch gesture: The child touches an object to share interest in the object. This could be a touch point, a tap on the object, or another similar gesture. This may be very subtle for children who are shy or anxious, but as long as they use an isolated finger/thumb and are not simply feeling/manipulating the object, score this behavior if it seems to be for the purpose of joint attention.

Examples:

- The child points at various people in the book and says what they are doing.
- The child taps the ball that is too large for the ball track and says "Uh-oh."

Non-examples:

- The adult says "What is that" and the child immediately points and says "bus." This is not coded because the child was prompted. If the child continued to point and label other items, the following unprompted points can be coded.

Distal point: The child uses an isolated finger/thumb to point to an object/event to share interest in the object/event. A point to an object/event outside of the view of the camera can be coded.

Examples:

- The child points to the clock on the wall.
- The child points at the penguin while it is activated and says "Look."

Non-examples:

- The child points to the bubble gun on the shelf after it is put away. This is not coded because the child desires access to the bubble. Instead, code as *point* under *initiation of behavior regulation*.
- The child says "look" and uses an open hand to gesture towards a toy on the table. This is not coded because it is not an isolated finger point. Instead, code as *other JA gestures* under *initiation of joint attention*.

Other JA gesture: The child uses other distal or symbolic gestures in order to to share interest in the object/event. This may include sign language or sign approximations, depictive gestures, or conventional gestures not included in any of the above categories. A gesture indicating an object/event outside of the view of the camera can be coded.

Examples:

- The child signs "blue" after holding up the squeeze toy in the marker box.
- The child opens both hands in front of a novel toy, and says "Oh my."

Non-examples:

- The signs "red" to pick out a juice box. This is not coded because the child wants a specific color juice box. Instead, code as *other BR gesture* under *initiation of behavior regulation*.

Vocalizations or Verbalizations only: The child uses vocalizations or verbalizations in the absence of a gesture in order to share interest in the object/event. For joint attention, this must be paired with eye contact and/or a clear gaze shift between an object/event and the adult. A gaze shift to an object/event outside of the view of the camera can be coded.

Examples:

- The child says "Look at that" while looking at the penguin and back to the adult.
- The child says "Uh-oh" and looks at the adult after the top falls off the table.

Non-examples:

- The child says "elephant" while looking at the book. This is not coded because the child must have eye contact or a clear gaze shift in order to code vocalizations or verbalizations only for initiation of joint attention.

Types and Tokens of Behaviors

For this coding system, *types* of behaviors will be coded, rather than *tokens* of behaviors.

Type refers to a novel occurrence of a specific social-communication act, which may involve a different form of communication (e.g. point vs. reach), a different function (e.g., behavior regulation vs. joint attention), or different materials (e.g., reaching for a balloon vs. reaching for a book).

Token refers to a pure frequency count of the behavior, regardless of the novelty of the social-communication act.

Rules for types vs. tokens of behaviors

- For each type, code the highest scoring instance of that behavior. This may not always be the first instance of the behavior. Also, if the child has maxed out on behaviors in a given category, but uses a higher scoring example of the behavior later in a different activity, score the higher scoring behavior.
    - Examples:
        - The child reaches for the bubbles, but later in the activity reaches for the bubbles, looks at the adult, and says "more", the second occurrence of the behavior would be scored since it would merit more points.
        - The child has 5 instances of *other BR gestures*, but 2 of those instances are without eye contact. In the snack activity, the child signs "more" while making eye contact. Replace one of the previous instances of the behavior with this higher scoring behavior from the snack activity.

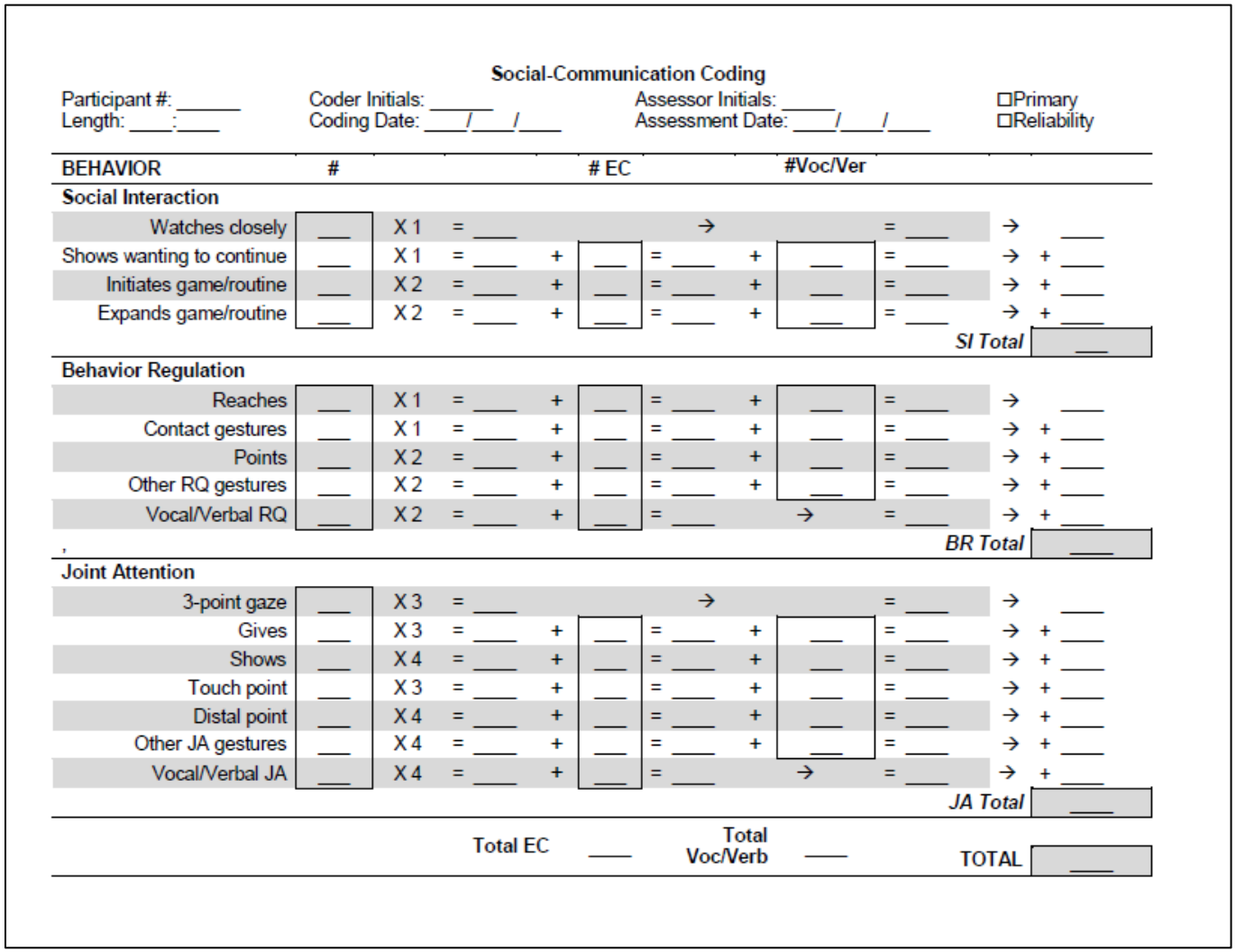
- Code a specific gesture only once per object in a given activity
    - All surprise items in the marker box count as a single object
    - All spinning tops materials count as a single object (e.g., spinner, and tops)
    - All bubbles materials count as a single object (e.g., bubble gun, bubble juice)
    - All food snacks count as a single object, juice is a different object

- Code a *vocalization or verbalization only* once related to a specific object/activity. This conservative coding is used because many students have verbalizations/vocalizations that are difficult to understand. However, if the child is referencing an object that is outside of the given activity, you may code a separate instance of vocalization or verbalization only.

- Two different gestures within the same category can each be coded within the same activity.

- Examples:
  - The child signs for “more” and then signs for “finished” within the same activity. These would both be coded under *other BR gesture*.
  - The child gives the top to the adult and pushes the top away. These would both be coded under *contact gestures* for *initiation of behavior regulation*.

Appendix C. Expressive communication coding and scoring sheet.



Social-Communication Coding

Participant #: _____ Coder Initials: _____ Assessor Initials: _____ ☐Primary
Length: ____:____ Coding Date: ____/____/____ Assessment Date: ____/____/____ ☐Reliability

BEHAVIOR	#			# EC			#Voc/Ver			
Social Interaction										
Watches closely	___	X 1	= ____		→			= ____	→	____
Shows wanting to continue	___	X 1	= ____	+ ___	= ____	+	___	= ____	→ +	____
Initiates game/routine	___	X 2	= ____	+ ___	= ____	+	___	= ____	→ +	____
Expands game/routine	___	X 2	= ____	+ ___	= ____	+	___	= ____	→ +	____
									SI Total	___
Behavior Regulation										
Reaches	___	X 1	= ____	+ ___	= ____	+	___	= ____	→	____
Contact gestures	___	X 1	= ____	+ ___	= ____	+	___	= ____	→ +	____
Points	___	X 2	= ____	+ ___	= ____	+	___	= ____	→ +	____
Other RQ gestures	___	X 2	= ____	+ ___	= ____	+	___	= ____	→ +	____
Vocal/Verbal RQ	___	X 2	= ____	+ ___	= ____	→		= ____	→ +	____
									BR Total	____
Joint Attention										
3-point gaze	___	X 3	= ____		→			= ____	→	____
Gives	___	X 3	= ____	+ ___	= ____	+	___	= ____	→ +	____
Shows	___	X 4	= ____	+ ___	= ____	+	___	= ____	→ +	____
Touch point	___	X 3	= ____	+ ___	= ____	+	___	= ____	→ +	____
Distal point	___	X 4	= ____	+ ___	= ____	+	___	= ____	→ +	____
Other JA gestures	___	X 4	= ____	+ ___	= ____	+	___	= ____	→ +	____
Vocal/Verbal JA	___	X 4	= ____	+ ___	= ____	→		= ____	→ +	____
									JA Total	____
			Total EC	____	Total Voc/Verb	____			TOTAL	____

SOCIAL INTERACTION: Child communicates to get attention or to maintain or initiate involvement in an activity

Behavior	Time	Description	EC	No EC	NC	Voc	Ver	No V/V
Watches closely ✓ Watches in anticipation of EX ✓ Watches at least 2-sec. ✓ Face/head of EX visible ✓ Social game/routine								
Shows want to continue ✓ Produces action, gesture or vocalization ✓ Social game/routine								
Initiates game/ routine ✓ Produces action, gesture or vocalization ✓ New activity *or* 30 sec. since game/routine ✓ Social game/routine								
Expands game/ routine ✓ Takes new role or adds new action, materials, *or* person ✓ Social game/routine								

EX = Examiner or other adult CH = Child being assessed
EC = eye contact No EC=no eye contact NC=not codeable Voc=vocalization Ver=verbalization
No V/V=no vocalizations/verbalizations

BEHAVIOR REGULATION: Child communicates to gain access to an object, gain assistance, direct a person or protest an activity/object

Behavior	Time	Description	EC	No EC	NC	Voc	Ver	No V/V
Reaches ✓ Open-hand reach or opens & closes hand ✓ Does not end in grab or attempt to grab ✓ To gain access to object or person								
Contact gestures ✓ Pulls on body part of EX *or* gives, taps or pushes object ✓ To gain access or assistance, direct, or protest								
Points ✓ Isolated point with any finger or thumb ✓ To gain access to object *or* to direct a person								
Other BR gesture ✓ CH uses action (e.g., signs, conventional non-contact gestures) ✓ To gain access or assistance, direct, or protest								
Vocal/verbal only ✓ Vocal or verbal behavior ✓ No gesture behavior ✓ To gain access or assistance, direct, or protest								

EX = Examiner or other adult CH = Child being assessed
EC = eye contact No EC=no eye contact NC=not codeable Voc=vocalization Ver=verbalization
No V/V=no vocalizations/verbalizations

JOINT ATTENTION: Child communicates to draw attention of person to an object or event to share interest

Behavior	Time	Description	EC	No EC	NC	Voc	Ver	No V/V
3-point gaze ✓ Object/event – EX – object/event *or* EX-object/event-EX ✓ Face/head of EX visible ✓ EX not talking/moving ✓ To share interest								
Gives ✓ Object makes contact with EX ✓ EX does not perform action with object ✓ To share interest								
Shows ✓ Moves or reorients object towards EX ✓ Object is real ✓ To share interest								
Touch gesture ✓ Touch point, tap, or other contact gesture ✓ Not the first gesture following EX prompt ✓ To share interest								
Distal point ✓ Isolated point with any finger or thumb ✓ Not the first point following EX prompt ✓ To share interest								
Other joint attention ✓ CH uses some type of action (e.g., signs, conventional non-contact gestures) ✓ To share interest								
Vocal/verbal only ✓ Vocal or verbal behavior ✓ Eye contact ✓ No gesture behavior ✓ To share interest								

EX = Examiner or other adult CH = Child being assessed No V/V=no vocalizatons/verbalizations
EC = eye contact No EC=no eye contact NC=not codeable Voc=vocalization Ver=verbalization

Appendix D. Classroom observation coding sheet.

Observer: _____ Prim.__ Rel.__ Date: _____ Large group ___ Small group ___
Classroom ID: _____ Time: ___:_____ One-to-one ___
Participant ID: _____ # peers present ___ # staff present ___

Complete this form immediately following each 5-minute observation session.

Materials:

Which of the following best describes the target student's access to relevant materials during the session?

- ❑ The student had access to relevant materials for most of the observation
- ❑ The student had access to relevant materials for some of the observation
- ❑ The student had access to relevant materials for a minimal part of the observation
- ❑ The student did not have access to relevant materials – teacher controlled materials or no materials used

Which of the following best describes the target student's interest in the relevant materials during the session?

- ❑ The student appeared highly interested in the relevant materials
- ❑ The student appeared moderately interested in relevant materials
- ❑ The student appeared minimally interested in relevant materials
- ❑ The student appeared uninterested in relevant materials –or – no materials were used

List the materials utilized in the session:

- _____
- _____
- _____
- _____
- _____
- _____

Activity/Task:

Which of the following best describes the adaptation of activities/tasks for the target student during the session?

- ❑ There was *clear evidence* of adaptation for the target student during *most* of the observation
- ❑ There was *clear evidence* of adaptation for the target student during *some* of the observation
- ❑ There was *some evidence* of adaptation for the target student during the observation
- ❑ There was *minimal or no evidence* of adaptation for the target student during the observation

Which of the following best describes most of the response requirements during the session?

- ❑ Open ended, different responses were acceptable
- ❑ Closed ended, only one correct response but responses were differentiated across activity
- ❑ Closed ended, primarily rote or repetitive verbal or motor responses
- ❑ Required student's attention but minimal verbal or motor response from student

Give a basic description of the activities within the five-minute segment:

_____
_____
_____
_____
_____

Appendix E. Definitions for student-directed practices.

Guidelines for Observation Coding

Complete a form immediately following each 5-minute observation session.

Large group: *4 or more total students (target student and 3+ other students)*
Small group: *2-3 total students (target student and 1-2 other students)*
One-to-one: *target student only*
peers present: *total number of other students (i.e., not including the target student)*
staff present: *total number of staff in instructional area*

Which of the following best describes the target student's access to relevant materials during the session?

- ❑ The student had access to relevant materials for most of the observation
- ❑ The student had access to relevant materials for some of the observation
- ❑ The student had access to relevant materials for a minimal part of the observation
- ❑ The student did not have access to relevant materials – teacher controlled materials or no materials used

Description: *This refers to the student's access to relevant materials, not their use of materials. If a student has access to materials/objects that are not part of the session, this does not count towards the code.*

Scoring: *If the target student has their own set of materials, they likely have access during <u>most</u> of the session. If the materials are shared among other students, they likely have access during <u>some</u> or <u>minimal parts</u> of the session. If materials are not used or the teacher maintains complete control of the materials without ever offering the target student access, than the student <u>did not have access</u> to the materials.*

Which of the following best describes the target student's interest in the relevant materials during the session?

- ❑ The student appeared highly interested in the relevant materials
- ❑ The student appeared moderately interested in relevant materials
- ❑ The student appeared minimally interested in relevant materials
- ❑ The student appeared uninterested in relevant materials –or – no materials were used

Description: *Look at the student's enthusiasm or interest related to the materials in the session. This can include interest in the materials alone, rather than the interaction (e.g., student looks very carefully at pictures in a book, but does not actually participate well in the instruction). Interest may be shown in different ways for different students, but look for interactions with the materials, intense looking at the materials, affect related to the materials, etc.*

Scoring: *This is qualitative rating of interest that should reflect your perception of student's interest.*

Which of the following best describes the adaptation of activities/tasks for the target student during the session?

- ❑ There was *clear evidence* of adaptation for the target student during *most* of the observation
- ❑ There was *clear evidence* of adaptation for the target student during *some* of the observation
- ❑ There was *some evidence* of adaptation for the target student during the observation
- ❑ There was *minimal or no evidence* of adaptation for the target student during the observation

Description: *This refers to evidence that the teacher has changed the task specific to the target student. This could include using different language, visual supports, prompt levels, etc.*

Scoring: *Clear evidence suggests it is obvious that the teacher is changing his/her instruction to match the student characteristics. This can be rated during most of the observation or some of the observation depending on the frequency. If the task is adapted, but the teacher doesn't appear to be making changes in the moment specific to the target student, this would be rated as some evidence of adaptation. If the task appears to be above the level of the student and the teacher is not offering adaptations in order for the student to be successful, rate as minimal or no evidence.*

Which of the following best describes most of the response requirements during the session?

- ❑ Open ended, different responses were acceptable
- ❑ Closed ended, only one correct response but responses were differentiated across activity

- ❑ Closed ended, primarily rote or repetitive verbal or motor responses
- ❑ Required student's attention but minimal verbal or motor response from student

Description: *This refers to the type of response that the teacher is requesting from the target student during the observation session. The responses can be verbal or motor responses depending on the activity and the level of the child*

Scoring: *<u>Open ended</u> response requirements stem from comments or questions in which varied responses are considered appropriate and correct. Response requirements that are <u>closed ended with differentiation</u> across the activity mean that there is a correct response but the teacher varies the response prompts within the observation. Response requirements that are <u>closed ended and rote/repetitive</u> suggest that the teacher is using similar prompts repetitively across tasks and the responses might be considered more automatic. Finally, if the teacher requires no or very few responses from the student, this would be coded as <u>minimal verbal or motor response</u>.*

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