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How core symptoms of Autism Spectrum Disorder predict engagement in specific topographies of challenging behavior

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HOW CORE SYMPTOMS OF AUTISM SPECTRUM DISORDER PREDICT
ENGAGEMENT IN SPECIFIC TOPOGRAPHIES OF CHALLENGING BEHAVIOR

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Psychology

by

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ABSTRACT

Challenging behavior, such as aggression, destructive behavior, and self-injurious behavior (SIB), are common among people of all ages with Autism Spectrum Disorder (ASD). Numerous researchers have found that greater severity of ASD or a diagnosis of ASD is significantly correlated with greater levels of challenging behavior. However, there is dearth of information on how core symptoms of ASD (i.e., socialization deficits, communication deficits, stereotypies) predict the engagement of specific topographies of challenging behavior above and beyond other variables, such as developmental functioning. The purpose of this study is to extend the current literature base through examining how core symptoms of ASD predict engagement in Aggressive/Destructive and SIB above and beyond developmental functioning among toddlers at risk for developing ASD. Validated measures for this population were used: *Baby and Infant Screen for Children with aUtism Traits (BISCUIT) - Part 1 and 3*. First, it was demonstrated that greater scores on factors reflecting socialization deficits and engagement in stereotypies significantly predicted engagement in Aggressive/Destructive Behavior. Only stereotypies significantly predicted engagement in SIB. However, findings were small in effect with odds ratios ranging from 1.03 to 1.11. When examining how core symptoms of ASD predict engagement of challenging behavior at an item level, results were not interpretable due to suppression effects. These suppression effects indicate that the interrelationship among the predictor variables were such that relations between individual predictors and a dependent variable were either enhanced or suppressed. Thus the effect of each independent variable/covariate alone was not clear. Consequently, examination at an item level did not provide added benefit over examination at a group level. Implications of these results and directions for future research are discussed.

INTRODUCTION

Pervasive Developmental Disorders, otherwise referred to as Autism Spectrum Disorders (ASD) are comprised of five neurodevelopmental disorders with core symptoms of socialization impairment, communication deficits, and stereotypies (Levy, Mandell, & Schultz, 2009). With recent advances in measurement, diagnosis of ASD can be made reliably from as young as 18 months of age (Matson, Wilkins, & Gonzalez, 2008). The ability to diagnose ASD at younger ages has enabled researchers to examine core symptoms and related features of ASD at these younger ages. One area of focus is that of challenging behavior. Although not a core symptom of ASD, challenging behavior is considered an associated feature as upwards of 94% of people, including toddlers, with ASD are noted to engage in challenging behavior (e.g., Matson, Wilkins, & Macken, 2009). There is an abundance of research supporting that a diagnosis of ASD and greater severity of ASD are each significantly associated with a variety of types of challenging behavior even among those as young as 17 to 36 months of age (Fodstad, 2011; Hattier, Matson, Belva, & Horovitz, 2011; Kozlowski & Matson, 2012; Matson, Boisjoli, Rojahn, & Hess, 2009; Rojahn, Matson, Mahan, Fodstad, Knight, Sevin, & Sharp, 2009). However, there is a dearth of research that expressly examines how specific core symptoms of ASD predict specific forms of challenging behavior. This research is even less common among the toddler population. Furthermore, other variables such as age (Holden & Gitlesen, 2006), gender (Alink et al., 2006), adaptive skills (Emerson, Kiernan, Alborz, Reeves, Mason, Swarbrick, Mason, & Hatton 2001), intellectual disability (ID; Fodstad, 2011), and psychopathology (Kearney & Healy, 2011) have been implicated by some researchers as affecting the presentation of challenging behavior. Even fewer studies examine the relation between core symptoms of ASD and challenging behavior while taking these aforementioned variables into account.

Determining whether specific symptoms of ASD are significantly associated with a specific challenging behavior above and beyond other implicated variables will not only enhance our understanding of the relation between ASD and challenging behavior but help improve the efficiency and effectiveness of current interventions. As such, the purpose of this study is to determine how each core symptom of ASD predicts the engagement of specific forms of challenging behavior while taking into account other implicated variables.

Symptoms of Autism Spectrum Disorder Among Toddlers

Individuals diagnosed with ASD reflect a heterogeneous group, with varying symptoms, symptom severity, comorbid disorders, and associated features. Despite this heterogeneity, there are core symptoms of ASD that best reflect this diagnostic paradigm: such as deficits in socialization, impairment in communicative skills, as well as restricted and repetitive behaviors. Communication and socialization impairments are often inseparable especially at young ages, as joint attention and imitation skills affect both these core impairments (Rutherford, Young, Hepburn, & Rogers, 2007; Toth, Munson, Meltzoff, & Dawson, 2006; Yoder, Stone, Walden, & Malesa, 2009). For example, Rutherford and colleagues (2007) found that deficits in joint attention among toddlers predicted development of pretend play skills whereas Toth and associates (2006) concluded that deficits in the same skill (i.e., joint attention) predicted level of communication up to five years later. Furthermore, impairments in communication and socialization are highly related and have been found to predict each other (Yoder, et al., 2009), indicating that these two deficits are likely similar constructs. Based on research, the American Psychiatric Association proposed that diagnostic criteria reflecting socialization and communication skills be merged together under one core symptom area in the newest *Diagnostic*

and Statistical Manual (APA, 2012). As such, socialization and communication impairments will be reviewed together for the purpose of this discussion.

Joint attention and imitation are socio-communicative skills often discussed in the literature as behaviors that promote skill acquisition and organization of social information which in turn affect a child's ability to learn from his environment. Joint attention is the process of sharing one's experience of observing an object or event and allows people to coordinate attention with a social partner. This coordination provides a person with vast information regarding social interactions and the environment. Joint attention is subdivided into two categories: responding and initiating. Responding to joint attention involves the ability to follow another's eye gaze or gesture whereas initiating joint attention involves using one's own eye gaze or gestures to initiate attention with someone else.

Initiating joint attention is further delineated into proto-declarative or proto-imperative acts. Proto-imperative acts consist of using gestures, such as pointing and eye gaze to request objects or actions whereas proto-declarative acts consist of using the same aforementioned behaviors to express an item or activity of interest to another person. Interestingly, those diagnosed with ASD tend to exhibit impaired proto-declarative, but not proto-imperative gestures (Paul, 2008). Although joint attention emerge by at least 6 months of age in typically developing (TD) children (Scaife & Bruner, 1975), toddlers later diagnosed with ASD demonstrate impairments in behaviors in these skills by 6 to 12 months of age (e.g., facial gaze; Ozonoff et al., 2010). In fact, by 12 months of age impairments in several proto-declarative skills (i.e., gazing at others, failing to orient to name, showing, and pointing) best classified toddlers with ASD (Osterling & Dawson, 1994). Impairments in skills related to joint attention continue to be observed among toddlers with ASD 36 months of age and older (Landa, Holman,

& Garrett-Mayer, 2007; Stone, Ousley, Yoder, Hogan, & Hepburn, 1997; Wetherby, Woods, Allen, Cleary, Dickinson, & Lord, 2004).

Infants imitate others from the first few days of life through imitation of oral movements, facial gestures, and manual movements (Meltzoff & Moore, 1997). These imitation skills, such as imitating facial expressions, facilitate the sharing of affect and social information (Gopnik & Meltzoff, 1994). In fact, early imitation skills have predicted later play and language skills (Stone et al., 1997). Imitation skills involve copying a model, and as a result promote skill acquisition including social communication skills (Gopnik & Meltzoff, 1994; Rogers, 1999; Rogers, Cook, & Meryl, 2005; Stone, Ousley, & Littleford, 1997; Stone, & Yoder, 2001; Uzgiris, 1981). Stone and Yoder (2001) found that motor imitation along with hours of speech therapy significantly predicted language outcome at 4 years of age whereas play level, joint attention, and socioeconomic status did not. Although there are some exceptions, the literature indicates that infants and toddlers with ASD consistently demonstrate impairments in various forms of imitation (e.g., actions with objects, body movements, and oral-facial movements) compared to controls (Aldridge, Stone, Sweeny, & Bower, 2000; Rogers, Hepburn, Stackhouse, & Wehner, 2003; Stone, Ousley, & Littleford, 1997).

The following discussion provides an overview of research regarding socio-communicative behavioral manifestations of ASD among infants and toddlers,. Topic include social smiling, orienting to name, use of gestures, facial expression, initiating interactions with others, and vocal language. Thus far researchers suggest that socio-communicative behavioral manifestations of ASD are not readily detected by current measures before 6 months of age (Nadig, Ozonoff, Young, Rozga, Sigman, & Rogers, 2007; Ozonoff et al., 2010; Zwaigenbaum, Bryson, Rogers, Roberts, Brian, Szatmari 2005). A prospective study comparing younger

siblings of those with ASD to TD peers found that significant differences between groups emerged from 6 to 12 months of age (Ozonoff et al., 2010). Infants in the at-risk group did not acquire social communication skills in a similar fashion as the TD control group (Ozonoff et al., 2010). Rather, a decreasing trend in the frequency of facial gaze and social smile for those with ASD were observed from 6 through 36 months of age. In contrast, there was an increasing trend for TD peers. These findings underscore that as children age, symptoms of ASD become more apparent due to the increasing discrepancy between typical and atypical behavior. Other researchers (Nadig et al., 2007; Volkmar & Charwaska, 2008; Werner et al., 2000) have observed significantly impaired responding or orienting to name in at-risk for ASD populations as young as 6 to 21 months of age. Decreased eye contact, social smiling, interactions with others, and impaired toy exploration were observed in infants later diagnosed with ASD when they were as young as 6 to 12 months of age (Bryson et al., 2007).

By 12 months of age, those later diagnosed with ASD exhibit greater skill deficits. Toddlers with ASD or later diagnosed with ASD continue to display impairments in previously discussed socio-communicative skills such as orienting or responding to name (Clifford & Dissanayake, 2008; Osterling & Dawson, 1994; Osterling, Dawson, & Munson, 2004), social smiling (Adrien et al., 1992; Adrien, Lenoir, Martineau, Perrot, Hameury, Larmande, & Sauvage, 1993), and gazing at others' (Clifford & Dissanayake, 2008; Osterling & Dawson, 1994; Osterling, Dawson, & Munson, 2004; Ozonoff et al., 2010). Interestingly, compared to TD peers, 12 month-olds later diagnosed with ASD demonstrated impairment in looking at objects held by others but not looking at objects in the environment that were not held by others (Osterling, Dawson, & Munson, 2004). Other impairments compared to TD peers by 12 months of age included impairment in joint attention skills such as proto-declarative pointing and eye

gaze (Osterling & Dawson, 1994), conventional gestures (Osterling, Dawson, & Munson, 2004, Zwaigenbaum et al., 2005), initiating contact with others (Osterling & Dawson, 1994), appropriate facial expressions (Adrien et al., 1993), and increased visual fixation on parts of objects (Bryson et al., 2007).

For toddlers 9 to 24 months of age, the single best behavior discriminating Autistic Disorder (AD) or Pervasive Developmental Disorder Not Otherwise Specified (PDD-NOS) from ID alone was poor response to name (Baranek, 1999; Osterling et al., 2002). Baranek (1999) found that among 32 toddlers, who ranged from 9 to 12 months of age, excessive mouthing, poor visual orientation in social situations, aversion to touch along with poor response to name provided the best profile of the AD group. Interestingly, impaired gaze towards others was not a useful indicator of AD. Slightly in contrast to Baranek (1999), Osterling and colleagues (2002) found that poor gaze towards others along with poor response to name best discriminated those with AD/PDD-NOS from ID alone and TD controls. Frequency of looking at objects held by others, gestures, and vocalizations were not useful in discriminating those with ASD from those with other developmental disabilities (Osterling et al., 2002).

In regard to receptive and expressive language use, 12-month-old toddlers later diagnosed with ASD demonstrated impairment in these skills (Zwaigenbaum et al., 2005; Ozonoff et al., 2010). Specifically, Ozonoff and colleagues (2010) found that by 12 months of age, toddlers later diagnosed with ASD had significant impairment in babbling and word use. This impairment in expressive communication continued to be evident through 24-month-olds diagnosed with ASD (Chawarska, Klin, Paul, & Volkmar, 2007; Landa, Holman, & Garrett-Mayer, 2007). When broadly examining core features of ASD among toddlers 17 to 36 months of age, Matson and colleagues (2010) found that toddlers with AD/PDD-NOS had significantly more impairment in

verbal and nonverbal communication as well as socialization than the atypically developing control group. Werner and Dawson (2005) compared 12 and 24 month birthday videotapes across 36 toddlers with ASD and 18 who were TD. At 12 months there were no significant differences among groups for orienting to name, gaze at people, affect, pointing, or repetitive motor behavior. However, by 24 months of age these aforementioned behaviors along with complex babbling and use of single words or phrases distinguished those with ASD from TD peers. Complex babbling and use of words or phrases were more impaired among those with ASD. Overall, researchers indicate that toddlers as young as 12 months of age display impairment in communication skills. However, and although prominent among those with ASD, deficits in expressive communication are not specific to ASD. Thus, communication deficits alone are not predictive of an ASD diagnosis (Tager-Flusberg, Paul, & Lord, 2005).

Another core feature of ASD is stereotypic and restricted behavior. This category is defined as stereotypic language and motor movements, resistance to change in the environment, adherence to routine/s, intense preoccupation with select interests (Charwaska, Klin, Paul, & Volkmar, 2007; Cunningham & Schreibman, 2008; MacDonald et al., 2007; Schreibman & Mills, 1983), and sensory abnormalities (APA, 2012; Matson, Boisjoli, Hess, & Wilkins, 2010). Stereotypies, also referred to as stereotypic or repetitive behavior in the literature, is an umbrella term for a heterogeneous group of behavior that are all similar in that they are all repetitive, rigid, and developmentally inappropriate in nature (Turner, 1999). Turner (1999) classified stereotypies into lower-level and higher-level categories. Lower-level stereotypies include motor movements such as repetitive body movements and interaction with objects. Stereotyped body movements include rhythmic and repetitive body rocking, hand flapping/waving, finger flicking, hair twirling, pacing, or jumping. Stereotyped interaction with objects includes behaviors such as

repetitive lining up of toys, flicking light switches, and repeatedly using a specific action with an object (e.g., object spinning). In contrast, higher-level stereotypies are more complex in that they comprise repetitive language, insistence on sameness, as well as restricted and repetitive patterns of behavior and interests. Stereotyped language consists of repeating the same sound, word, or phrase. Insistence on sameness and stereotyped pattern of behavior reflects an inflexibility to change routines or the environment (e.g., furniture arrangement) whereas stereotyped patterns of interests consist of an abnormal preoccupation with a specific object or subject. Some forms of self-injurious behavior (SIB) that are repetitive in nature, such as head-banging, are also conceptualized as a stereotypy.

While low levels of repetitive behaviors may be common among infants and toddlers, toddlers at-risk for ASD or later diagnosed with ASD were found to engage in significantly greater amounts of repetitive behavior than atypically developing controls (Matson, Dempsey, & Fodstad, 2009). The more severe the symptoms of ASD the greater the motor and vocal stereotypies, highly restricted activities, routine-oriented behavior, the limited number of interests, preoccupation with a part of an object, and odd body postures (Matson et al., 2009). Similarly, Wetherby and colleagues (2004) found that toddlers diagnosed with an ASD at approximately 21 months of age were significantly more likely to engage in motor and object stereotypies and significantly less likely to play with a variety of toys than TD peers or those with non ASD developmental delays. Levels of stereotypies remained relatively stable among those with ASD from 24 to 36 months (Charwaska et al., 2007), but tended to increase around 48 months (Charman, Taylor, Drew, Cockerill, Brown, & Baird, 2005).

Researchers have indicated that toddlers (e.g., Baranek, David, Poe, Stone & Watson, 2006; Lord, 1995; Rogers, Hepburn, & Wehner, 2003; Matson, Boisjoli, Hess, & Wilkins, 2010)

and children (e.g., Billstedt, Gillberg, & Gillberg, 2007; Dahlgren & Gillberg, 1989; Gabriels et al., 2008; Gillberg et al., 1990; Kanner, 1943; Leekam, Nieto, Libby, Wing, & Gould, 2007) with ASD display sensory abnormalities in the form of hyper or hypo sensitivities. Correspondingly, the American Psychiatric Association (2012) proposed that sensory abnormalities be formally included as one of the four subdomains comprising stereotypies. Sensory abnormalities are typically divided into two types: hypo and hyper responsiveness. Hypo-responsiveness to sensory stimuli indicates that there is an atypical lack of response to sensory stimuli (e.g., staring at lights or fans), as well as lack of response to loud noises and pain (Baranek et al., 2006). Hyper-responsiveness to sensory stimuli occurs when a person engages in an over-reactive response to sensory stimuli. Behavior often indicative of hyper-responsiveness include covering ears in response to noise, and aversive responses to textures or visual stimuli (e.g., Baranek et al., 2006).

Many toddlers with ASD display significantly greater sensory abnormalities compared to TD controls (Baranek et al., 2006). However, this has not been consistently found when comparing toddlers with ASD to atypically developing controls (e.g., Rogers et al., 2003; Stone & Hogan, 1993). Using a parent report measure, Rogers and colleagues (2003) compared sensory abnormalities among toddlers 21 through 50 months of age diagnosed with ASD, Fragile X syndrome, developmental delay, and TD. Overall, toddlers with ASD or Fragile X displayed significantly greater levels of sensory abnormalities than control groups. Toddlers diagnosed with ASD had significantly greater impairment in sensory abnormalities relating to smell and taste than all other groups. Both the ASD and Fragile X groups displayed significantly greater impairment in auditory filtering and tactile sensitivity than others. No significant differences among groups were found for visual sensitivity (Rogers et al., 2003). Additionally, Cox and

colleagues (1999) found no consistent pattern of sensory abnormalities (i.e., unusual fears, unusual sensory interests) across those diagnosed with ASD or Learning disability among toddlers 20 through 42 months of age. Unusual fears were endorsed relatively equally by caregivers of 20-month olds with AD and Learning disability. Some researchers hypothesize that this lack of discrimination among atypically developing groups is due to toddlers with ASD displaying significantly greater levels of hypo but not hyper-responsiveness (Baranek et al. 2006). For example, Baranek and colleagues (2006) compared hypo and hyper sensory responses among toddlers with ASD and non ASD developmental disability. Toddlers with ASD engaged in significantly greater levels of hypo but not hyper-responsiveness compared to a developmental disability control group.

Stereotypies including restricted interests as well as motor and sensory abnormalities are a core feature of ASD. However, researchers have found that, overall, stereotypies alone are not useful in discriminating ASD from other developmental disabilities, such as ID (Baranek, 1999; Cox et al., 1999; Osterling et al., 2002). Similarly, expressive communication skills in and of themselves have not consistently discriminated among ASD and non ASD groups. Socio-communicative skills, especially those reflective of joint attention and poor response to name have consistently differentiated those with ASD from other groups. Yet, when taken into consideration along with socio-communicative deficits, information regarding stereotypies and expressive communication has been found to increase the stability of ASD diagnoses over time (APA, 2012).

Challenging Behavior

Definitions of the term challenging behavior vary slightly but all refer to behavior that cause physical harm and/or destruction of property, are considered socially unacceptable, and/or affect living and/or educational placement. A common definition of challenging behavior is

provided by Mudford and colleagues (2008) who defined challenging behavior as "...culturally abnormal behavior of such intensity, frequency, or duration that the physical safety of the person or others is placed in serious jeopardy or behavior which is likely to seriously limit or deny access to the use of ordinary community facilities" (Emerson, Robertson & Gregory, 2000 as cited in Mudford, et al., 2008, p. 268). Challenging behavior can be considered extrapersonal or intrapersonal (Sturme, Seiverling, & Ward-Horner, 2008). Extrapersonal challenging behavior is conceptualized as interfering with others' activities (e.g., property destruction, verbal aggression, physical aggression, tantrum behavior, and self-injury). In contrast, intrapersonal challenging behavior does not usually directly interfere with others' activities but rather hinders the person's social interactions (e.g., stereotypies and other odd behavior; Sturme et al., 2008).

The earliest accounts of children with ASD written by Kanner (1943) describe these children engaging in a variety of challenging behavior such as physical aggression, verbal aggression, property destruction, tantrum behavior, pica, and stereotypies. Since then, numerous researchers have demonstrated that people diagnosed with ASD across the lifespan not only engage in various forms of challenging behavior (e.g., Matson, Fodstad, Mahan, & Rojahn, 2010; Matson, Wilkins, & Macken, 2009; Rojahn, Matson, Mahan, Fodstad, Knight, Sevin, & Sharp; 2009), but do so at high rates. For example, many researchers have found that up to 94% of toddlers, children, adolescents, and adults with ASD engage in challenging behavior (e.g., Jang, Dixon, Tarbox, & Granpeesheh, 2011; McTiernan, Leader, Healy, & Mannion, 2011; Matson, Wilkins, & Macken, 2009; Rojahn, et al., 2009). However, it is not just people with ASD who exhibit challenging behavior. People across diagnoses, developmental level, and medical conditions also engage in challenging behavior (e.g., Gal, Dyck, & Passmore, 2009; Scheepers, Salahudeen, & Morelli, 2004; Sipes, Rojahn, Turygin, Matson, & Tureck, 2011). As

the focus of this study is how symptoms of ASD predict various forms of challenging behavior using an at-risk for ASD sample, research on challenging behavior among ASD and other atypically developing toddler populations are discussed.

Aggression. Although some researchers limit the term aggression to acts that can physically harm others (e.g., Dominick, Davis, Lainhart, Tager-Flusberg & Folstein 2007) others have included temper tantrums (Sturmeiy et al., 2008) or behavior that could result in property destruction (e.g., Sturmeiy et al., 2008). Verbal aggression is also commonly assessed for in measures of challenging behavior used for clinical and research purposes (e.g., *Nisonger Child Behavioral Rating Form*; Aman, Tasse, Rojahn, & Hammer, 1995). Physical aggression includes behavior such as hitting, kicking, biting, scratching, and throwing items at others whereas property destruction includes behavior such as banging on objects, throwing items, and destruction of objects. Temper tantrums tend to comprise a variety of challenging behaviors such as banging on items, throwing items, verbal aggression, as well as dropping to the floor. Verbal aggression is typically defined as yelling or screaming above typical conversational level, threatening others, cursing, yelling insults at others, or making negative statements. Various forms of aggression are common among adults, children, and toddlers with developmental disabilities (e.g., Jang, et al., 2011; Kanne & Mazurek, 2011; Matson, Fodstad, Mahan, & Rojahn, 2010; Matson, Wilkins, & Macken, 2009; Rojahn, Matson, Mahan, Fodstad, Knight, Sevin, & Sharp; 2009).

A recent study by McTiernan and colleagues (2011) found that 56.3% of children 3 through 14 years of age diagnosed with an ASD displayed aggression. This prevalence is similar to other studies examining children 3 through 20 years of age with ASD or ID (e.g., Farmer & Aman, 2011; Matson, Wilkins, & Macken, 2009). Farmer and Aman (2011) not only focused on

overall occurrence of aggression but examined the prevalence of specific forms of aggression. For those with ASD and ID the most common endorsed items reflective of physical aggression were “shoves or pushes others” (48% and 36%, respectively), “pinches others” (44% and 32%, respectively), and “hits forcefully” (43% and 26%, respectively). Other commonly endorsed items were “scratches others,” “hit others with objects,” “bite others,” and “pull others’ hair.” Those specific types of physical aggression had endorsement frequencies ranging from 33 to 18%, 31 to 23%, 31 to 14%, and 20 to 16%, respectively for those with ASD as compared to ID.

In regard to challenging behavior likely to result in property destruction, Farmer and Aman (2011) found that 47% and 29% of those with ASD and ID, respectively, reportedly “throws objects.” Furthermore, 43% and 51% (ASD vs. ID, respectively) were noted to “shout at others.” This is similar to the frequency found by Matson, Wilkins, and Macken (2009) who found that 44% of a sample of children with ASD was reported to engage in “yelling or shouting at others.” Farmer and Aman (2011) found that “verbally threatens,” “uses profanity, and “insults others to face” were less commonly endorsed (i.e., ranging from 9% to 14%) than “yelling or shouting at others,” (i.e., ranging from 43% to 51%).

There are fewer researchers that solely focus on the prevalence of challenging behavior among atypically developing toddlers, including those with ASD. However, researchers’ findings using this population are analogous to child studies. That is, atypically developing toddlers engage in high rates of aggression. Through caregiver report, Rojahn and colleagues (2009) examined the frequency of various forms of aggression among toddlers with ASD. The highest endorsement rate was for “throwing items at others” (41%). Another form of physical aggression, “pulling others’ hair” was exhibited by 30% of the sample. “Kicking objects,” “property destruction,” and “banging on objects” were reported for 26%, 27%, and 37%, of the

sample, respectively. Twenty-six-percent of the sample engaged in verbal aggression. A parallel study by Matson, Fodstad, Mahan, and Rojahn (2010) examined an atypically developing toddler population who did not have an ASD diagnosis. Rather, these participants were diagnosed with Developmental Delay (DD), Seizure Disorder (SD), Cystic Fibrosis (CF), Down Syndrome (DS), as well as other genetic disorders. Similar to Rojahn and colleagues (2009), “throwing items at others’ was the most frequently endorsed (19%). Ten percent reportedly engaged in “pulling others’ hair.” “Banging on objects,” “kicking objects,” and “verbal aggression” occurred less frequently for atypically developing toddlers without an ASD diagnosis than those with ASD. That is, only 7% to 10% of atypically developing toddlers without ASD displayed each aforementioned challenging behavior. A later study by Hattier, Matson, Belva, and Horovitz (2011) replicated these findings among atypically developing toddlers with and without ASD.

Self-injurious behavior. Similar to aggression, definitions of SIB vary slightly. However, all definitions integrate the notion that SIB relates to behavior where a person harms himself (Rojahn et al., 2008). A commonly referred to definition of SIB was developed by Rojahn and colleagues (2008). This definition requires that a behavior require intervention, is repetitive/rhythmic, and will cause physical harm to one’s self in order to be labeled as SIB. Examples of SIB include self-biting, self-pinching, self-scratching, pulling out finger or toenails, pica, self-induced vomiting, mouthing or swallowing items that will cause harm, hitting body parts, and head banging. Other researchers have also included hair pulling and eye poking as forms of SIB (e.g., Berkson, Tupa, & Sherman 2001; Berkson, 2002; Matson & LoVullo, 2008). Forms of SIB that involve a repetitive component can also be classified as stereotypies. However, for the sake of this literature review and study, only stereotypies that are likely to cause harm to one’s self are considered a form of SIB.

About 50% of children with ASD reportedly engage in SIB (e.g., Baghdadli, Pascal, Grisi, & Aussiloux, 2003; McTiernan et al., 2011). Two sets of researchers (i.e., Jang et al., 2011; Matson, Wilkins, & Macken, 2009) recently examined the frequency of specific forms of SIB among children and adolescents with ASD using *Autism Spectrum Disorders-Behavior Problems for Children* (Matson, Gonzalez, & Rivet, 2008). Frequencies for “harming self by hitting, pinching, scratching” were 36% for Matson, Wilkins, and Macken (2009) and 27% for Jang and colleagues (2011). Frequencies of “mouthing or swallowing objects causing bodily harm,” and “poking self in the eye” were more disparate; Jang and colleagues (2011) found that 29% of the sample engaged in “mouthing or swallowing objects causing bodily harm,” whereas Matson, Wilkins, and Macken (2009) found that 17% did. Although both studies found that “poking self in the eye” was the least frequently endorsed form of SIB, Matson, Wilkins, and Macken (2009) found that it occurred slightly more frequently than did Jang and colleagues (2011), at 10% compared to 2%.

Researchers have also examined the prevalence of specific forms of SIB among toddlers 17 through 36 months of age with ASD (i.e., Rojahn et al., 2009). Rojahn and colleagues (2009) found that 25% of toddlers with ASD engaged in harming themselves through self-hitting, pinching, or scratching. Less frequent was harming self through eye poking (i.e., 11%). A parallel study utilizing same aged participants who were atypically developing without ASD found that frequencies of harming self through hitting, pinching, or scratching, as well as eye poking were less common than in the ASD population, at 8% and 2%, respectively (Matson, Fodstad, Mahan, & Rojahn, 2010). A later study by Hattier and colleagues (2011), utilizing a larger sample size of 2,131 toddlers, corroborated prevalence percentages found by Rojahn and colleagues (2009) as well as Matson, Fodstad, Mahan, and Rojahn (2010).

Stereotypies. Stereotypies, also referred to as stereotypic or repetitive behavior in the literature, is an umbrella term for a heterogeneous group of behavior that are all similar in that they are all repetitive, rigid, and developmentally inappropriate in nature (Turner, 1999). A comprehensive description of stereotypies was discussed in a previous section on symptoms of ASD, and as such, an additional description is not provided here. Some forms of SIB which are repetitive in nature, such as head-banging, are also conceptualized as a stereotypy. However, for the purpose of this discussion, repetitive behavior that is likely to cause harm to oneself is discussed as an SIB, whereas all other stereotypic behavior is considered below.

As stereotypies are a core symptom of ASD, this topography of challenging behavior is frequently discussed in the literature and observed among those with ASD. Stereotypies are a diagnostic criteria for AD and Asperger's Disorder but not necessary for a diagnosis of PDD-NOS (APA, 2000). The heterogeneity of those with ASD likely explains why studies do not consistently find that 100% of all toddlers and children with ASD engage in stereotypies. For example, McTiernan and colleagues (2011) found that 92% of 174 children aged 3 to 14 years diagnosed with an ASD engaged in stereotypies. Researchers have found that stereotypies was the most highly endorsed form of challenging behavior among those with ASD (e.g., Jang et al., 2011; Matson, Wilkins, & Macken, 2009).

Researchers examining the prevalence of specific forms of challenging behavior among children with ASD have inspected the prevalence of specific forms of stereotypies. Matson, Wilkins, and Macken (2009) and Jang and colleagues (2011) both found that 54% of children with ASD engaged in repeated and unusual body movements. Repeated and unusual vocalization was even more commonly observed at 60% and 74%, respectively, for Matson, Wilkins, and Macken (2009) and Jang and colleagues (2011). Although reportedly less frequent in the Matson,

Wilkins, and Macken (2009) than in the Jang and colleagues (2011) study, unusual play with objects (57% and 49%, respectively) and playing with own saliva (29% and 22%, respectively) were noted to occur.

Interestingly, the prevalence of specific forms of stereotypies was found to occur at less inappropriate levels among toddlers than children with ASD. Both Rojahn and colleagues (2009) and Hattier and colleagues (2011) found that motor stereotypies occurred for about 30% of the toddler sample. This is in contrast to researchers' findings in the child literature that the majority of children with ASD engage in some form of motor stereotypy. Unusual play as well as repeated and unusual vocalizations were slightly less frequent than motor stereotypies among toddlers with ASD. Unusual play with objects occurred for 29% and 26% of the sample whereas stereotyped vocalizations occurred for 27% and 25% of the sample, respectively, for Rojahn and colleagues (2009) and Hattier and colleagues (2011). Playing with saliva was the least common stereotypy exhibited by toddlers with ASD, occurring for 13% of the sample across studies (Hattier et al., 2011; Rojahn et al., 2009). Prevalence rates are likely lower for toddler as compared to older populations as some level of stereotypies are considered part of typical development during the infant and toddler years (Berkson & Tupa, 2000; Thelen, 1979). As such, items reflective of stereotypies are less likely to be endorsed for toddlers as the behavior is not yet considered inappropriate or unusual.

Consistent with the fact that stereotypies are one diagnostic criterion for some forms of ASD, atypically developing toddlers without ASD engaged in specific forms of stereotypies less frequently than did toddlers with ASD. Researchers that combined toddlers with different forms of atypical development into one group found that between 2 and 4% of toddlers engaged in repeated and unusual vocalizations, repeated and unusual body movements, unusual play with

objects, and/or playing with own saliva (Hattier et al., 2011; Matson, Fodstad, Mahan, & Rojahn, 2010). However, when the percentage of various forms of stereotypies were examined for each atypically developing group alone (i.e., DS, DD, premature birth [PB], CP, and SD), different percentages were found. Sipes and colleagues (2011) found that atypically developing toddlers with DS, DD, PB, CP, and SD engaged in various forms of stereotypies and odd behavior at varying frequencies. All groups engaged in “repeated and unusual body movements” with frequencies ranging from 3 through 13% across groups. Overall, “repeated and unusual vocalizations” were slightly less common across groups with some not endorsing this challenging behavior (i.e., DS, CP). Other forms of odd behavior, such as “playing with own saliva” and “unusual play with objects” were endorsed with frequencies ranging from 0 to 7%, and 0 to 17%, respectively, across groups.

Other forms of challenging behavior. Some forms of challenging behavior such as elopement, inappropriate disrobing, fecal smearing, and inappropriate sexual behavior are not usually discussed as a form of aggression, SIB, or stereotypy but are common presenting concerns for caregivers of atypically developing toddlers. Each of these forms of behavior is considered a challenging behavior as they are socially unacceptable and disrupt routines or the activities of those around them.

Among children and adolescents with ASD, two separate sets of researchers examined the frequencies of these other challenging behaviors among those with ASD (i.e., Jang et al., 2011; Matson, Wilkins, & Macken, 2009). These researchers found similar results in that there were comparable frequencies of leaving the supervision of a caregiver without permission, removal of clothing at inappropriate times, fecal smearing, and inappropriate sexual behavior across studies. Leaving the supervision of a caregiver without permission was the highest

endorsed of the aforementioned forms of challenging behavior, at 47% and 50% for Matson, Wilkins, and Macken (2009) and Jang and colleagues (2011), respectively. The next highest endorsed item was removal of clothing at inappropriate times, at 36% for each study.

Inappropriate sexual behavior was endorsed by 19% and 23% of caregivers in the study by Matson, Wilkins, and Macken (2009) and Jang and colleagues (2011), respectively. The least common of the aforementioned forms of challenging behavior was fecal smearing which was endorsed by 11% of the sample in each study.

Atypically developing toddlers without ASD also engage in these other forms of challenging behavior. Similar to the child and adolescent research, fecal smearing was the least frequently reported challenging behavior by caregivers of toddlers 17 through 36 months of age with ASD (Hattier et al, 2011; Rojahn et al., 2009). Leaving the supervision of caregivers was the most common at 33% and 32%, respectively for Hattier and colleagues (2011) and Rojahn and colleagues (2009). Removal of clothing was slightly less frequent, at 21% and 23% for both Hattier and colleagues (2011) and Rojahn and colleagues (2009). Both leaving the supervision of caregivers (i.e., about 10%) and removal of clothing at inappropriate times (i.e., 6%) were even less concerning for caregivers of atypically developing toddlers without ASD (Hattier et al, 2011; Matson, Fodstad, Mahan, & Rojahn, 2010).

Conclusion. Overall, researchers have found that atypically developing toddlers engage in a range of aggressive behavior, SIB, stereotypies, and other forms of challenging behavior. It is interesting to note that endorsement rates for specific forms of challenging behavior often vary based on the study. These differences are likely due to variations in the sample and methods used to assess for specific forms of the challenging behavior. For example, researchers utilized different measures of challenging behavior which incorporate different item wordings that can

alter the specific challenging behavior that could be included as a form of that topography of challenging behavior. Also, different researchers examined challenging behavior in different samples and age ranges which may have impacted the prevalence of specific topographies of challenging behavior and challenging behavior overall. Despite the variability, it is clear that atypically developing toddlers, especially those with ASD, engage in a variety of forms of aggression, SIB, stereotypies, and other forms of challenging behavior.

Risk Factors for Challenging Behavior

Current literature indicates that multiple factors play a role in the emergence, development, and maintenance of challenging behavior. The most common theories implicate a combination of biological and environmental variables. While these are two of the broad factors affecting challenging behavior, factors such as intellectual or developmental functioning, severity of ASD, adaptive skills, psychopathology, gender, and age have also been implicated in affecting the presentation of challenging behavior. First, general biological variables will be reviewed followed by general environmental factors. Then, the specific factors will be discussed. Biological variables include genetic syndromes, medical conditions, and neurotransmitters that predispose a person to engage in specific forms of challenging behavior. For example, those diagnosed with Lesch-Nyhan syndrome, a genetic disorder, are predisposed to engaging in SIB as 100% of people with this syndrome were noted to self-bite and standard behavioral intervention is noted to be ineffective (Anderson & Ernst, 1994). Another example of genetic syndromes predisposing engagement in specific topographies of challenging behavior is Rett syndrome where a diagnostic feature is stereotypic hand wringing (Hagberg, Hanefeld, Percy, & Skeldal, 2002). Various medical conditions such as blindness, deafness, and epilepsy have also been positively associated with challenging behavior (Emerson et al., 2001; Holden & Gitlesen,

2006; Maisto, Baumeister, & Maisto, 1978). Other biological factors that may affect engagement in challenging behavior are related to neurotransmitters. For example, repetitive behavior in animals and humans has been shown to be affected by levels of various neurotransmitters, such as serotonin (Rapp & Vollmer, 2005; Schoenecker & Heller, 2003). Among some people serotonin has also been found to affect the presentation of aggression (Tsopeles, Kapsali, Tsetsou, Aggeli, & Kardaras, 2009).

Environmental variables include antecedent and consequent variables that help shape and maintain a behavior, making it more likely that a person will engage in the behavior in the future. This notion of how challenging behavior develops and is maintained follows operant theory. Operant theory hypothesizes that variables that evoke challenging behavior are learned. Many clinicians and researchers adhering to the operant model conceptualize that four main variables or factors are responsible for the maintenance of challenging behavior (Dunlap, & Fox, 2011; Hanley, Iwata, & McCord, 2003; Matson, & Minshawi, 2006). Three are socially maintained in that the reaction of others in the environment is thought to maintain the challenging behavior: attention, tangible (i.e., item or activity), and escape (i.e., stop a non-preferred activity, allow escape from an aversive setting, or have another person stop a non-preferred activity). The fourth main hypothesized reason is referred to as automatic. A behavior is thought to be automatically maintained when the stimulus produced from engagement in the behavior in and of itself is positively or negatively reinforcing, regardless of other people's reactions (Dunlap & Fox, 2011; Hanley et al., 2003; Matson & Minshawi, 2006). Researchers and clinicians have found a trend where some topographies of challenging behavior, such as stereotypies and SIB, are more likely to be maintained by automatic reinforcement over others (Applegate, Matson, & Cherry, 1999; Didden, Korzilius, & Curfs, 2007; Iwata, Dorsey, Slifer, Bauman, & Richman, 1994). For

example, aggression is more likely to be maintained by social reinforcement (Applegate et al., 1999; Embregts, Didden, Schreuder, Huitink, & Nieurwenhuijzen, 2009; Matson & Mayville, 2001; Matson, Sipes, et al Horovitz, Worley, Shoemaker, & Kozlowski, 2011).

These overall differences in the variables that evoke specific topographies of challenging behavior suggest that individual characteristics play an important role in the emergence, development, and maintenance of challenging behavior. Furthermore, researchers have identified correlates and risk factors to the engagement in and severity of challenging behavior among people with developmental disabilities. Individual characteristics that have been implicated in increased engagement in challenging behavior include intellectual or developmental functioning, severity of ASD, socialization skills, communication skills, other adaptive skills (e.g., daily living skills, motor skills), stereotypies, age, psychopathology, and gender, (Alink et al., 2006; Emerson et al., 2001; Fodstad, 2011; Holden & Gitlesen, 2006; Kearney & Healy, 2011). The majority of information regarding the association among these individual characteristics and topographies of challenging behavior stems from the child, adolescent, and adult literature. Although sparse in comparison to research involving children, adolescents, and adults, some researchers have examined the association among these individual characteristics and topographies of challenging behavior among atypically developing toddlers (e.g., Fodstad, 2011; Kozlowski & Matson, 2012; Matson, Mahan, Sipes, & Kozlowski, 2010).

Intellectual functioning. Overall, impaired intellectual functioning is implicated as a risk factor for engaging in challenging behavior. Although there are some exceptions (e.g., Kanne & Muzarek, 2011), researchers focusing on atypically developing people from toddlerhood through adulthood consistently found greater levels of various forms of challenging behavior among those who also demonstrated greater impairment in developmental or intellectual functioning

(e.g., Fodstad, 2011; Holden & Gitlesen, 2006; McClintock, Hall, & Oliver, 2003; Miltiterni, Bravaccio, Falco, Fico, & Palermo, 2002; Myrbakk & Tetzchner, 2008).

Researchers of several large scale studies examining the relationship between ID and challenging behavior among adults concluded that as ID approaches profound levels challenging behavior increases (Holden & Gitlesen, 2006; Jones, Cooper, Smiley, Allan, Williamson, & Morrison, 2008; Wilkins, Matson, & Boisjoli; 2009). One such study by Jones and colleagues (2008) examined predictors of challenging behavior among 1,023 adults diagnosed with ID. Overall, severity of ID predicted greater levels of challenging behavior with those diagnosed with more impaired forms of ID displaying the greatest levels. For example, challenging behavior was more likely to occur among those with Moderate, Severe, and Profound ID as compared to Mild ID demonstrated by odds ratios of 1.50, 2.7, and 4.2, respectively. Researchers examining the prevalence of challenging behavior among people with ID have also found that as level of intellectual functioning becomes more severe, the percentage of the group engaging in challenging behavior increases (e.g., Borthwick-Duffy, 1994). Borthwick-Duffy (1994) found that 7%, 14%, 22%, and 33% of those with Mild, Moderate, Severe, and Profound levels of ID engaged in challenging behavior, respectively.

Holden and Gitlesen (2006) found similar results among a large sample ($n = 904$) of adults and children living in Norway. As severity of ID increased, overall levels of challenging behavior increased. These researchers expanded on the research by Jones and colleagues (2008) by examining the relationship between ID and specific topographies of challenging behavior. Results indicated that diagnoses of severe and profound ID were correlated with greater levels of SIB whereas aggression was more common among those with mild and moderate ID. Smearing feces was more common among people with profound rather than other forms of ID.

Similarly, McClintock and colleagues (2003) examined the relationship between degree of intellectual functioning and specific topographies of challenging behavior (i.e., SIB, stereotypies, and aggression) through a meta-analysis. Studies included in the meta-analysis utilized samples of children and adults, with only one study including toddlers in inspecting the development of stereotypies (i.e., Berkson, McQuiston, Jacobson, Eyman, & Borthwick, 1985). Similar to previously discussed research, McClintock and colleagues concluded that people with severe or profound levels of intellectual functioning engaged in greater levels of SIB. People with more impaired intellectual functioning engaged in significantly greater levels of stereotypies. In contrast to findings by Holden and Gitlesen (2006), level of aggression was similar across all levels of ID. For aggression, Kanne and Muzarek (2011) found comparable results in that level of intellectual functioning did not predict aggression among 1,380 children and adolescents with ASD.

Comparable to the aforementioned adult and child literature, McTiernan and colleagues (2011) found that intellectual functioning was a significant predictor of the severity and frequency of challenging behavior for 174 children, 3 through 14 years of age, diagnosed with ASD. More specifically, low IQ predicted greater frequency and severity of SIB, aggression, and stereotypies. A strength of the McTiernan and colleagues' (2011) methods were that gender, age, age at diagnosis, presence of challenging behavior at diagnosis, level of intellectual functioning, current intervention type, and duration of previous intervention were included in the regression model to predict the frequency and severity of each topography of challenging behavior. Findings were consistent with other researchers' in that lower levels of intellectual functioning were significantly related to higher levels of stereotypies, SIB (Bishop, Richler, & Lord, 2006) and aggression (Dominick et al., 2007). Although finding a significant relation between

intellectual functioning and aggression, Dominick and colleagues (2007) found no significant link between level of intellectual functioning and SIB or tantrum behavior. Similar to McClintock and colleagues (2002) and Kanne and Muzarek (2011) other studies also found no link between intellectual functioning as determined by IQ scores and levels of aggression among atypically developing children (Farmer, 2011; Holden, & Gitlesen, 2006; McClintock, et al.; 2003).

Researchers have also examined the relation between intellectual functioning and stereotypies. Miltiterni and colleagues (2002) exclusively investigated the effect of intellectual functioning on various forms of stereotypies among children 2 through 11 years of age with ASD. Repetitive vocalizations and engagement with objects were significantly more frequent among those in the high IQ group (i.e., $IQ > 70$) as compared to the low (i.e., $IQ \leq 35$) and medium (i.e., $IQ 36$ through 70) groups. In contrast, Bishop and colleagues (2006) found that those 1 to 11 years of age with ASD and lower nonverbal intellectual functioning had a greater proclivity for engaging in various forms of stereotypies (e.g., “unusual preoccupations,” “repetitive use of objects,” and “hand/finger mannerisms). Although significant, the effects were small, ranging from beta weights of .01 to .02. Thus, for every one unit decrease in nonverbal intellectual functioning there was a .01 to .02 increase in stereotypic behavior. Circumscribed interests were an exception where for every one unit increase in nonverbal intellectual functioning, there was a .02 increase in this form of stereotypy. There were no significant findings for verbal stereotypies, resistance to change in routine or environment, and sensory abnormalities (Bishop et al., 2006).

As traditional measures of intellectual functioning are not considered reliable among toddlers 36 months of age and younger (Rapport & Weyant, 2008), tests of developmental

functioning are used for this age group as a comparable measure (Chawarska & Bearss, 2008). Research examining the relation between level of developmental functioning and level of specific topographies of challenging behavior among toddlers 36 months of age and younger is sparse. Watt, Wetherby, Barber, and Morgan (2008) examined various forms of stereotypies among toddlers with ASD and other developmental disorders. Similar to Bishop and colleagues (2006), repetitive behavior involving objects but not the body was significantly negatively correlated with developmental functioning among 4 year olds with ASD and other developmental disorders (Watt et al., 2008).

Fodstad (2011) examined the relation between developmental functioning and various topographies of challenging behavior among toddlers. Developmental functioning was assessed by the *Battelle Developmental Inventory, 2nd Edition (BDI-2; Newborg, 2005)* for 624 atypically developing toddlers with and without an ASD diagnosis 12 to 39 months of age. A significant relation was found between overall aggression and level of developmental functioning such that toddlers with higher levels of developmental functioning engaged in greater levels of aggression. This finding is in contrast to the majority of findings across the child and adult literature which indicated either that there was no meaningful relation between intellectual functioning and aggression or that lower levels of intellectual functioning were correlated with greater engagement in aggression. In contrast to aggression, stereotypies and SIB were most common among toddlers with lower levels of developmental functioning (Fodstad, 2011). Specifically, on the cognitive domain of the *BDI-2*, there were small, albeit significant relations between higher levels of cognitive functioning and greater levels of aggression ($r = .11$) and lower levels of stereotypies ($r = -.15$; Fodstad, 2011). With a correlation coefficient of .10, Fodstad (2011) found no significant relation between level of cognitive functioning and SIB.

As delayed developmental functioning or a diagnosis of ID is predicated on significantly impaired cognitive and adaptive functioning, impairments in communication, socialization, daily living skills, and/or motor skills may drive differences in levels of challenging behavior. Yet, researchers utilizing IQ scores as opposed to diagnosis of intellectual functioning have consistently found that people with lower scores tend to engage in greater levels of challenging behavior (e.g., Miltiterni, Bravaccio, Falco, Fico, and Palermo, 2002; McTiernan et al., 2011). The only exception was aggression where there were mixed results. Interestingly, only one study examining toddlers by Fodstad (2011) found that greater cognitive functioning was correlated with greater aggression. Yet, a limitation of many studies is that they examined IQ without reporting or taking into account the adaptive functioning of their participants. Thus, impairments in socialization, communication, and other adaptive skills may impact how IQ alone affects presentation of challenging behavior.

ASD. Information in this section reviews the literature base in regard to how a diagnosis of ASD or greater severity of ASD is associated with engagement in challenging behavior. For a review of the research regarding specific core features of ASD and their relation to challenging behavior readers are referred to later sections of this literature review. Overwhelmingly, the majority of researchers have found that having a diagnosis of ASD or more severe symptoms of ASD is a significant correlate or risk factor for engaging in challenging behavior.

Nevertheless, there are a few studies that have not found a significant relation between ASD and challenging behavior (e.g., Emerson et al., 2001; Kanne & Muzarek, 2011; Lowe et al., 2007). Through only examining the association between overall severity of ASD and aggression Kanne and Muzarek (2011) found no significant relation between the two among 1,380 children and adolescents. Similarly, Lowe and colleagues (2007) found that among a large sample of

people 5 through 93 years of age with ID, ASD diagnosis was not significantly associated with aggression, SIB, temper tantrums, destructive behavior, or non-compliance with correlation coefficients ranging from .02 to .15. However, a limitation of the above study was that diagnosis of ASD was based on caregiver report. Data collection methods included obtaining information from various settings (e.g., community homes, nursing homes, day care services, assessment and treatment units, vocational services, and schools) without standardized methods to determine or confirm ASD diagnoses. In fact, ASD diagnosis appeared to be based on the report of the setting, with no information regarding how the setting determined diagnostic status. Similar to Kanne and Muzarek (2011) as well as Lowe and colleagues (2007), Emerson and colleagues (2001) indicated that a diagnosis of autism was not significantly associated with SIB, aggression, or destructive behavior among a sample of adults. However, akin to Lowe and colleagues, autism diagnosis was based upon report without measures taken to confirm this information. As such, results from the aforementioned studies may not truly be reflective of the association among ASD and dimensions of challenging behavior.

Further, there is an overabundance of researchers indicating that those with a greater severity of ASD engage in greater levels of various topographies of challenging behavior (e.g., Bodfish, Symons, Parker, & Lewis, 2000; Holden & Gitlesen, 2003; Farmer & Aman, 2011; Fodstad, 2011; Matson, Boisjoli, Rojahn, & Hess, 2009; McCarthy, Hemmings, Kravariti, Dworsynski, Holt, Bouras, & Tsakanikos, 2010; McClintock et al., 2003; Rojahn, Matson, Mahan, Fodstad, Knight, Sevin, & Sharp, 2009). For example, there is a plethora of research indicating that adults with comorbid ASD and ID diagnoses engage in significantly greater levels of challenging behavior than those with ID alone (e.g., Bodfish, Symons, Parker, & Lewis, 2000; Holden & Gitlesen, 2003; Matson & Rivet, 2008; McCarthy et al., 2010; McClintock, et

al., 2003). More specifically, Matson and Rivet (2008) found that adults with more severe symptoms of ASD had a greater proclivity for engaging in SIB and disruptive behavior. Although weaker, symptoms of ASD and aggression/destructive behavior were also significantly and positively related.

The aforementioned findings are consistent with studies incorporating children into adult aged samples (Holden & Gitlesen, 2003; McClintock et al., 2003). A large scale study of children and adults in Norway found that those with comorbid ASD and ID diagnoses exhibited significantly greater frequencies of challenging behavior than those with ID alone (Holden & Gitlesen, 2003). Further cementing the notion that ASD is strongly associated with challenging behavior are results of a meta-analysis conducted in 2003 by McClintock and colleagues (2003). These researchers concluded that individuals with a diagnosis of autism were significantly more likely to engage in disruptive behavior, aggression, and SIB than those without an autism diagnosis (McClintock et al., 2003).

Researchers expressly examining the association between ASD or severity of ASD and challenging behavior solely among children found similar results (Baghdadli et al., 2003; Farmer & Aman, 2011; Jang et al., 2011; Matson, Wilkins, & Macken, 2009). Baghdadli and colleagues (2003) found that among 222 children with ASD, greater severity of ASD predicted engagement in SIB. Extending this previous study, Matson, Wilkins, and Macken (2009) found that children with more severe symptoms of ASD were more likely to exhibit challenging behavior. In fact, SIB and stereotypic behavior were the most highly endorsed types. Also, children with ASD engaged in significantly greater levels of challenging behavior than did those with other Axis I diagnoses and those who were typically developing (Matson, Wilkins, & Macken, 2009). A later study by Worley & Matson (2011) found similar results. That is, children with ASD

demonstrated significantly greater impairments in tantrum behavior, conduct problems, and repetitive behavior than children without ASD.

Jang and colleagues (2011) extended previous research by examining how ASD predicted a number of specific challenging behaviors among 84 children, 2 through 18 years of age, diagnosed with ASD. Overall level of ASD, as determined by a psychometrically sound measure of ASD, significantly predicted overall engagement in challenging behavior with severity of ASD accounting for 22% of the variance in total challenging behavior. After placing participants into a mild, moderate, or severe ASD group, analyses indicated that 7 out of the 18 specific items relating to challenging behavior were significantly different among groups. All challenging behavior items were more prominent in the severe ASD group with greater endorsement of “aggression toward others,” “unusual play with objects,” “playing with own saliva,” “repeated and unusual vocalizations,” and “repeated and unusual body movements” in the severe as compared to the mild ASD group. There were also greater endorsement levels of “smearing or playing with feces,” and “property destruction” in the severe as compared to the moderate ASD group. Overall, results revealed that as severity of ASD increased so did engagement in challenging behavior (Jang et al., 2011).

Similarly, Farmer and Aman (2011) found that school-aged people from 3 to 20 years of age with ASD were more likely to engage in a variety of specific forms of challenging behavior (i.e., verbal aggression, bullying, covert aggression, hostility, and physical aggression) than those with comorbid ID and ASD. People with ASD had significantly higher scores for bullying, hostility, and physical aggression. It is important to note that most items that were significantly greater for the ASD group within the Bullying subscale related to physical aggression or property destruction. (i.e., “breaks others’ things,” “takes other’s things,” “shoves or pushes,” “throws

others,” “breaks own belongings,” “charges at others,” and “hits forcefully). In regard to the Physical Aggression subscale the following items were endorsed more often for those with ASD than for those with other non ASD developmental disorders: “pinches others,” “bites others,” “head-butts others,” “pulls others’ hair,” and “scratches others.”

Findings that those with ASD or more severe symptoms of ASD are more likely to engage in challenging behavior and at more severe levels has been extended to toddlers (Fodstad, 2011; Hattier, Matson, Belva, & Horovitz, 2011; Kozlowski, & Matson, 2012; Matson, Boisjoli, Rojahn, and Hess, 2009; Rojahn, Matson, Mahan, Fodstad, Knight, Sevin, & Sharp, 2009). In a sample of 775 toddlers 17 through 36 months of age, Matson, Boisjoli, Rojahn, and Hess (2009) investigated whether there were significant differences on the Aggressive/Destructive, Stereotypies, and SIB subscales of the *Baby and Infant Screen for Children with aUtism Traits, Behavior Problems (BISCUIT - Part 3*; Matson, Boisjoli, Rojahn, & Hess, 2009) between toddlers diagnosed with ASD or no ASD. Multiple Mann Whitney tests found significant differences between the ASD and control groups for Aggressive/Destructive, Stereotypies, and SIB subscales of the *BISCUIT-Part 3* (Matson, Boisjoli, Rojahn, & Hess, 2009). These researchers used logistic regression with factors of the *BISCUIT-Part 3* serving as predictors and ASD group membership serving as the outcome variable. Overall, all factors of the *BISCUIT-Part 3* significantly predicted diagnostic status. Aggressive/Destructive behavior had a sensitivity and specificity of 33% and 93%, respectively, for predicting a diagnosis of ASD versus no ASD. The sensitivity and specificity of SIB for predicting diagnosis of ASD versus no ASD was 28% and 90%, respectively. Not surprisingly, as stereotypy is a core feature of ASD, stereotypies had the highest levels of sensitivity and specificity: 46% and 94%, respectively (Matson, Boisjoli, Rojahn, & Hess, 2009).

In a follow-up study, Rojahn and colleagues (2009) compared toddlers classified with various forms of ASD (AD, $n = 172$; PDD-NOS, $n = 140$) to a control group (atypically developing toddlers without an ASD diagnosis, $n = 450$) on overall engagement in various forms of challenging behavior reflective of Aggressive/Destructive behavior, SIB, and Stereotypies. Moderate correlations between diagnosis and the Aggressive/Destructive and Stereotypies subscales of the *BISCUIT-Part 3* were found. That is, participants with ASD were more likely to have significantly higher scores on these subscales than other groups. Interestingly, with a correlation coefficient of $-.30$, the SIB subscale was not significantly correlated to diagnosis. At an item level, there was a general trend where toddlers diagnosed with AD endorsed the greatest amount of each type of challenging behavior (Rojahn et al., 2009). This is consistent with the notion that symptom severity predicts greater challenging behavior as those with AD would likely have more severe symptoms than those with PDD-NOS or no ASD.

Further supporting the validity of the above study are corroborating results from other researchers. Across all items of a measure of challenging behavior, toddlers classified with AD had the greatest percent endorsement followed by the PDD-NOS and then the atypically developing without ASD group (Rojahn, Matson, Mahan, Fodstad, Knight, Sevin, & Sharp, 2009). Results from Fodstad (2011) further highlight that toddlers with ASD and more severe symptoms of ASD are more likely to engage in challenging behavior. Fodstad (2011) found a general trend where toddlers with ASD as compared to no ASD were noted to engage in a greater frequency and more severe challenging behavior. More specifically, toddlers with ASD ($n = 297$) displayed a greater frequency of Aggressive/Destructive behavior, stereotypies, and SIB than those without ASD ($n = 327$) with effect sizes of $.16$, $.21$, and $.09$, respectively. Similarly, Hattier and colleagues (2011) found that toddlers ($n = 2,131$), 17 through 25 months

of age, with ASD engaged in significantly greater levels of challenging behavior than those who were atypically developing but without an ASD classification. Caregivers of toddlers with ASD were more likely to endorse that their child engaged in a form of SIB, stereotypic, and Aggressive/Destructive behavior than caregivers of atypically developing toddlers without an ASD classification.

Overall, researchers have found that people across the lifespan diagnosed with ASD are more likely to engage in challenging behavior. People with more severe symptoms of ASD are more likely to engage in various forms of challenging behavior than those with less severe symptoms. However, core symptoms of ASD may differentially affect the presentation of challenging behavior and may affect the presentation of unique challenging behaviors differently. To better understand the mechanisms affecting the relation between ASD and challenging behavior it is important to consider the association among each core symptom of ASD and specific forms of challenging behavior.

Social skills. A core feature of ASD is impaired socialization (APA, 2000). Additionally, other groups who also display impaired social skills, such as those with ID, also tend to engage in challenging behavior (Cook & Oliver, 2011; Chadwick, Piroth, Walker, Bernard, & Taylor, 2000). Thus, an interesting question is whether impaired social skills significantly drive engagement in challenging behavior in and of itself. In general, findings are conflicting in that across different studies using various measures, age groups, and specific diagnostic populations, impairments in socialization are inconsistently related to greater levels of specific forms of challenging behavior.

Researchers examining how overall positive socialization skills affected the presentation of Aggressive/Destructive, SIB, and stereotypies among adults with comorbid ASD and ID

found no significant results (Matson & Rivet, 2008). Thus, level of socialization did not affect the presentation of specific topographies of challenging behavior. However, the above finding is in contrast to other studies (e.g., Kearny & Healy, 2011; Murphy et al., 2005). Among adults with moderate and mild ID those displaying severe challenging behavior had significantly more impaired social skills than those displaying mild to moderate or no levels of challenging behavior (Kearny & Healy, 2011). These results were comparable to that of Murphy and colleagues (2005) who found that lower levels of social skills were related to greater levels of challenging behavior. Although the aforementioned studies demonstrate the relation between impaired socialization and challenging behavior, they do not provide information regarding specific topographies of challenging behavior. Perhaps impaired socialization was only significantly related to some forms of challenging behavior but not others.

Not only have low levels of positive social skills been found to affect the presentation of challenging behavior, but so have higher levels of negative social skills. Matson, Fodstad, and Rivet (2009) examined how specific social skills, both positive and negative, predicted stereotypies, SIB, as well as Aggressive/Destructive and disruptive behavior among 257 adults diagnosed with ID and ASD or ID alone. Positive social skills are social skills that are socially accepted whereas negative social skills indicate inappropriate and socially unacceptable behavior. For those with ID alone, high levels of general negative and positive nonverbal social skills as well as low levels of general positive social skills predicted engagement in Aggressive/Destructive behavior. However, only low levels of general positive social skills significantly predicted greater engagement in stereotypies and SIB. Level of social skills was not found to significantly predict disruptive behavior. Similar results were found in regard to SIB and disruptive behavior for those with ASD and ID. In contrast, higher levels of negative

nonverbal and overall negative social skills significantly predicted greater levels of aggression/destruction among those with ASD and ID. Yet for stereotypies only higher levels of negative nonverbal social skills significantly predicted this form of challenging behavior.

A large scale study by Lowe and colleagues (2007) extended analyses of the effects of social skills on challenging behavior to children and adolescents. In a large scale study of 1,770 people 5 through 93 years of age with ID, these researchers found that low levels of socialization were related to higher levels of SIB ($r = .19$), but not physical aggression, ($r = .03$), temper tantrums ($r = .09$), destructive behavior ($r = .10$), or non-compliance ($r = .15$). The lack of statistical significance with large sample sizes further supports the notion that among those with ID there is no association among social skills and certain topographies of challenging behavior. Lack of a significant relation between physical aggression and social skills among children with ASD was also found by Farmer (2011). That is, Farmer (2011) also found that level of socialization did not affect presentation of verbal aggression.

Other researchers have examined the effects of verbal communication skills and level of challenging behavior on overall level of social skills among children and adolescents with ASD. Matson, Hess, and Mahan (in press) found that those with fewer deficits in verbal communication and challenging behavior demonstrated the least impairments in overall social skills. As this examination was correlational in nature perhaps a person's overall level of socialization skills affected the presentation of challenging behavior. In fact, correlational analyses found a significant moderate relation between impaired social skills and higher levels of challenging behavior.

The previously discussed studies included samples of children, adolescents, and adults, but not toddlers. It is important to examine the relation between level of socialization and

challenging behavior at younger ages, as throughout infancy and toddlerhood socialization skills develop and challenging behaviors emerge. One such study by Matson, Neal, Fodstad, and Hess (2010) examined the relation between a set of variables reflecting personal-social skills and challenging behavior among 153 toddlers 22 through 36 months of age diagnosed with ASD. The subdomains of the *BDI-2* personal-social domain were used to assess socialization (i.e., adult interaction, peer interaction, as well as self-concept and social role) and the subscales of the *BISCUIT - Part 3* were used to assess challenging behavior (i.e., Aggressive/Destructive behavior, SIB, and Stereotypies). Overall, higher levels of Aggressive/Destructive behavior, Stereotypies, and to a lesser extent SIB, were associated with lower levels of adult and peer interaction. As this analysis was correlational, causation cannot be inferred. Thus, low levels of interaction from other people may have evoked challenging behavior or engagement in challenging behavior may have caused other people to avoid interacting with them.

Fodstad (2011) examined the effects of social skills on Aggressive/Destructive behavior, SIB, and stereotypies among atypically developing toddlers 12 through 39 months of age. She found some conflicting results in that no significant relation between overall level of socialization and stereotypies were found. However, significant yet small positive correlations between socialization and Aggressive/Destructive behavior ($r = .14$) and SIB ($r = .16$) were found. Differing results between Fodstad (2011) and Matson, Neal, Fodstad, and Hess (2010) may be accounted for by the use of different sample sizes (leading to Fodstad finding smaller effects as significant) or different definitions of socialization. Fodstad (2011) used the socialization domain on the *BDI-2* as a measure of overall socialization skill whereas Matson, Neal, Fodstad, and Hess (2010) used the subdomains that comprise the socialization domain on the *BDI-2* as measures of socialization. Thus, aggregating scores on all specific types

of socialization skills as well as the use of samples with different characteristics may have led to differing results.

Overall, the literature base is mixed as to whether those demonstrating impaired socialization skills have a greater proclivity for engaging in or engaging in more severe levels of specific forms of challenging behavior. Some researchers suggest that poor socialization skills are related to increased levels of aggression, SIB, and stereotypies whereas others found different results. Additionally, some researchers suggest that greater levels of certain socializations skills were significantly correlated with engaging in and overall greater levels of specific topographies of challenging behavior, such as Aggressive/Destructive behaviors (Matson, Fodstad, & Rivet, 2009). Thus, studies providing additional knowledge regarding the association among impaired socialization skills and specific forms of challenging behavior are needed.

Communication skills. Communicating with others is a skill that is often discussed in relation to challenging behavior (Alink et al., 2006; Durand & Carr, 1991; Hanley et al., 2003). Many researchers have hypothesized that advanced communication skills result in less challenging behavior as these people experience less frustration from misunderstanding others (e.g., Alink et al., 2006; Farmer, 2011). Researchers often conceptualize, and have demonstrated through functional assessment and analyses, that problem behavior occurs as a means for a child to communicate their want for an item/activity, attention from others, or escape from a task demand/location (e.g., Dunlap & Fox, 2011; Hanley et al., 2003; Pinkston, Reese, LeBlanc, & Baer, 1973). In fact, functional communication training is typically a component of treatment packages designed to decrease challenging behavior. Studies focusing on decreasing challenging behavior and enhancing functional communication skills have consistently found that when communication skills increase, challenging behavior decrease (e.g., Derby et al., 1997; Durand,

2001; Durand, & Carr, 1991; Frea, Arnold, & Vittimberga, 2001; Hagopian, Fisher, Sullivan, Acquisto, & LeBlanc, 1998). These consistent findings implicate functional communication skills as a key determinant in challenging behavior.

However, researchers utilizing group design analyses have found mixed results when comparing people with varying levels of expressive and receptive communication on various topographies of challenging behavior. Many researchers have demonstrated that level of communication impacts engagement in challenging behavior (e.g., Emerson et al., 2001; Lowe et al., 2007; Matson, Hess, & Mahan, in press; Matson & Rivet, 2008; Murphy et al., 2005).

Communication significantly predicted engagement in Aggressive/Destructive behavior but not other forms of challenging behavior or overall engagement in challenging behavior among adults with comorbid ASD and ID (Matson & Rivet, 2008). Among adults and adolescents with ID and/or ASD, lower levels of expressive communication as well as social interaction skills were related to greater levels of challenging behavior (Murphy et al., 2005). When examining the relation between communication and specific topographies of challenging behavior among 1,770 people 5 through 93 years of age with ID, Lowe and colleagues (2007) found mixed results. Language development was significantly related to higher levels of SIB ($r = -.21$) but not aggression, ($r = .09$), temper tantrums ($r = -.02$), destructive behavior ($r = -.09$), or non-compliance ($r = -.05$).

Consistent with Lowe and colleagues (2007), Emerson and colleagues (2001) found that those with lower expressive communication skills consistently engaged in greater levels of SIB but not destructive behavior. In contrast with findings by Lowe and colleagues (2007), greater expressive communication skills were related to greater levels of aggression and non-compliance. However, this significant relationship was not stable as it was only observed for

participants in either the 1988 or 1995 sample, rather than both samples (Emerson et al., 2001). Interestingly, children and adults with ID with more demanding challenging behavior demonstrated significantly greater impairment in both receptive and expressive communication than the group with less demanding challenging behavior (Emerson et al., 2001).

Consistent with Lowe and colleagues (2007) but in contrast to Emerson and colleagues (2001), Farmer (2011) found that for children and adolescents 1 through 18 years of age expressive and receptive communication skills were not significantly related to level of verbal or physical aggression. These null results were found across one standardized assessment of receptive communication conducted with the child and two parent report measures. One of those parent report measures combined receptive and expressive communication into one score and the other provided a score for both expressive and receptive communication. Kanne and Muzarek (2011) found similar results in a sample of 1,380 children and adolescents with ASD: communication did not predict engagement in physical aggression.

Ando and Yoshimura (1979a; 1979b) also found no significant relation between receptive or expressive communication and specific topographies of challenging behavior (i.e., physical aggression, property destruction, tantrum behavior, SIB, and stereotypies) among 175 children with AD or ID. However, when dividing the sample into groups who displayed a specific topography of challenging behavior and those that did not, the group who engaged in SIB demonstrated significantly lower levels of expressive communication than the group that did not engage in SIB (Ando & Yoshimura, 1979b). There were still no significant differences in level of receptive communication when the sample was divided into groups that displayed and did not display physical aggression, property destruction, tantrum behavior, and stereotypies (Ando & Yoshimura, 1979a). This study does highlight, however, the need to examine challenging

behavior by individual topographies so differences are not masked by collapsing all challenging behavior together.

Results from Dominick and colleagues (2007) underscore the role of communication in the development and engagement in challenging behavior. Among children with ASD, Dominick and colleagues (2007) found small, albeit significant, negative correlations between aggression and a standardized test of receptive communication and a test of expressive communication. Thus, the presence of aggression was significantly correlated with lower levels of receptive and expressive communication. Similarly, the presence of SIB was significantly correlated with lower levels of expressive but not receptive communication. There were no significant relationships between receptive or expressive communication and temper tantrums. A study by Chiang (2008) further implicates the role of communication in affecting engagement in challenging behavior. A descriptive analysis of 32 children, 3 through 16 years of age diagnosed with ASD, demonstrated that children with less expressive communication skills were more likely to engage in challenging behavior. More specifically, Chiang (2008) found that 5% of acts were determined to be reflective of expressive communication (i.e., participants utilized challenging behavior to express their needs).

These results are in contrast to findings from Matson, Hess, and Mahan (in press) and Matson, Boisjoli, and Mahan (2009) who both found that greater communication skills were implicated in greater rates of overall challenging behavior (which included physical aggression, verbal aggression, destructive behavior, SIB, and stereotypies). Matson, Hess, and Mahan (in press) found a significant moderate relation between greater expressive communication skills and higher levels of overall challenging behavior among children and adolescents with ASD. Similarly, findings from Matson, Boisjoli, and Mahan (2009) found that a combination of greater

receptive and expressive communication skills were significantly related to greater levels of SIB and Aggressive/Destructive behavior (which included verbal aggression) among 168 atypically developing toddlers 17 through 36 months of age with ASD. When examining receptive communication alone there was a significant relationship between lower receptive communication and greater level of stereotypies, SIB, and Aggressive/Destructive behavior. Likewise, Estrem (2005) found that preschoolers who engaged in greater levels of physical aggression tended to exhibit worse receptive communication skills.

Differences in sample (e.g., age, diagnosis, developmental level, motor skills), measures used to assess communication, and varying statistical analyses to examine differences and relations may explain some disparate findings. For example, some studies aggregated overall language abilities together whereas others examined receptive and expressive communication separately. Also, some researchers only examined receptive or expressive abilities. Moreover, the measures each study used to determine communication varied. This variability impacts the specific communication skills that were assessed. These differences in the challenging behavior under study may have accounted for dissimilar findings. However, disparate findings are likely not solely due to abovementioned differences but also due in part to participants' individual learning history for a specific challenging behavior which were not captured in statistical analyses. For example, perhaps communication skills only significantly predict a specific form of challenging behavior when it is maintained by a certain function (e.g., tangible, attention, escape, automatic). Also, some null findings may reflect that a certain level of communicative functioning is required to engage in certain forms of challenging behavior such as verbal aggression. Combining all forms of challenging behavior into one overall group may have

masked noteworthy relationships between communication skills and certain forms of challenging behavior.

Other adaptive skills. Skills other than communication and socialization, such as daily living and motor skills, are considered a form of adaptive behavior. Daily living skills, such as completing age appropriate chores and self-help tasks as well as motor skills are usually assessed in clinical practice and research (Sparrow, Cichetti, & Balla, 2005). These skills are considered adaptive as completing them with a certain competency is necessary to interact with the world in an age appropriate manner. A commonly used measure of adaptive functioning, the *Vineland Adaptive Behavior Scales, 2nd Edition* (Sparrow et al., 2005) examines motor and daily living skills (i.e., personal, domestic, and community) along with communication and social skills. Although research comparing daily living and motor skills to challenging behavior is sparse, there is research to support the link between impaired daily living or motor skills and challenging behavior. However, it is important to note that other variables, such as level of intellectual functioning, likely impact the relationship.

Among 1,023 adults with ID, urinary incontinence along with other factors (e.g., lower ability level and visual impairment) predicted engaging in challenging behavior (Jones et al., 2008). Similarly, Emerson and colleagues (2001) found that incontinence along with requiring greater levels of assistance in eating, dressing, and self-washing were significantly related to engagement in more demanding challenging behavior. Across time periods (1988 and 1995) children, adolescents, and adults with ID who demonstrated lower mobility, self-care skills, continence, and intellectual functioning were more likely to engage in SIB (Emerson et al., 2001). Likewise, Baghdadli and colleagues (2003) found that among 222 children with ASD, greater impairment in daily living skills predicted, in part, engagement in SIB. Interestingly, no

significant relation was found between destructive behavior and self-care skills or continence (Emerson et al., 2001). Similar to Emerson and colleagues' (2001) findings for destructive behavior, Farmer (2011) found that daily living and motor skills were not significantly related to verbal or physical aggression among people 1 through 18 years of age, many of whom had a diagnosis of ASD. Yet, Emerson and colleagues (2001) also found that greater, not lower, self-care skills and continence were significantly related to aggression. Perhaps, this is reflective that these people had greater motor skills, and as such had better independent control of their limbs and ability to effectively engage in aggression. However, these significant relationships were only observed in 1988 and not 1995.

Further supporting the notion that some forms of challenging behavior are associated with more developed motor and adaptive skills are results from Fodstad (2011) who examined the relation between adaptive functioning and tantrum/conduct problems among atypically developing toddlers. Greater levels of adaptive functioning (e.g., self-care and personal responsibility skills), as measured by the *BDI-2* Adaptive domain, was significantly correlated with greater levels of tantrum and conduct problems. Despite significance this correlation coefficient was small (i.e., $r = .13$), indicating that it only explained 1.69% of the variance in tantrum and conduct problems. Similarly, greater motor skills were significantly correlated with engaging in greater levels of tantrum and conduct problems, explaining 6.76% of the variance (Fodstad, 2011).

Discrepant findings are likely due to methodological differences (e.g., specific adaptive skills under study, measures used) in combination with confounding factors, such as intellectual functioning and lack of control for level of other adaptive skills (e.g., motor skills). Impaired intellectual and adaptive functioning co-occur in those diagnosed with ID as diagnostic criteria

require deficits in both these constructs (APA, 2000). As previously discussed, lower levels of intellectual functioning has overwhelmingly been implicated in greater levels of challenging behavior. As such, impairment in intellectual functioning may have driven, in part, the significant correlations between adaptive skills and SIB found by Baghdadli and colleagues (2003).

Also, Baghdadli did not control for motor skills, and as such, differences in motor and not daily living skills possibly accounted for significant findings. Perhaps greater motor skills enabled some children to complete daily living skills more independently, including engaging in activities that competed with SIB, thus decreasing incidence of SIB. In regard to physical aggression, effective engagement likely requires a certain level of motor functioning.

Accordingly, significant relations found by Emerson and colleagues (2001) between greater levels of physical aggression and self-help skills may have been affected by these people presenting with greater motor skill. Further complicating the relationship between adaptive functioning and presentation of challenging behavior is that engagement in challenging behavior itself, rather than deficits in self-care or domestic skills, may affect the level of supports a person requires to complete daily tasks/routines. The need for supervision to complete tasks and daily routines decreases a person's scores on commonly used measures of adaptive functioning (e.g., *Vineland Adaptive Behavior Scales, 2nd Edition*).

Stereotypy. Stereotypies, including restricted and repetitive interests, are a core feature of ASD (APA, 2000) and are also considered a form of challenging behavior. As stereotypies have been previously defined, this discussion will focus solely on the association between stereotypies and other forms of challenging behavior, such as physical aggression, verbal aggression, and SIB. Researchers examining how core symptoms of ASD (i.e., socialization,

communication, and stereotypies) predict Aggressive/Destructive behavior, SIB, and disruptive behavior among adults with comorbid ID and ASD found that stereotypies significantly predicted overall engagement in challenging behavior and more specifically, SIB and disruptive behavior (Matson & Rivet, 2008). Stereotypies did not predict Aggressive/Destructive behavior (Matson & Rivet, 2008).

Using a different population Boyd, McBee, Holtzclaw, Baranek, and Bodfish (2009) also found that greater engagement in SIB was associated with increased levels of repetitive motor behavior that was not self-injurious ($r = .33$) among TD children and children with ASD. However, there was no significant relation between sensory abnormalities and SIB. Additionally, these researchers compared sensory abnormalities against other forms of stereotypies and found that greater sensory abnormalities were associated with significantly greater levels of repetitive motor behavior ($r = .41$). However, no significant relations were found among sensory abnormalities and ritualistic behavior or restricted interests (Boyd et al., 2009). A later study by Boyd and colleagues (2010) among children with developmental delays, including ASD, implicated hyper-responsiveness as likely driving the high relation between repetitive behaviors and sensory abnormalities. There was no significant association between hypo-responsiveness and other forms of stereotypies.

Similar to the adult and child literature, stereotypies were significantly correlated to SIB and Aggressive/Destructive behavior among toddlers with ASD (Rojahn, Matson, Mahan, Fodstad, Knight, Sevin, & Sharp, 2009). Correlation coefficients were .36 and .50 for SIB and Aggressive/Destructive subscales of the *BISCUIT-Part 3*, respectively. Unfortunately, this study did not examine the relation among each specific item reflective of Stereotypies, Aggressive/Destructive behavior and SIB. As such, it is not known whether specific forms of

stereotypies (e.g., unusual play with objects, repetitive vocalization, and repetitive motor movements) were more likely to impact engagement in Aggressive/Destructive behavior and SIB.

A study by Hattier and colleagues (2011) examined these relations at an item level and found negligible to small positive correlations between vocal and motor stereotypies and challenging behaviors reflecting SIB, disruptive behavior, physical aggression, verbal aggression, elopement, and inappropriate removal of clothing among 2,131 toddlers with developmental concerns (e.g., ASD, developmental delay). Thus, contrary to previous findings, there were no meaningful relations between some stereotypies and other topographies of challenging behavior. Fodstad (2011) examined predictors of stereotypic behavior among 297 toddlers with ASD and found that tantrum and conduct problems did not significantly increase the odds of a toddler engaging in stereotypies. Other researchers also found non-significant, small correlations between stereotypies and other challenging behaviors (e.g., Aman et al., 1995).

Overall, there is a paucity of research examining the relation between stereotypies and other topographies of challenging behavior. This is likely because stereotypies can be conceptualized as a core feature of ASD and as a challenging behavior. Although researchers have found mixed results it is possible that the use of different measures for stereotypies, other forms of challenging behavior, and varying populations (e.g., age, diagnosis) affected the consistency of results. Furthermore, studies that aggregated forms of challenging behavior into overall topographical groups, as opposed to examining at an item level, tended to find significant results. It may be that researchers comparing the relation among stereotypies and challenging behavior are not capturing the functional relation between these two behaviors for some people.

For example, through extended analogue functional analyses, White and colleagues (2011) found that two children diagnosed with ASD likely engaged in physical aggression to gain access to toys that were used to engage in stereotypies. Thus, White and colleagues (2011) identified a functional relation between stereotypies and physical aggression that might otherwise have been missed.

Psychopathology. In this section, when referring to psychopathology, developmental disorders such as ASD and ID are excluded. Some researchers have found no significant associations between psychopathology and challenging behavior (e.g., Emerson et al., 2001; McCarthy et al., 2010). For example, McCarthy and colleagues (2010) found no significant differences in presentation of challenging behavior based on comorbid psychopathology among adults with ASD and ID after controlling for gender, age, and level of ID. Similarly, among children and adults with ID, comorbid psychopathology determined by caregiver report was not significantly related to level of aggression, SIB, or destructive behavior (Emerson et al., 2001). These findings were consistent across two testing periods (Emerson et al., 2001).

However, the majority of published research has found a positive association between psychopathology and challenging behavior (e.g. Jones et al., 2008; Kearney & Healy, 2011; Reiss & Rojahn, 1993; Rojahn et al., 2004). Among adults with ID, Attention Deficit Hyperactivity Disorder has been found to be a significant predictor of challenging behavior (Jones et al., 2008). In a child and adult ID sample, the presence of depressive symptoms significantly increased the likelihood of aggression among children and adults (Reiss & Rojahn, 1993). Yet another study by Rojahn and colleagues (2004) examining adults with ID found significant positive associations among symptoms of depression and levels of aggression, SIB, and stereotypies when using the *Diagnostic Assessment of the Severely Handicapped, 2nd edition*

(*DASH-II*; Matson, 1995) as a measure of psychopathology. This same study also concluded that aggression, SIB, and stereotypies were significantly associated with increased symptoms of mania, anxiety, schizophrenia, impulse control, stereotypies/tics, and organic syndromes (Rojahn et al., 2004). Similarly, Kearney and Healy (2011) found that adults with ID and with more severe levels of challenging behavior had significantly greater scores on subscales of the *DASH-II* reflecting anxiety, mood, mania, impulse, organic, ASD, schizophrenia, and stereotypic movement disorders than those displaying lower levels of challenging behavior.

Recently, there have been several researchers examining the relation between symptoms of comorbid psychopathology and challenging behavior among toddlers with developmental disabilities (e.g., Fodstad, 2011; Matson, Mahan, Fodstad, Worley, Neal, & Sipes, 2011; Matson, Mahan, Sipes, & Kozlowski, 2010). Through examining the emergence of challenging behavior among atypically developing toddlers 12 through 39 months of age, Fodstad (2011) found that symptoms related to psychopathology were significantly associated with Aggressive/Destructive behavior, stereotypies, and SIB. The *BISCUIT-Part 2* (Matson, Boisjoli, & Wilkins, 2007) and *Part-3* were used to assess symptoms of psychopathology and challenging behavior, respectively. The *BISCUIT-Part 2* Tantrum/Conduct problems subscale was highly and positively correlated with *BISCUIT-Part 3* Aggressive/Destructive behavior subscale. Symptoms reflective of impulsivity, anxiety/repetitive behavior, and avoidant behavior were also significantly associated with greater levels of Aggressive/Destructive behavior, stereotypy, and SIB, but at small to moderate levels.

Similarly, Matson, Mahan, Sipes, and Kozlowski (2010) found that greater levels of symptoms of comorbid psychopathology were significantly associated with higher levels of challenging behavior among atypically developing toddlers without an ASD diagnosis 17

through 36 months of age. More specifically, greater levels of Tantrum/Conduct Problems, Inattention/Impulsivity, Anxiety/Repetitive Behaviors, and Avoidant Behavior were significantly related to high rates of Aggressive/Destructive behaviors, Stereotypies, and SIB. Examining toddlers with ASD, Matson, Mahan, Fodstad, Worley, Neal, and Sipes (2011) found that those with higher scores on symptoms of Avoidance and Tantrum/Conduct Problems engaged in significantly greater levels of Aggressive/Destructive behaviors, SIB, and stereotypies. However, toddlers scoring higher on Inattention/Impulsivity engaged in significantly greater levels of Aggressive/Destructive behavior and stereotypies but not SIB. In regard to Anxiety/Repetitive behavior, those with higher scores only engaged in significantly greater levels of stereotypies.

It is important to note that the association among challenging behavior and symptoms of psychopathology in the aforementioned studies were likely artificially inflated by some content overlap. For example, the majority of items comprising the impulse subscale of the *DASH-II* are a form of challenging behavior (e.g., tantrum behavior, property destruction, verbal aggression, physical aggression, elopement, stealing). Although less of a content overlap, some items of the other subscales also reflect challenging behavior. As such, perhaps the scores on those items drove the differences in symptoms of psychopathology found between people engaging in low and more severe forms of challenging behavior. Furthermore, terms used to describe challenging behavior by psychiatrists and other medical professionals such as agitation, irritability, and crying were also used as symptoms of psychopathology in all studies.

For research utilizing toddlers, content overlap between subscales also likely explain some of the shared variance between subscales of the *BISCUIT-Part 2* and *Part 3*. For example, both the *BISCUIT-Part 2* Tantrum/Conduct Problems and *BISCUIT-Part 3* Aggressive/Destructive behavior subscales assess physical aggression, property destruction, and

tantrum behavior. In fact, Fodstad (2011) notes this as a limitation. Significant associations among *BISCUIT-Part 2* Impulsivity, Anxiety/Repetitive behavior, and Avoidant behavior subscales and *BISCUIT-Part 3* subscales are also confounded by overlapping constructs. Some items reflective of impulsivity (e.g., engages in behavior that interferes with daily activities, and eats non-edible items) may confound results as they are also indicative of challenging behavior as challenging behavior by nature interferes with a person's daily activities. Furthermore, eating non-edible items is considered a form of SIB. Similarly, symptoms of anxiety/repetitive behavior include stereotypic and odd behaviors which were also assessed with the *BISCUIT-Part 3* Stereotypy subscale.

The above noted overlap in symptoms between psychopathology and challenging behavior is common. Specific forms of challenging behavior are considered symptoms of psychopathology, such as Oppositional Defiant Disorder, Conduct Disorder, and anxiety disorders among children (APA, 2000). Additionally, challenging behavior is often considered indicative of having irritability and agitation, which are symptoms of many psychological disorders, such as mood disorders (APA, 2000). In fact, challenging behavior is frequently interpreted as symptoms of psychopathology (Holden & Gitlesen, 2009) but doing so increases the rate of false positives for psychopathology among those with ID (McBrien, 2003). As such, there is a natural confound between psychopathology and challenging behavior. If challenging behavior is commonly used to assess for psychopathology among children and those with developmental disabilities than it is not surprising that positive associations have been found between these two variables.

Gender. Overall there is a burgeoning literature base indicating that gender does not significantly affect the presentation of a wide range of topographies of challenging behavior

among atypically developing people (Baghdadli et al., 2003; Chadwick et al., 2000; Fodstad, 2011; Holden & Gitlesen, 2006; Kanne & Muzarek, 2011; Kozlowski & Matson, 2012; Lowe et al., 2007; McTiernan et al., 2011; Totsika, Toogood, Hastings, & Lewis, 2008; Worley & Matson, 2011). This is in contrast to the majority of literature focusing on the typically developing population for which significant differences on challenging behavior in regard to gender have consistently been found (Alink et al., 2006). Although few, some researchers have found gender differences in the presentation of some topographies of challenging behavior among atypically developing people. For example, among children and adults with ID, Emerson and colleagues (2001) found that being male was positively correlated to engagement in destructive behavior. However, this significant relation was small and only found at one assessment time but not another.

The body of research by researchers indicating no gender differences in the presentation of challenging behavior utilizes participants across the lifespan with a developmental disability. For example, in a study consisting of 1,770 people 5 through 93 years of age with ID, gender was not associated with physical aggression, SIB, temper tantrums, destructive behavior, or non-compliance (Lowe et al., 2007). Correlation coefficients ranged from .04 to .09 (Lowe et al., 2007). Focusing on aggression, Kanne and Muzarek (2011) found that gender did not predict engagement among 1,380 children and adolescents with ASD. The lack of statistical significance with the use of large sample sizes across studies provides strong evidence for the lack of gender differences for those topographies of challenging behavior among children, adolescents, and adults. Further demonstrating the robustness of the previous findings, researchers utilizing similar populations and challenging behavior found similar results (e.g., Holden & Gitlesen, 2006; Totsika et al., 2008). Totsika and colleagues (2008) also found no gender differences for

disruptive behavior and stereotypies. Comparable results were found for a sample of adults with ID living in Norway (Holden & Gitlesen, 2006).

Researchers examining the effect of gender on various topographies of challenging behavior expressly for atypically developing children found similar results. That is, researchers overwhelmingly found no link between gender and level of challenging behavior (e.g., Chadwick et al., 2000; Farmer, 2011; McTiernan et al., 2011; Worley & Matson, 2011). For example, Chadwick and colleagues (2000) found no significant differences between male and female children with ID on level of SIB or aggression. Other researchers using child samples diagnosed with ASD have also consistently found that gender does not predict SIB (e.g., Baghdadli et al., 2003; Farmer, 2011; McTiernan et al., 2011), physical aggression (Farmer, 2011; McTiernan et al., 2011; Worley & Matson, 2011), stereotypy (McTiernan et al., 2011), destructive behavior (Worley & Matson, 2011), verbal aggression, bullying behavior, hostile behavior, and covert forms of aggression (Farmer, 2011).

Although there are fewer researchers solely examining gender differences on challenging behavior among toddlers with developmental disabilities, results are analogous to the adult and child literature (e.g., Fodstad, 2011; Kozlowski & Matson, 2012). Kozlowski and Matson (2012) conducted one of the first studies specifically examining the effects of gender on presentation of challenging behavior among atypically developing toddlers. Among 322 toddlers 17 to 36 months of age presenting with a variety of developmental delays, no gender effects were found across a variety of challenging behaviors (e.g., physical aggression, property destruction, verbal aggression, SIB, stereotypies, elopement, and disrobing in inappropriate places). Fodstad (2011) conducted a large scale study consisting of 2,214 toddlers 19 to 39 months of age with a developmental disability (e.g., ASD, developmental delay) and found similar results. That is, she

found that gender was not a significant risk factor for challenging behavior. Similar to the child, adolescent, and adult literature, the non-significant findings with large sample sizes further substantiates the notion that gender itself does not likely affect the presentation of challenging behavior among toddlers with developmental disabilities.

Age. The emergence and trajectory of various topographies of challenging behavior among atypically developing people is important to consider. Overall, researchers found no significant age differences on challenging behavior among atypically developing children, adolescents, and adults. There are numerous studies examining the emergence and trajectory of challenging behavior overall and specific topographies of challenging behavior among those with ASD and other atypically developing groups (e.g., Dominick et al., 2007; Emerson et al., 2001; Farmer & Aman, 2011; Fodstad, 2011; Holden & Gitlesen, 2006; Matson, Mahan, Hess, Fodstad, & Neal, 2010) .

One of the few researchers finding significant age differences among atypically developing children, adolescence, and adults were Holden and Gitlesen (2006). They examined the trajectory of challenging behavior across the lifespan for 904 people with ID. In examining age trends of challenging behavior the authors divided the population into 10-year age groups starting from 0 to 9 through 70 to 79 years of age. Overall, rates of challenging behavior decreased from the 0 to 9 to the 20 to 29 age groups, and then increased through the 50 to 59 age group, whereupon rates gradually declined through the 70 to 79 year old age group. As each group included a range of 10 years Holden and Gitlesen (2006) were unable to examine the trajectory of challenging behavior within the age groups. As such, significant changes in rate of challenging behavior were only able to be attributed to a large range of ages as opposed to more specific ages. For example, perhaps the greater rates in challenging behavior seen in the 0 to 9

year age group as opposed to the 20 to 29 year age group was driven by those who were 2 to 4 years of age and not by those who were 7 to 9 years of age.

A study by Lowe and colleagues in 2007 examined the relation between age (as a continuous variable) and specific topographies of challenging behavior among 1,770 people 5 through 93 years of age with ID. Younger age was significantly associated with greater levels of temper tantrums ($r = -.18$), aggression ($r = -.20$), non-compliance ($r = -.23$), and destructive behavior ($r = -.27$), but not SIB ($r = -.10$). Although significant, these correlations were small and at most only accounted for about 7% of the variance. Thus, significance may be more reflective of the sample size than indicative of meaningful differences in levels of challenging behavior across age. In contrast, Chadwick, Kusel, Cuddy, and Taylor (2005) found no overall difference in rates of physical aggression, destructive behavior, or SIB between two assessment times across 82 children with ID indicating that engagement in challenging behavior is stable among atypically developing children. Challenging behavior for each child was assessed two separate times across 5 years using the *Behaviour Problems section of the Disability Assessment Schedule* (Holmes, Shah, & Wing, 1982) and the *Aberrant Behavior Checklist* (Marshburn & Aman, 1992).

Although, overall, results of both the Lowe and colleagues (2007) and Chadwick and colleagues (2005) studies suggest that age does not significantly affect the presentation of challenging behavior among those with developmental disabilities, they only focus on people 4 years of age and older. Yet research indicates that challenging behavior emerges by at least 12 months of age for typically and atypically developing people (Alink et al., 2006; Dominick et al., 2007, Fodstad, 2011; Tremblay, Japel, Pérusse, Boivin, Zoccolillo, Montplaisir, & McDuff, 1999) and some researchers suggest that certain forms of challenging behavior, like physical

aggression, reach its peak by 2 to 3 years of age (Gimenez & Blatier, 2004; Cote et al., 2006; Tremblay et al., 1996; 1999). As such, it is imperative that researchers examining the effects of age on challenging behavior in atypically developing populations incorporate toddler-aged participants.

The following researchers incorporated people 3 years of age into their analyses and consistently found that age did not significantly affect the presentation of challenging behavior. For example, Matson, Mahan, Hess, Fodstad, and Neal (2010) found no significant age trends among 167 children 3 through 14 years of age with ASD on 18 specific topographies of challenging behavior related to physical aggression, verbal aggression, destructive behavior, SIB, and stereotypies. These results were similar to those by Murphy, Healy, and Leader (2009) as well as McTiernan and colleagues (2011). Both studies examined children 3 through 14 years of age with a developmental disability (e.g., ID or ASD) and found similar results in that age did not predict the frequency or severity of aggression, SIB, or stereotypies. Further supporting the notion that there are no significant age differences for specific forms of challenging behavior across childhood, a recent study by Farmer and Aman (2011) found no significant age differences for verbal aggression, physical aggression, hostility, bullying, covert behavior, or hostile behavior among 121 people with ASD, 3 through 20 years of age.

Although aforementioned results indicate that age does not affect the presentation of challenging behavior, the researchers did not solely focus on the trajectory of challenging behavior among toddlers 3 years of age and younger. One set of researchers that examined the emergence of challenging behavior from toddlerhood through childhood is Dominick and colleagues (2007). Through retrospective caregiver report Dominick and colleagues (2007) found that physical aggression, temper tantrums, and SIB emerged from 0 through 11 years of

age among children with ASD or a history of language impairment with a mean age of onset ranging from 2 to 3.5 years of age. Furthermore, 20% of the children with ASD were noted to engage in temper tantrums by 1 year of age which increased to 50% by 3 years of age (Dominick et al., 2007). Thus, when examining the trajectory of challenging behavior among a toddler-aged population some age differences were found with older toddlers engaging in greater levels of challenging behavior than younger toddlers.

These results are consistent with findings from Fodstad (2011) who conducted the first study known to this writer to examine the emergence of various topographies of challenging behavior among atypically developing toddlers 12 through 39 months of age. Fodstad (2011) examined the development of Aggressive/Destructive, SIB, and stereotypic behavior using a large sample size of 624 atypically developing toddlers. To examine the development of various challenging behavior across toddlerhood, groups with a 6-month age span were made: 12-18, 19-25, 26-32, and 33-39 months of age. Overall, older toddlers engaged in more severe challenging behavior compared to younger toddlers, with the only significant age trend occurring for Aggressive/Destructive behavior where at 26-32 months of age levels significantly increased. The mean score of Aggressive/Destructive behavior increased from the 12-18 month group through the 33-39 month group. Perhaps as children became older, they acquired more advanced motor skills which provided these toddlers with a greater physical ability to engage in aggressive and destructive behavior. This increase was more apparent in the ASD as compared to the atypically developing without ASD group. Within the Aggressive/Destructive behavior subscale there was a significant age trend for property destruction and yelling at others such that the 26-32 and 33-39 month old groups engaged in significantly greater levels than the younger age groups. For throwing objects at other, kicking objects, aggression toward others, and pulling others' hair,

the 26-32 and 33-39 month age groups engaged in significantly greater levels than the 12-18 but not the 19-25 month age group. Thus, there was an overall trend where the older groups engaged in greater levels of specific forms of challenging behavior than the younger groups.

Results found by Fodstad (2011) are consistent with research focusing on typically developing toddlers where physical aggression was found to increase through the toddler years (e.g., Alink et al., 2006; Tremblay et al., 1999). Similarly, Fodstad (2011) found that other specific forms of aggressive and destructive behavior were more common among older than younger toddlers. Yet, research indicates that after 3 to 4 years of age, these forms of challenging behavior become more stable. That is, for atypically developing populations, the majority of researchers have found that level of and engagement in various topographies of challenging behavior is consistent across childhood, adolescence, and adulthood.

PURPOSE

Research overwhelmingly indicates that people with ASD, including toddlers, are more likely to engage in challenging behavior and at greater levels than comparison groups. However, the majority of researchers have focused on comparing groups of individuals diagnosed with ASD or overall severity of ASD on overall engagement in challenging behavior as opposed to specific types of challenging behavior. Despite the general consensus that toddlers, children, adolescents, and adults with ASD are more likely to engage in challenging behavior than other populations, the literature base is mixed in regard to how socialization skills, communication skills, and stereotypic behavior affect engagement in and presentation of challenging behavior. When core symptoms of ASD are examined, they are frequently examined in isolation and with measures that have no or limited psychometric support for identifying individuals with ASD. In fact, researchers have expressed the need for further research examining the collection of risk factors and how they interplay and affect specific forms of challenging behavior, at an item level, among people with developmental disabilities (Baghdadli, et al., 2003; Matson & Nebel-Schwalm, 2007).

Researchers focusing on adults with comorbid ASD and ID found that core symptoms of ASD predicted engagement in subscales representative of SIB, disruptive behavior, and Aggressive/Destructive behavior (Matson & Rivet, 2008). Although more fine-grained than other studies, specific forms of aggression, destructive behavior, disruptive behavior, and SIB were not examined separately. This information is important as different variables may affect the presentation of different distinct forms of challenging behavior. To this author's knowledge, researchers to date have not examined how core symptoms of ASD (i.e., impaired socialization and communication as well as stereotypic behavior) predict engagement in specific discrete

forms of challenging behavior among a toddler sample at risk for developing ASD while controlling for developmental functioning.

In an effort to extend previous literature and examine relations that have not previously been under investigation, the purpose of this study was to determine how specific core symptoms of ASD predict engagement in specific forms of challenging behavior among atypically developing toddlers above and beyond developmental functioning. First, how core symptoms of ASD predict overall topographies of challenging behavior (i.e., Aggressive/Destructive and SIB) was examined. For those core symptoms that significantly predicted overall engagement in a topography of challenging behavior, follow-up analyses at an item level were conducted comparing items that comprise that core symptom to items that comprise the topography category. Subscales and items of the *BISCUIT-Part 1*, a psychometrically sound measure of ASD for toddlers was used to assess core symptoms of ASD whereas subscales and items of the *BISCUIT-Part 3*, a psychometrically sound measure of challenging behavior among atypically developing toddlers was used to assess engagement in challenging behavior. The *Battelle Developmental Inventory, 2nd Edition (BDI-2; Newborg, 2005)* was used as a measure of developmental functioning to help determine whether the aforementioned variables were significantly related after accounting for developmental level.

Knowledge of how specific core features of ASD predict specific topographies of challenging behavior from a young age would likely provide invaluable knowledge toward guiding early assessment and intervention strategies (McTiernan, et al., 2011). Among atypically developing populations, engaging in challenging behavior is related to greater psychotropic medication and restraint use, more restrictive school and living placements, less community outings, and complicates implementation of interventions to increase skill acquisition (Anderson,

Laken, Bradley, & Chen, 1992; Harris, 1993; Matson & Wilkins, 2007; Sturmey, Lott, Laud, & Matson, 2005). Given the negative impact of challenging behavior on the child and family, identifying more precise risk factors of specific forms of challenging behavior can help guide future research on treatment to help offset their severity or engagement.

HYPOTHESES

Based on the literature some hypotheses were developed. Hypothesis one was that overall developmental functioning would significantly predict engagement in all topographies of challenging behavior. The second set of hypotheses concern the Social/Nonverbal Communication subscale of the *BISCUIT-Part 1*. Researchers have indicated that poorer socialization skills are significantly related to greater engagement and severity of challenging behavior among atypically developing toddlers (Fodstad, 2011; Matson, Neal, Fodstad, & Hess, 2010); however, this has not been consistently studied or replicated across topographies of challenging behavior. Researchers examining atypically developing individuals have consistently found that poorer social skills are related to higher levels of Aggressive/Destructive Behavior (Fodstad, 2011; Matson, Neal, Fodstad, & Hess, 2010). As such, it is hypothesized that higher scores on the Social/Nonverbal Communication subscale (indicative of greater impairment) would significantly predict those who engage in aggressive and destructive forms of challenging behavior when controlling for developmental functioning. It is further predicted that when controlling for developmental functioning, items comprising the Social/Nonverbal Communication subscale would significantly predict items representing aggressive and destructive behavior of the Aggressive/Destructive Behavior factor. In contrast, there were no specific hypotheses for how specific items reflective of socialization skills would predict engagement in items reflecting verbal aggression, removing clothing at inappropriate times, and elopement that comprise the Aggressive/Destructive Behavior factor of the *BISCUIT-Part 3*. These lack of hypotheses are based on mixed findings and paucity of research examining these specific behaviors. There is also no specific hypothesis for how core symptoms of ASD predict

SIB as there is a mixture of inconsistent findings and a paucity of research focusing on this specific topography of challenging behavior.

The third set of hypotheses concern the Communication subscale of the *BISCUIT-Part 1*. There is a plethora of single subject design research demonstrating that increases in functional communication skills are related to a variety of forms of challenging behavior across those of all ages who are atypically developing (Derby et al., 1997; Durand, 2001; Durand, & Carr, 1991; Frea, et al., 2001; Hagopian, et al., 1998). However, this has not been consistently replicated in group design research (Emerson et al., 2001; Farmer, 2011; Lowe et al., 2007; Matson, Boisjoli, & Mahan, 2009; Matson, Hess, & Mahan, in press). Furthermore, some researchers have found that greater levels of communication are significantly related to greater engagement in challenging behavior (e.g., Matson, Hess, & Mahan, in press) whereas other researchers have found the opposite to be true (e.g., Murphy et al., 2005). As such, there are no specific hypotheses on how level of communication will affect engagement of topographies of challenging behavior when controlling for developmental functioning. Yet, if analyses were conducted at the item level, it was hypothesized that scores on items related to communication would be negatively correlated with the item “yelling or shouting at others” when developmental functioning was accounted for. Those with greater communication skills are more likely to use words to communicate, and thus, are more likely to have the ability to yell words at others.

The fourth set of hypotheses considers how scores on the Repetitive Behavior/Restricted Interests predict engagement in challenging behavior. Similar to findings examining the relationship between socialization and challenging behavior and communication and challenging behavior, researchers focusing on atypically developing toddlers found mixed results on the affects of stereotypies on aggressive, destructive, SIB and other forms of challenging behavior.

Only Rojahn and colleagues (2009) found significant results whereas other researchers (i.e., Fodstad, 2011; Hattier et al., 2011) have found null results. Due to the lack of research and inconsistent results, no hypotheses were developed for how Repetitive Behaviors/Restricted Interests would predict engagement in challenging behavior when controlling for developmental functioning.

METHODS

Participants

A preexisting database consisting of at-risk toddlers for ASD was used for this study. Despite heterogeneity among the ASD population, those with ASD are more likely to have more severe symptoms of ASD, thus limiting the range of scores endorsed for each item reflecting a core feature of ASD. All participant information was collected from July 2008 through February 2012. At the time of this study, there was information for 4,196 toddlers. All toddlers and their caregivers had participated or currently participate in the State of Louisiana's EarlySteps program. EarlySteps is the State of Louisiana's Early Intervention System under the Individuals with Disabilities Education Act, Part C. This system provides services to infants and toddlers, from birth to 36 months of age who are currently experiencing a developmental delay or have a medical condition (e.g., seizure disorder, cerebral palsy, Down syndrome) that is likely to result in a developmental delay.

When reading this section readers are urged to view Figure 1 which highlights the flow of participants through this study. Participants were excluded from participation if they were missing data for an entire measure (i.e., *BISCUIT-Part 1*, *BISCUIT-Part 3*, and *BDI-2*) or for one page of a measure that was used in this study. This excluded 1,271 participants from the study. Participants were also excluded if they were outside of the 17 to 36 month age range at the time the measures were administered or if no age was provided. This age exclusion was done as the psychometric viability of two measures used in this study (i.e., *BISCUIT-Part 1* and *Part 3*) had only been determined using infants and toddlers from 17 to 36 months of age. The exclusion of infants and toddlers younger than 17 months and older than 36 months resulted in 20 participants being excluded from this study.

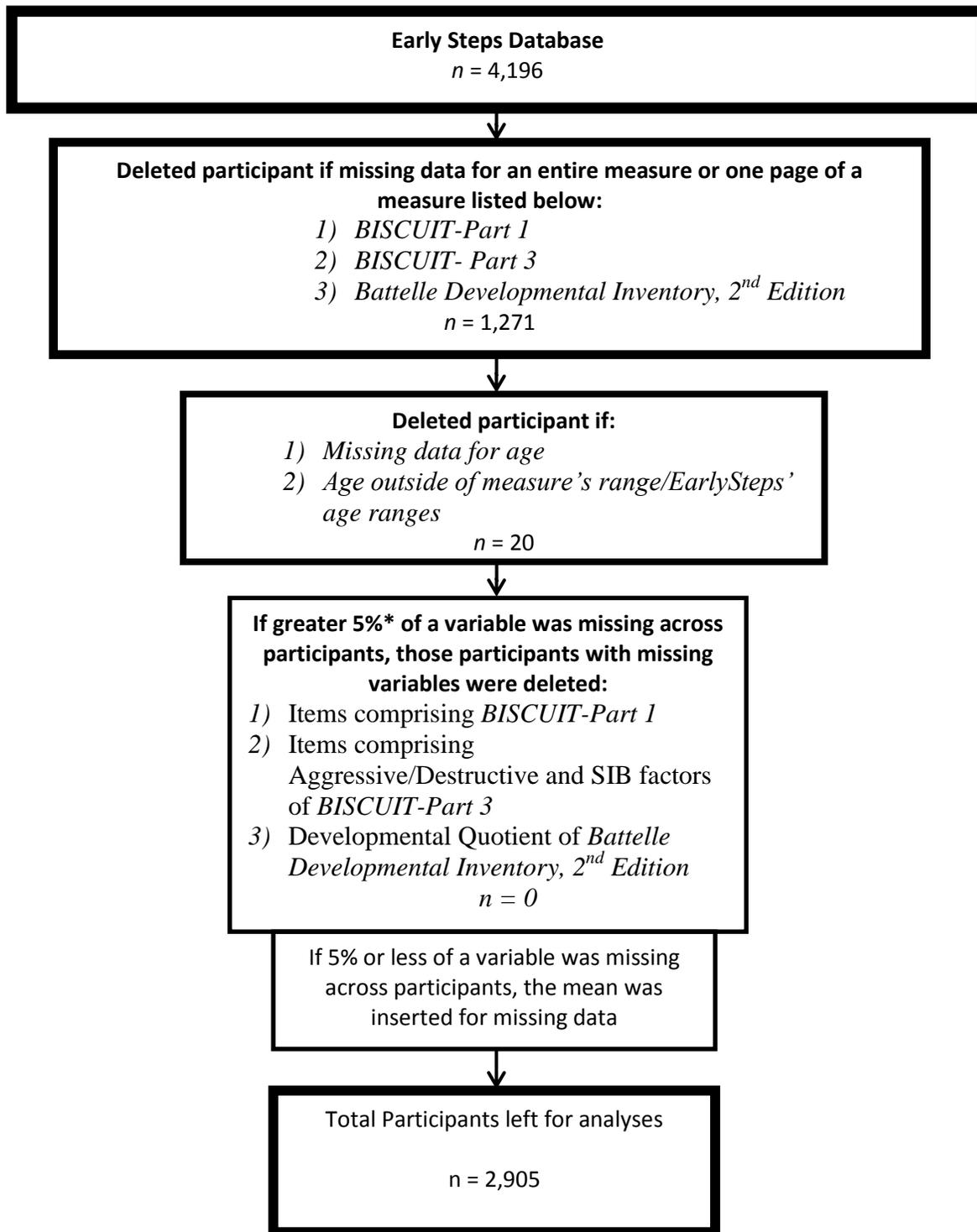


Figure 1

Flow Chart of Participants

Tabachnick & Fidell (2007); Other researchers have used this missing value criterion in studying toddler populations at risk for ASD and other developmental disabilities and/or challenging behavior (e.g., Fodstad, 2011; Dempsey, 2011). Other researchers inserted the mean for missing data when using logistic regression and/or studying challenging behavior among those with/at-risk for developmental disabilities (e.g., Fodstad, 2011; Rudy, 2012).

Prior to analyses all variables were examined for missing data. The pattern of missing values was determined through Missing Value Analyses for *BDI-2* Developmental Quotient, and all items comprising factors used in this study (i.e., *BISCUIT-Part 1*: Social/Nonverbal Communication, Communication, and Repetitive Behavior/Restricted Interests factors; *BISCUIT-Part 3* Aggressive/Destructive Behavior and SIB factors). Missing Value Analyses determined that the pattern of missing data was 0 to 1.1% across all participants for all items. As less than 5% of data was missing for a variable across participants, no participants were deleted from analyses. Although there are no specific rules for how much missing data is acceptable, Tabachnick & Fidell (2007) suggest that missing 5% of values is acceptable. Researchers using logistic regression, examining similar populations, and challenging behavior have used this missing value criterion (e.g., Fodstad, 2011). Mean substitution for a variable across participants was used in an effort to estimate missing values as this provides the best approximation of the value of a variable (Tabachnick & Fidell, 2007). This method was chosen as it does not alter the mean of the distribution. Other researchers have used this method for dealing with missing data when using logistic regression and/or studying challenging behavior among toddler populations at-risk for developmental disabilities (Fodstad, 2011; Rudy, 2012).

In total, 2,905 participants were included into this study with ages ranging from 17 to 36 months of age. See Table 1 for demographic information of toddlers used in this study. Consistent with findings for this population, the majority of infants and toddlers were male (71%). For ethnicity, 48.5% of participants were Caucasian. Other ethnicities were also represented, such as African American (39.3%) and Latino (5.3%). Some caregivers of infants and toddlers (4.4%) chose not to indicate ethnicity. Out of toddlers with a physical or medical

condition, the most common were history of chronic ear infections (2.9%), asthma (2.2%), seizures (1.1%), allergies (0.9%), Cerebral Palsy (0.6%), a heart condition (0.5%),

Table 1
Demographic information

	<i>n</i>	Age Range (months)	Age		Gender (%)		Ethnicity (%)				
			<i>Mdn</i>	<i>SD</i>	Male	Female	C	A	L	O	NP
Participants	2,905	17- 36	26.0	4.5	71.0	29.0	48.5	39.3	2.5	5.3	4.4

Note: *n* = number of participants per group, *Mdn* = median, *SD* = standard deviation, C = Caucasian, A = African American, L = Latino, O = other ethnicity, and NP = ethnicity information was not provided.

gastrointestinal related disorders (0.4%), and Down’s syndrome (0.3%). A minority of toddlers were noted to be taking psychotropic medication at the time of this study (17.2%). The most common type of psychotropic medication taken at the time of this study was Antiepileptic/mood stabilizers (13.7%).

Table 2
Engagement in challenging behavior at the group level

	Engage in (1)		Do not Engage in (0)	
	<i>n</i>	%	<i>n</i>	%
Aggressive/Destructive Behavior	1286	44.30	1619	55.70
SIB	480	16.50	2425	83.50

As the purpose of this study was to examine how symptoms of ASD predict engagement in challenging behavior above and beyond developmental functioning, scores on items of the Aggressive/Destructive and SIB factors of the *BISCUIT-Part 3* were first transformed into a binary variable (i.e., 0 and 1). Scores above 0 were transformed to 1 to indicate that the participant engaged in challenging behavior that was considered problematic by the caregiver. Scores of 0 remained 0, indicating no concern with that type of challenging behavior. See Tables

2 (above) and 3 (below) for information regarding number and percent of participants engaging in each form of challenging behavior. The majority of participants did not engage in each specific form of challenging behavior.

Table 3
Engagement in challenging behavior at the item level

	Engage in (1)		Do not engage in (0)	
	<i>n</i>	%	<i>n</i>	%
Aggressive/Destructive Behavior				
3	442	15.2	2463	84.8
4	258	8.9	2647	91.1
6	180	6.2	2725	93.8
7	708	24.4	2197	75.6
8	527	18.1	2378	81.9
9	515	17.7	2390	82.3
10	648	22.3	2257	77.7
11	502	17.3	2403	82.7
12	441	15.2	2464	84.8
13	451	15.5	2454	84.5
SIB				
1	123	4.2	2782	95.8
2	435	15.0	2470	85.0

Procedure

Prior to initiation of the study, Institutional Review Board (IRB) approval was obtained from Louisiana State University and the State of Louisiana Department of Health and Hospitals (DHH). Louisiana's Office for Citizens with Developmental Disabilities (OCDD) is the organization that oversees the EarlySteps program within DHH. All caregivers of toddlers participating in the State of Louisiana's EarlySteps programs were offered the opportunity to

complete the *BDI-2* (Newborg, 2005), and a battery to screen for ASD. This battery included the *BISCUIT* Battery (Matson, Boisjoli, & Wilkins, 2007), which consisted of a demographic form, a diagnostic measure of ASD (*BISCUIT-Part 1*), symptoms of comorbid psychopathology (*BISCUIT-Part 2*) and challenging behavior (*BISCUIT- Part 3*). Furthermore, all caregivers of toddlers participating in EarlySteps were offered the opportunity to complete the aforementioned *BISCUIT* battery, and *BDI-2* at initial and annual assessment dates, as well as upon aging out of EarlySteps. Caregivers were also offered the opportunity to complete the *BISCUIT* battery at 6-month follow-ups and upon special request. When completing the *BISCUIT* battery, the assessor read the instructions and items aloud to the caregiver/s in a quiet and private area convenient for the caregiver with the toddler present. The *BDI-2* was completed by the assessor with the toddler. A caregiver was present throughout the administration of the *BDI-2*. All assessors met criteria for state employment and completed training on administration of the *BDI-2*, *BISCUIT* battery, and symptoms and measurement of ASD in general. Assessors were licensed in their respective disciplines and held degrees ranging from bachelor to doctoral level. Disciplines included speech-language pathology, social work, occupational therapy, physical therapy, teacher, and psychology.

Measures

BISCUIT-Part 1. The *BISCUIT-Part 1* is an informant based measure designed to assess for symptoms of ASD among toddlers 17 through 36 months of age. It is part of a larger test battery which consists of measures discussed in the procedure section. To complete the *BISCUIT-Part 1*, assessors asked a toddler's caregiver to rate the severity of 62 behaviors on a likert-type scale, ranging from 0 (*not different/no impairment*) to 2 (*very different/severe*)

impairment). A total score can range from 0 to 124, with higher scores reflecting greater symptoms of ASD.

Originally, the *BISCUIT-Part 1* consisted of 71 items which were derived based on a literature review of early ASD identification, *DSM-IV-TR* and *International Classification of Diseases, 10th edition* (World Health Organization, 1992) criteria, as well as review by Clinical Psychologists with experience working with the ASD population (Matson, Wilkins, Sevin, Knight, Boisjoli, & Sharp, 2009). Nine items were subsequently removed due to low endorsement rates ($n = 5$) or low item-scale/inter-item correlations ($n = 4$). The remaining 62 item *BISCUIT-Part 1* had an internal consistency of .97(Matson, Wilkins, Sevin, Knight, Boisjoli, & Sharp, 2009).

Using 62 items of the *BISCUIT-Part 1*, exploratory factor analysis found three factors that best accounted for the variance (33.33%) among the items: 1) Social/Nonverbal Communication, 2) Repetitive Behavior/Restricted Interests, and 3) Communication (Matson, Boisjoli, Hess, & Wilkins, 2010). See Appendix A for a list of items comprising each *BISCUIT-Part 1* factor. Twenty four items comprise the Social/Nonverbal Communication subscale. These items reflect socialization skills such as interaction with peers (e.g., “social interactions with others his/her own age,” “ability to make and keep friends,” and “participates in games or other social activities”) and the ability to attend to and utilize nonverbal cues to moderate social interactions (e.g., “able to understand the subtle cues or gestures of others,” “body posture and/or gestures,” and “ability to recognize the emotions of others”). Twenty three items comprise the Repetitive Behavior/Restricted Interest subscale which reflect stereotypic behavior and hyper- or hypo-sensitivity (e.g., “becomes upset if there is a change in routine,” “saying words or phrases repetitively,” “abnormal fascination with the movement of spinning objects,” “reactions to

normal, everyday sounds,” and “prefers food of a certain texture or smell”). Within the Communication subscale there are seven items. These items reflect functional expressive communication skills (e.g., “use of language to communicate,” and “communicates effectively”) as well as the use of non-verbal skills to facilitate communicating with others (e.g., “use of non-verbal communication”).

Internal consistency and Cronbach’s alpha for the three factors were .93, .90, and .87, respectively. On all factors, toddlers classified with ASD were differentiated from other groups (Matson, Boisjoli, Hess, & Wilkins, 2010). Additionally, all 62 items significantly differentiated between toddlers, 17 to 36 months of age, diagnosed with ASD and no ASD (Matson, Wilkins, Sharp, Knight, Sevin, & Boisjoli, 2009). Convergent validity of the *BISCUIT-Part 1* was supported by a moderate to high correlation among the *BISCUIT-Part 1* total and total *Modified Checklist for Autism in Toddlers* (Robins, Fein, Barton, & Green, 2001; $r = .80$) and personal-social *BDI-2* domain scores (Matson, Wilkins, & Fodstad, in press). Discriminant validity of the *BISCUIT Part-1* was supported through a small correlation between the *BISCUIT-Part 1* total score and the motor and adaptive domains of the *BDI-2* (Matson, Wilkins, & Fodstad, in press). For the purpose of this study, the three factors of the *BISCUIT-Part 1*, and then all items were initially included as potential predictors of challenging behavior.

BISCUIT-Part 3. The *BISCUIT-Part 3* is a 15 item measure designed to assess for challenging behavior among toddlers 17 through 36 months of age. This measure is administered following the *BISCUIT-Part 1* and *BISCUIT-Part 2*. In completing the *BISCUIT-Part 3* a qualified assessor asked the caregivers of a toddler to rate the extent 15 items have been a recent problem on a likert-like scale, ranging from 0 (*not a problem or impairment; not at all*) to 2 (*severe problem or impairment*). A total score ranges from 0 to 30, with higher scores indicating

greater recent problems with challenging behavior. Originally, this measure contained 20 items which were derived based on a review of relevant literature (Matson, Wilkins, Sevin, Knight, Boisjoli, & Sharp, 2009). However, three items were removed due to low endorsement rates (Matson, Wilkins, Sevin, Knight, Boisjoli, & Sharp, 2009).

Following further psychometric analyses two additional items were removed from this measure for it to be psychometrically viable for a toddler population (Matson, Boisjoli, Rojahn, & Hess, 2009). Exploratory factor analysis was conducted using a sample of 207 toddlers, 17 through 36 months of age (Matson, Boisjoli, Rojahn, & Hess, 2009). Three factors best accounted for the variance (38%) among the items, and were named 1) Aggressive/Destructive Behavior, 2) Stereotypies, and 3) SIB. See Appendix B for a list of items comprising the Aggressive/Destructive Behavior and SIB factors of the *BISCUIT-Part 3*. The Aggressive/Destructive Behavior, Stereotypies, and SIB factors each individually accounted for 29%, 6%, and 4% of the variance. Furthermore, each factor displayed internal consistency with alpha levels ranging from .51 to .88.

The Aggressive/Destructive Behavior factor is comprised of 10 items with loadings ranging from .34 to .82. Out of the ten items on the Aggressive/Destructive Behavior factor, three can be conceptualized as types of physical aggression (i.e., “throwing objects at others,” “aggression towards others,” and “pulling others’ hair”), and three as property destruction (“property destruction,” “kicking objects,” and “banging on objects with hand”). The other four items on the Aggressive/Destructive Behavior factor reflect verbal aggression (i.e., “yelling or shouting at others”) or other problematic behaviors (i.e., “removal of clothing at inappropriate times,” “leaving the supervision of caregiver without permission,” “playing with own saliva”). The Stereotypies factor is comprised of three items with factor loadings ranging from .61 to .72

(i.e., “repeated and unusual body movements,” “repeated and unusual verbalizations,” and “unusual play with objects”). The SIB factor is comprised of two items (i.e., “poking him/herself in the eye,” and “harming self by hitting, pinching, scratching, etc”) with factor loadings of .66 and .65, respectively (Matson, Boisjoli, Rojahn, & Hess, 2009).

For the purpose of this study the Aggressive/Destructive and SIB factors, and items that comprise those factors, were used as outcome variables. In an effort to control for confounds, outcome variables that reflect stereotypies, a core symptom of ASD, were excluded from analyses. If these items were retained there would be similar items for both the predictor and outcome variables. Consequently, the predictability of these behaviors would likely be artificially increased. Thus, the Stereotypies factor and items comprising this factor were excluded from analyses.

Battelle Developmental Inventory, 2nd Edition (BDI-2). The *BDI-2* is a revision to the original *BDI* and is an informant and observation based assessment that takes approximately 1 to 2 hours to complete. The *BDI-2* consists of 450 items intended to assess developmental skills from birth to 7 years 11 months and is comprised of five domains 1) adaptive, 2) personal-social, 3) communication, 4) motor, and 5) cognitive. At the item level, the child’s skills are scored as 0 (*no ability in this skill*), 1 (*emerging ability*), or 2 (*ability at this skill*). The personal-social domain is comprised of: 1) adult interaction, 2) peer interaction, and 3) self-concept and social role. The communication domain is comprised of receptive and expressive subdomains. The adaptive domain is comprised of two subdomains: 1) self care, and 2) personal responsibility. Three subdomains comprise the motor domain: 1) gross motor, 2) fine motor, and 3) perceptual motor. The cognitive domain is comprised of three subdomains: 1) attention and memory, 2) reasoning and academic skills, and 3) perception and concepts. Subdomain scores combine to

form the *BDI-2* domain scores and overall *BDI-2* Developmental Quotient which each have a mean standard score of 100 and a standard deviation of 15. Thus, on the *BDI-2* standard scores can range from 40 to 160.

The *BDI-2* is considered to be reliable and valid (Bliss, 2007; Newborg, 2005). In regard to reliability, research has revealed excellent (i.e., .98 and above) internal consistency for the total score and domain scores, with the exception of the Adaptive domain that had a slightly lower internal consistency of .80 (Bliss, 2007). The *BDI-2* was also found to have acceptable levels of test retest reliability. Additionally, research has demonstrated the content and convergent validity of this measure (Bliss, 2007). Convergent validity was demonstrated through moderate to high correlations between the *BDI-2* and other psychometrically sound measures of developmental functioning in toddlers and young children (e.g., *Wechsler Preschool and Primary Scale of Intelligence* [Wechsler, 2002], *Bayley Scales of Infant Development* [Bayley, 1993]). Furthermore, the *BDI-2* has been validated for use in the ASD child population (Bliss, 2007). For the purposes of this study, the participants' Cognitive, Adaptive, and Motor Developmental Quotients will be examined for use as covariates in statistical analyses. The Developmental Quotient will be used as a covariate in this study as it encapsulates adaptive and motor functioning as well as estimates intellectual functioning.

ANALYSES

Statistical Analyses

All analyses were conducted using SPSS 16.0. As the purpose of this study was to examine how symptoms of ASD predict engagement in challenging behavior above and beyond developmental functioning, scores on items of the Aggressive/Destructive and SIB factors of the *BISCUIT-Part 3* were first transformed into a binary variable (i.e., 0 and 1). Scores above 0 were transformed to 1 to indicate that the participant engaged in challenging behavior that was considered problematic by the caregiver. Scores of 0 remained 0, indicating no concern with that type of challenging behavior. Please view Figure 2 for an overview of statistical analyses used in this study. The same statistical procedures, and in the same order, will be conducted for each dependent variable (i.e., Aggressive/Destructive and SIB).

Prior to conducting logistic regression analysis, point-biserial correlation analyses were conducted to determine the optimal set of predictor variables from the following variables: Socialization/Nonverbal Communication factor of the *BISCUIT-Part 1*, Communication factor of the *BISCUIT-Part 1*, Repetitive Behavior/Restricted Interests factor of the *BISCUIT-Part 1*, and Developmental Quotient of the *BDI-2*. Point-biserial correlation analyses were used as the challenging behavior variables are dichotomous (i.e., yes/no engaging in challenging behavior; Field, 2005)

Developmental Quotient was included as a potential covariate in this study as it encapsulates adaptive and motor functioning as well as estimates intellectual functioning. Researchers suggest that cognitive, adaptive, and motor functioning, as assessed by respective *BDI-2* domains, were significantly related to challenging behavior among atypically developing toddlers (Fodstad, 2011). Conceptually, age is an alternative to developmental functioning

among typically developing toddlers. As age is likely, at least in part, redundant with developmental functioning (i.e., *BDI-2* cognition, adaptive behavior, and motor skills domains), it was not included as a separate covariate. Other variables, such as symptoms indicative of psychopathology were also not included as covariates. There is a natural confound in that challenging behavior is often used as a symptom in diagnosing psychopathology, especially among toddlers and those with developmental delays. Researchers have consistently found that gender does not affect the presentation of challenging behavior among atypically developing toddlers (e.g., Fodstad, 2011; Kozlowski & Matson, 2012). As such, gender was not included as a covariate.

Examining results of correlational analyses helps protect against suppressor effects (i.e., variables that artificially enhance the relationship between a predictor and outcome variable when this predictor is actually only significantly related to other predictors but not outcome variables) and Multicollinearity. It is important to examine the effects of independent variables on dependent variables prior to incorporating them into the model to ensure that only relevant variables are included (Thompson & Levine, 1997). Adding irrelevant variables to a predictor model reduces the precision of estimates (Wright, 2000). Subsequent logistic regression analyses only included independent variables or covariates which had a correlation coefficient .10 (negligible relationship) or greater and was significant at $p < .01$ with dependent variables. As negligible correlation coefficients indicate that two variables share very little variance it is a good indicator of whether potential independent variables or covariates affect engagement in challenging behavior at a meaningful level. Furthermore, correlation coefficients are not affected by sample size like significance levels are where smaller coefficients, representing a smaller effect size, are more likely to be found significant with larger sample sizes. Multicollinearity was

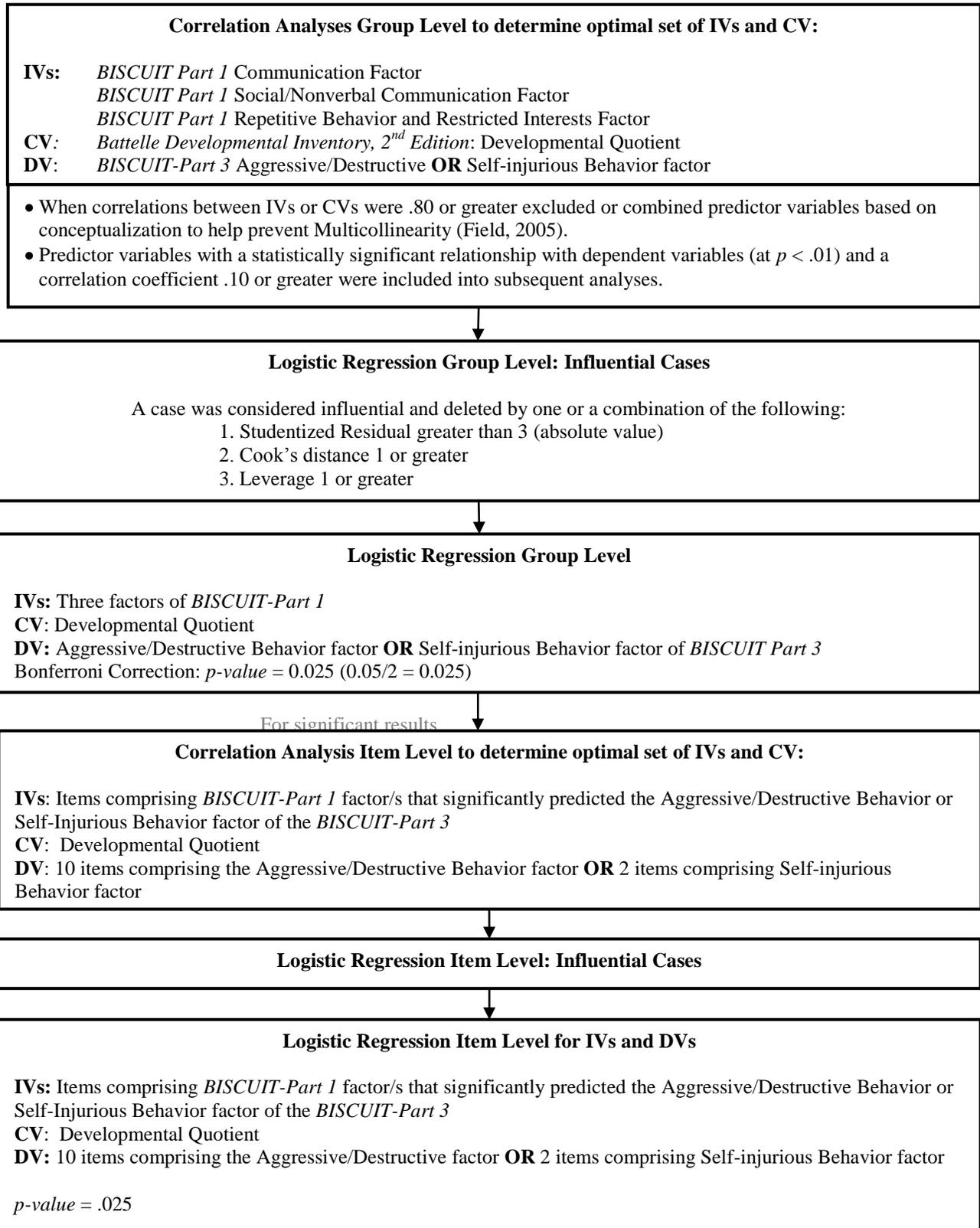


Figure 2
Flow Chart of Statistical Analysis That Were Completed for Each Dependent Variable

determined by a correlation coefficient at .80 or greater between two variables (Field, 2005). Predictor variables that are highly related, at .80 or greater, increase the probability of falsely accepting the null hypothesis (Field, 2005).

Next, within each logistic regression analysis, influential cases were determined through a combination of Studentized residuals, Cook's distance, and leverage (Field, 2005; Tabachnick & Fidell, 2007). All cases with Studentized residuals greater than 3, Cook's distance greater than 1, or leverage greater than 1 were considered influential cases (Field, 2005; Tabachnick & Fidell, 2007). All of these data provide information about the influence of a case on the model and when used together provide a researcher with a combination of information to help gauge whether a case is highly influential. Cases deemed highly influential were deleted and that logistic regression analysis was re-evaluated.

Two separate binary logistic regression analyses were conducted to determine how Socialization/Nonverbal Communication, Communication, and Repetitive Behavior/Restricted Interests (factors of the *BISCUIT-Part 1*) predict Aggressive/Destructive or SIB above and beyond developmental functioning as represented by Developmental Quotient. There is likely a loss of power when reducing a continuous variable to a binary variable. However, logistic regression was chosen because these analyses enable the detection of clinically significant predictors of challenging behavior. Logistic regression analyses identify variables that significantly affect the odds of engaging in the dependent variable (Field, 2005). Another benefit of logistic regression is the lack of assumptions including those regarding distribution of the data and homoscedasticity (Field, 2005).

As Developmental Quotient from the *BDI-2* was used as a covariate, this variable was entered into the first step of the model. All other independent variables were entered into step 2

to determine whether they add to the predictive power of the model after developmental functioning is accounted for. To help ensure that Type 1 error (i.e., falsely reject the null hypothesis) was not inflated, the *p-value* was Bonferroni corrected by dividing the *p-value* of .05 by the number of analyses that were conducted. Thus, in these analyses, a *p-value* of .025 (i.e., $.05/2 = .025$) were used to determine significance.

For significant results, an item analysis using logistic regression was conducted for a more fine grained analyses of how symptoms of ASD predict specific forms of challenging behavior. Prior to the item analysis, correlation analyses were conducted to determine the optimal set of predictors and then potential influential cases were identified. As this level of analyses was exploratory the *p-value* was not further Bonferroni corrected. Rather a *p-value* less than .025 was considered significant.

Power Analyses

For logistic regression analyses, a *post hoc* analysis of significance level, choosing the Logistic Regression statistical test, was run on G*POWER 3.1.3 (Faul, Erdfelder, Buchner, & Lang, 2009). To determine power, tailedness of the test (i.e., one or two tail), effect size through odds ratio, and alpha level were considered. A two-tailed test, odds ratio of 1.2, and a significance level of .025 (Bonferoni corrected; $.05/2$) were utilized. The level of power was .95, which is greater than the desired power of .80, which is an acceptable level in the behavioral sciences (Hinkle, Wiersma, & Jurs, 2003). Adding further support to the evidence that there are enough participants to find reliable results are guidelines suggesting that 50 times the number of predictor variables (i.e., 50k) is required for reliable results when conducting logistic regression analyses (Aldrich & Nelson, 1984). Thus, with four independent variables (i.e., Developmental Quotient, Social/Nonverbal Communication, Communication, and Repetitive

Behavior/Restricted Interests) 200 participants were sufficient for obtaining reliable results. Follow-up analyses of significant findings also had sufficient number of participants to find reliable results with over 2,400 ($50 \times 48 = 2,400$) participants used for finding predictors of items comprising the Aggressive/Destructive factor and over 1,200 ($50 \times 24 = 1,200$) participants when examining predictors of items comprising the SIB factor. As such, this study had a sufficient number of participants to yield reliable results.

RESULTS

***BISCUIT-Part 1* factors predict Aggressive/Destructive and SIB.** First, preliminary analyses were conducted for how core symptoms of ASD (factors of *BISCUIT-Part 1*) and developmental functioning (i.e., Developmental Quotient from *BDI-2*) predict engagement in overall topographies of challenging behavior (i.e., Aggressive/destructive and SIB factors of *BISCUIT-Part 3*). Correlation analyses conducted to help determine the optimal set of independent variables and covariates entered into subsequent logistic regression analyses revealed that these correlation coefficients ranged from .39 to .79 (see Table 4). All coefficients were less than .80 suggesting no concerns with Multicollinearity. Thus, no independent variables or covariates were combined or excluded from analyses based on concerns with Multicollinearity.

Furthermore, all correlation coefficients between independent variables/covariates and dependent variables were .10 or greater and statistically significant at $p < .01$. Correlations amongst independent variables/covariates ranged from moderate to large (absolute value of $r = .39$ to $.79$). All correlations between Developmental Quotient and factors of the *BISCUIT-Part 1* were negative and moderate to large in strength ($r = -.44$ to $-.54$). That is, as a toddler's developmental functioning increased impairment on core symptoms of ASD tended to decrease. The strength of the relationship between Developmental Quotient and topographies of challenging behavior, although small (i.e., both at $-.15$), were significant. Correlation coefficients indicated that as developmental functioning increased, engagement in Aggressive/Destructive behaviors or SIB tended to decrease. All relationships among core symptoms of ASD and topographies of challenging behavior were positive implying that as overall core symptoms of ASD become more severe, a toddler tended to engage in more Aggressive/Destructive behavior

Table 4

Correlation analyses between predictor and outcome variables at group level

	DQ	Social	Com	Repetitive	Aggressive-Destructive	SIB
DQ	1	–	–	–	–	–
Social	-.54	1	–	–	–	–
Comm	-.44	.47	1	–	–	–
Repetitive	-.44	.79	.39	1	–	–
Aggressive-Destructive	-.15	.39	.15	.44	1	–
SIB	-.15	.27	.10	.35	.54	1

Notes: DQ = Developmental Quotient, Social = Social/Nonverbal Communication, Com = Communication, Repetitive = Repetitive Behavior and Restricted Interests, and Aggressive-Destructive = Aggressive/Destructive Behavior

and SIB. Also, Aggressive/Destructive behavior and SIB were strongly and positively correlated.

That is, toddlers who engaged in one form of challenging behavior also tended to engage in other types of challenging behavior.

As all correlation coefficients among core symptoms of ASD and topographies of challenging behavior were .10 and greater, as well as statistically significant at $p < .01$, all factors of the *BISCUIT-Part 1* were included in subsequent analyses as independent variables. Similarly, all correlation coefficients between Developmental Quotient and topographies of challenging behavior were greater than .10 and statistically significant at $p < .01$. As such, Developmental Quotient was included in analyses as a covariate.

First, a logistic regression analysis was conducted to determine how core symptoms of ASD (i.e., Social/Nonverbal Communication, Communication, and Repetitive Behavior/Restricted Interests) predicted engagement in Aggressive/Destructive behavior above and beyond developmental functioning. Analysis of residuals indicated that one case was an outlier with a Studentized residual greater than three. As such, this case was deleted and the

logistic analysis was re-run. Interestingly, a comparison of results with and without this potential influential case yielded almost identical results.

Table 5
Descriptive statistics for independent variables and covariates for aggressive/destructive behavior

Factor	<i>N</i>	Range (min – max)	Mean	SD
<i>BISCUIT-Part 1</i>				
Social	2904	48 (0 – 48)	6.68	9.83
Communication	2904	14 (0 – 14)	7.77	4.13
Repetitive	2904	43 (0 – 43)	4.47	6.76
<i>BDI-2</i>	2904	93 (40 – 133)	84.40	14.31

Notes: Social = Social/Nonverbal Communication, and Repetitive = Repetitive Behavior and Restricted Interests.

Descriptive statistics (Table 5) were used to examine the range, mean, and standard deviation of independent variables and covariates included in analyses. The full range of scores was observed for the Social/Nonverbal Communication and Communication factors of the *BISCUIT-Part 1*. For Repetitive Behavior and Restricted Interests, the highest score was a 43 compared to the highest possible score of 46. The range of possible scores on the *BDI-2* is 120 (40 – 160) compared to 93 (40 – 133) found in this study.

When conducting logistic regression, the model including only developmental functioning was statistically significant $\chi^2(1) = 64.73, p < .001$, and correctly classified 81.50% of toddlers who did not engage in Aggressive/Destructive Behavior and 26.60% of toddlers who did. Overall correct classification was 57.2%. Although this was a little less than a 2% increase from the constant model, the model which included Developmental Quotient was better able to classify toddlers who engaged in Aggressive/Destructive Behavior. The constant model was unable to correctly classify any toddlers as engaging in Aggressive/Destructive Behavior whereas the model with Developmental Quotient was able to correctly classify 26.60% of toddlers. Approximation of effect size using Nagelkerke R^2 indicates that only 3% of the

variance in Aggressive/Destructive Behavior is best explained by Developmental Quotient. Although small in effect, lower scores on developmental functioning were related to engagement in Aggressive/Destructive Behavior with a beta weight of -.02 and an odds ratio less than one (0.98). However, with the inclusion of core symptoms of ASD, developmental functioning alone, no longer significantly impacted engagement in Aggressive/Destructive Behavior (Wald $\chi^2=2.80$, $p = .10$; $B = 0.01$; $OR = 1.01$).

The overall model with the three core symptoms of ASD as independent variables and Developmental Quotient as a covariate predicted engagement in Aggressive/Destructive behavior better than chance alone, $\chi^2 (4) = 391.16$, $p < .001$. The -2 Log Likelihood Ratio further supports that this more comprehensive model better fits the data as this value is smaller (i.e., 3596.60) compared to previous steps in the model (i.e., 3923.03). This decrease in the -2 Log Likelihood ratio was also statistically significant (i.e., $\chi^2 (1) = 326.43$, $p < .001$) indicating that the more comprehensive model was better able to predict engagement in Aggressive/Destructive behavior. Approximations of effect size were larger with the inclusion of core symptoms of ASD into a model which previously only consisted of developmental functioning. Nagelkerke R^2 suggests that about 17% of the variation in Aggressive/Destructive Behavior was explained by the combination of predictors. This is compared to 3% with only Developmental Quotient in the model. Overall correct classification of whether a toddler engages in Aggressive/Destructive Behavior increased to 66.40% when including core symptoms into the model. This percentage is compared to 57.20% with only developmental functioning included in the model. The more comprehensive model was better able to predict toddlers who do not engage in Aggressive/Destructive Behavior (87.4%) than toddlers who do engage in Aggressive/Destructive Behavior (39.9%).

The previous data provides information regarding the model as a whole. However, data on how individual predictors function in the model is also important. Wald statistics, logistic coefficient or beta weights (B), and odds ratios (OR) provide information on the relevance of individual predictors in a model. The Wald statistic tests whether B is significantly different from 0. Statistically significant findings indicate that B is statistically different from 0 and thus, after controlling for other independent variables in the model, predicts the dependent variable better than chance alone. B coefficients are similar to partial correlation coefficients in that they provide an indication of direction and strength of the relationship between an independent and dependent variable while holding other variables constant; however, Bs are in log-odd units. That is, they represent a one unit change in the independent variable on the log-odds of the dependent variable. An OR with a value above 1 indicates that the variable increases the odds of the dependent variable and a value below 1 indicates that the variable decreases the odds of the dependent variable. Values further from 1 indicate that the independent variable better predicts the dependent variable.

Wald statistics suggest that Social/Nonverbal Communication and Repetitive Behavior/Restricted Interests, each with all other independent variables and covariates held constant, significantly predicted Aggressive/Destructive behavior (Wald $\chi^2 = 14.41$ and 84.11 , respectively, both $p < .001$). With all other independent variables held constant, there were nonsignificant findings for Communication. That is Communication skills did not significantly predict Aggressive/Destructive behavior (Wald $\chi^2 = 0.11$, $p = .74$). B (i.e., 0.00) and OR (1.00) further support that Communication skills do not, on an individual level, affect engagement in Aggressive/Destructive Behavior. Although Wald statistics indicate that Bs were statistically different than 0, Bs were small (i.e., .03 and .11, respectively for Social/Nonverbal

Communication and Repetitive Behavior/Restricted Interests). Thus, for any one-unit increase in Socialization/Nonverbal Communication a 0.03 increase in the log-odds of Aggressive/Destructive behavior is expected when all other variables are held constant.

Similarly, ORs were small. Small values indicate that these independent variables only relate to small changes in the likelihood of engaging in Aggressive/Destructive behavior for a one unit increase in the independent variable. (See Table 6 for data on the effect of the individual independent variables and covariates on Aggressive/Destructive and SIB.) The odds of engaging in Aggressive/Destructive Behavior improve by 1.03 for every one unit increase in Social/Nonverbal Communication. In 95% of samples drawn from this population, the true range of the OR is from 1.01 to 1.04. Scores on the Social/Nonverbal Communication factor range from 0 to 48; thus, an increase from a score of 0 to 48 is associated with an odds ratio of 4.13 (1.03^{48}). That is, the probability of engaging in Aggressive/Destructive Behavior among those with the highest level of socialization impairment is approximately 4.13 times that of toddlers with no socialization impairment.

Likewise, each one unit increase in Repetitive Behavior/Restricted Interests increases the odds of engaging in Aggressive/Destructive Behavior by a small amount, at 1.11 (95% Confidence Interval 1.09 to 1.13). However, when comparing the odds of engaging in Aggressive/Destructive Behavior between those with no impairments in Repetitive Behavior/Restricted Interests and those with the most severe impairments (i.e., a score of 46), the odds of engaging in Aggressive/Destructive Behavior increased by a factor of 121.58 (i.e., 1.11^{46}) for those with the most severe impairments. Thus, overall, the odds of engaging in Aggressive/Destructive Behavior were more likely among toddlers with greater impairment in

Social/Nonverbal Communication and Repetitive Behavior/Restricted Interests as opposed to less impairment.

Table 6
Data for variables in the model of logistic regression analyses at the group level

	Aggressive/Destructive Behavior			Self-injurious Behavior		
	B (SE)	Wald	OR (CI)	B (SE)	Wald	OR (CI)
Social/Nonverbal Communication	0.03 (0.01)	14.41*	1.03 (1.01-1.04)	0.01 (.01)	0.50	1.01 (0.99-1.02)
Communication	.00 (0.01)	0.11	1.00 (0.97-1.02)	0.02 (0.02)	1.04	1.00 (0.96-1.02)
Repetitive Behavior/Restricted Interests	0.10 (0.01)	84.11*	1.11 (1.09-1.13)	0.10 (0.01)	86.43*	1.11 (1.08-1.13)
Developmental Quotient	0.01 (0.00)	2.80	1.01 (1.00-1.01)	0.00 (0.01)	0.10	1.00 (0.99-1.01)

* $p < .025$ (two tailed); All values were significant at $p < .001$.

Note: all data were rounded to two decimal places; B = logistic coefficient or beta weight; SE = Standard Error, OR = Odds ratio, CI = 95% Confidence interval.

Secondly, a binary logistic regression analysis was conducted to determine the extent to which specific core symptoms of ASD (i.e., Socialization/Nonverbal Communication, Communication, and Repetitive Behavior/Restricted Interests) predicted engagement (yes/no) in SIB above and beyond developmental functioning. Examination of residuals, Cook’s distance, and leverage revealed no influential cases. Thus, all 2,905 participants were retained for analysis.

Descriptive statistics (Table 6) were used to examine the range, mean, and standard deviation of independent variables and covariates included in analyses. The full range of scores was observed for the Social/Nonverbal Communication and Communication factors of the *BISCUIT-Part 1*. For Repetitive Behavior and Restricted Interests, the highest score was a 45 compared to the highest possible score of 46. The range of possible scores on the *BDI-2* is 120 (40 – 160) compared to 93 (40 – 133) found in this study.

Table 7

Descriptive statistics for independent variables and covariates for self-injurious behavior

Factor	<i>N</i>	Range (min – max)	Mean	SD
<i>BISCUIT-Part 1</i>				
Social	2905	48 (0 – 48)	6.70	9.86
Communication	2905	14 (0 – 14)	7.77	4.13
Repetitive	2905	45 (0 – 45)	4.49	6.80
<i>BDI-2</i>	2905	93 (40 – 133)	84.38	14.32

Notes: Social = Social/Nonverbal Communication, and Repetitive = Repetitive Behavior and Restricted Interests.

When conducting logistic regression, the model including only developmental functioning was statistically significant, $\chi^2(1) = 50.94, p < .001$, and correctly classified all toddlers who did not engage in SIB but did not correctly classify any toddlers who engaged in SIB. Overall correct classification was 83.50%. This percent did not increase as a result of the inclusion of Developmental Quotient to the constant model. Approximations of effect size indicated that only 3% of the variance in SIB was explained by Developmental Quotient. Although small in effect, lower scores on developmental functioning were related to engagement in SIB with a beta weight of $-.03$ and an odds ratio less than one at 0.98 . However, with the inclusion of core symptoms of ASD, developmental functioning at an individual level, no longer significantly impacted engagement in SIB (Wald $\chi^2 = 0.10, p = .75$; $B = 0.01$; $OR = 1.00$).

The overall model with the addition of the three independent variables reflecting core features of ASD was statistically significant, $\chi^2(4) = 263.41, p < .001$. Thus, this more comprehensive model better predicted engagement in SIB than models with only developmental functioning. With the inclusion of all four variables the -2 Log Likelihood value decreased (2,341.09) compared to previous steps in the model (2,553.37) and significantly improved the model's ability to predict whether a toddler does or does not engage in SIB, $\chi^2(1) = 212.28, p < .001$. Approximation of effect size with Nagelkerke R^2 was 14.6%. Thus, 14.6% of the variation in SIB scores was explained by the combination of predictor variables. Overall, the model

classified 82.8% of toddlers into the correct SIB engagement group. The combination of predictor variables correctly classified 97% of those toddlers not engaging in SIB but only 11% of those who engaged in SIB. Including core symptoms of ASD as predictor variables over and beyond Developmental Quotient increased the percent of toddlers the model correctly identified as engaging in SIB (0% to 11%). However, there was a slight decrease in the accuracy of the model predicting toddlers who do not engage in SIB (100% to 97%).

At an individual predictor level, only Repetitive Behavior/Restricted Interests, when all other variables were held constant, significantly predicted engagement in SIB. The Wald statistic (Wald $\chi^2 = 86.43, p < .001$) was significant at $p < .001$, indicating that the B weight of 0.10 was significantly different than 0. This positive B specified that higher scores on the Repetitive Behavior/Restricted Interests factor of the *BISCUIT-Part 1* correlated with engagement in SIB. B weights for all other predictor variables were not significantly different than 0 (i.e., *p-values* ranging from .31 to .75) suggesting that these variables did not significantly correlate with change in SIB engagement. However, the odds of engaging in SIB were greater among toddlers with greater impairment in Repetitive Behavior/Restricted Interests. That is, for every one unit increase in Repetitive Behavior/Restricted Interests a toddler was 1.11 times more likely to engage in SIB, with a 95% confidence interval ranging from 1.08 to 1.13. As the range in scores on this factor is 0 to 46, the probability of engaging in SIB among those with the highest level of impairment in Restricted Behavior/Restricted Interests is approximately 121.58 (i.e., 1.11^{46}) times that of toddlers with no impairment.

Items of *BISCUIT-Part 1* factors predict items from Aggressive/Destructive and SIB.

Item analysis using logistic regression was conducted for more fine grained analyses of how specific forms of Socialization/Nonverbal Communication and Repetitive Behavior/Restricted

Interests predict specific types of Aggressive/Destructive Behavior and how specific forms of Repetitive Behavior/Restricted Interests predict specific forms of SIB. Only items comprising factors of the *BISCUIT-Part 1* that were found to significantly predict engagement in overall Aggressive/Destructive Behavior or SIB were included. Overall, an additional 12 logistic regression analyses were conducted. Ten separate logistic regression analyses were conducted with items of the Aggressive/Destructive Behavior factor of the *BISCUIT-Part 3* as dependent variables. In these analyses all items comprising the Socialization/Nonverbal Communication and Repetitive Behavior/Restricted Interests factors originated in the pool for independent variables. Developmental Quotient was also considered as a covariate. Another two separate logistic regression analyses were conducted to examine how specific items of Repetitive Behavior/Restricted Interests predicted engagement in specific forms of SIB as described by items of the SIB factor from the *BISCUIT-Part 3* above and beyond developmental functioning.

To control for family wise error the *p*-value was Bonferroni corrected based on the number of analyses conducted. Thus, the *p*-value used to determine significance was .002 ($.025/12 = .002$). Prior to analyses, correlational analyses were conducted in the same manner and using the same decision rules as previously discussed to determine the optimal set of independent variables to include in analyses. Correlation analyses revealed that several variables were related at .80 or greater resulting in the combination of five variables. These five variables were all similar in content in that they asked about broad level of peer interaction. Thus, these five variables were combined to form one variable reflecting broad peer interaction.

Correlational analyses incorporating this combined variable revealed no correlation coefficients at .80 or greater. Please view Table 8 for the range of correlation coefficients among and between items of relevant *BISCUIT-Part 1* factors as well as the range of correlation

coefficients among items of *BISCUIT-Part 1* factors and overall engagement on Aggressive/Destructive and SIB. Correlations among items of the Repetitive Behavior/Restricted Interests ranged from .13 to .78 and correlation coefficients among items of Social/Nonverbal Communication ranged from .04 to .79. Correlation coefficients among items of these two factors of the *BISCUIT-Part 1* ranged from .08 to .61. Correlation coefficients among developmental functioning and Social/Nonverbal Communication items ranged from -.10 to -.45 whereas this range was -.09 to -.32 with items from Repetitive Behavior/Restricted Interests. All relationships among items comprising the *BISCUIT-Part 1* were positive. In contrast, all relationships between items of the *BISCUIT-Part 1* and Developmental Quotient were negative; indicating that as developmental functioning decreased there was an increase in ASD symptomatology.

Table 8
Range of correlation coefficients among subset of predictor items and overall topographies of Aggressive/Destructive and Self-injurious Behavior

	Developmental Quotient	RBR items	Social items
Developmental Quotient	1	-.09 to -.32	-.10 to -.45
RBR items	-.09 to -.32	.13 to .78	.08 to .61
Social items	-.10 to -.45	.08 to .61	.04 to .79
Aggressive/Destructive Behavior	-.03 to -.15	.08 to .32	.00 to .33
SIB	-.09 to -.11	.05 to .32	N/A

Note: all data were rounded to two decimal places; RBR = reflects items comprising the Repetitive Behavior/Restricted Interests factor of *BISCUIT-Part 1*; Social = reflects items comprising Social/Nonverbal Communication factor of *BISCUIT-Part-1*; SIB = Self-injurious behavior factor of *BISCUIT-Part 3*, and N/A = not applicable to this analysis.

Except for two relationships, correlation coefficients between independent variables/covariates and dependent variables were all significant at $p < .01$. Specifically, correlation coefficients ranged from .00 to .33 among items comprising Social/Nonverbal Communication and items comprising Aggressive/Destructive Behavior. Items comprising

Repetitive Behavior/Restricted Interests had correlation coefficients ranging from .08 to .32 with items comprising Aggressive/Destructive Behavior. Correlation coefficients between items of Aggressive/Destructive Behavior and developmental functioning ranged from -.03 to -.15. Correlation coefficients ranged from .05 to .32 among items comprising Repetitive Behavior/Restricted Interests and items comprising SIB. Correlation coefficients between developmental functioning and the two items comprising SIB were -.09 and -.11. There were 39 pairs of correlation coefficients among potential independent variables/covariates and dependent variables that had a correlation coefficient less than $r = .10$.

Table 9
Independent variables and covariates excluded based on correlation coefficient less than .10.

	Aggressive/Destructive Behavior										SIB	
	Item number										Item number	
	<i>(n = 2,904)</i>										<i>(n = 2,905)</i>	
	3	4	6	7	8	9	10	11	12	13	1	2
CV Excluded	Y	Y	Y	Y	N	N	N	N	Y	N	Y	N
<i>r</i>	-.09	-.09	-.09	-.07	-	-	-	-	-.03	-	-.09	-
IVs Total Excluded	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	N
<i>(n)</i>	(2)	(2)	(7)	(5)			(5)	(3)	(8)	(1)	(6)	
RBR IVs Excluded	Y	N	Y	Y	-	N	Y	Y	Y	N	Y	N
<i>(n)</i>	(1)		(2)	(1)			(2)	(2)	(1)		(6)	
Item	6		13	57			13	13	6		13	
<i>r</i>	.08	-	.08	.07	-	-	.09	.09	.09	-	.06	-
			26				57	57			26	
			.09				.08	.08			.05	
											29	
											.09	
											38	
											.05	
											41	
											.07	
											58	
											.08	

Table 9 continued

	Aggressive/Destructive Behavior Item number										SIB Item number	
	<i>(n = 2,904)</i>										<i>(n = 2,905)</i>	
	3	4	6	7	8	9	10	11	12	13	1	2
Social IVs Excluded (n) Item <i>r</i>	Y (1)	Y (2)	Y (5)	Y (4)	N	N	Y (3)	Y (1)	Y (7)	Y (1)	N/A	NA
	23 .06	3 .09	22 .09	22 .08	-	-	23 .02	23 .06	3 .09	23 .06	-	-
	-	23 .07	23 .05	23 .00	-	-	32 .09	-	21 .09	-	-	-
	-	-	32 .09	46 .07	-	-	47 .08	-	22 .09	-	-	-
	-	-	45 .09	47 .06	-	-	-	-	23 .06	-	-	-
	-	-	47 .09	-	-	-	-	-	45 .06	-	-	-
	-	-	-	-	-	-	-	-	46 .08	-	-	-
	-	-	-	-	-	-	-	-	47 .07	-	-	-

Note: all data were rounded to two decimal places; SIB = Self-injurious behavior, CV = covariate and refers to Developmental Quotient, Social = reflects items comprising the Social/Nonverbal Communication factor of *BISCUIT-Part 1*, RBR = reflects item comprising the Repetitive Behavior/Restricted Interests factor of *BISCUIT-Part 1*, IVs = independent variables, *n* = sample size, Y = Yes, N = No, *r* = correlation coefficient; N/A = not applicable.

See Table 9 for a list of independent variables and covariates excluded from analyses due to negligible relationships (i.e., $r < .10$) between a potential independent variable/covariate and dependent variable.

See Table 10 for information regarding the number of independent variables and whether the covariate was included for each analysis with an item from the *BISCUIT-Part 3* Aggressive/Destructive or SIB factors as a dependent variable. Table 10 also includes information regarding influential cases for each logistic regression analysis. Analyses for

influential cases were conducted in the same manner as in prior logistic regression analyses.

Across all twelve analyses, there was only one influential case. This influential case was found when examining how core symptoms of ASD (at the item level) and developmental functioning predict the presentation of Aggressive/Destructive Behavior item 6 (i.e., “playing with saliva”).

This case was deleted, leaving 2,903 participants in that analysis.

Table 10

Number of independent variables and covariates included in each of twelve logistic regression analyses, influential cases, and sample size

	Aggressive/Destructive Behavior										SIB	
	Item number										Item number	
	3	4	6	7	8	9	10	11	12	13	1	2
# IVs	45	45	41	42	47	47	42	44	39	46	17	24
CV included (Yes or No)	No	No	No	No	Yes	Yes	Yes	Yes	No	Yes	No	Yes
# Infl Case	0	0	1	0	0	0	0	0	0	0	0	0
<i>n</i>	2904	2904	2903	2904	2904	2904	2904	2904	2904	2904	2905	2905

Note: IVs = independent variables and refer to items comprising either Social/Nonverbal Communication or Restricted and Repetitive Interests; CV = covariate and refers to Developmental Quotient; # = number; # Infl Case = number of Influential Cases; *n* = sample size used in each logistic regression analysis.

The overall model was significant for all 12 logistic regression analyses, at $p < .001$. The reader is referred to Table 11 for specific data on model fit (i.e., χ^2 , Nagelkerke R^2), the ability of the model to correctly classify cases, as well as information regarding variables included in the model. Approximations of effect size (represented by Nagelkerke R^2) were small, ranging from .20 to .30 for items comprising the Aggressive/Destructive Behavior factor. Approximations of effect size were slightly smaller, ranging from .15 to .16 for items comprising the SIB factor.

These approximations of effect size indicate that although the overall model was significant, the combination of independent variables/covariates only explain a small portion of the variation in the dependent variables. Overall correct classification into engagement or no engagement groups were high, ranging from 78 to 96%. However, correct classification into the no engagement group (i.e., 95 to 100%) was greater across all analyses compared to correct classification into the engagement group (i.e., 1 to 31%).

Table 11
Overall model fit, classification of cases, and information regarding model variables across the twelve separate logistic regression analyses

	Aggressive/Destructive Behavior Item number										SIB Item number	
	3	4	6	7	8	9	10	11	12	13	1	2
Overall Model Fit												
χ^2 (df)	417 (44)	320 (44)	227 (40)	458 (41)	595 (47)	581 (47)	553 (42)	569 (44)	399 (38)	458 (46)	133 (16)	279 (24)
Nagelkerke R Square	.23	.23	.20	.22	.30	.30	.27	.29	.22	.25	.15	.16
Classification												
Overall	86	92	94	78	84	85	81	85	86	86	96	85
% not engage	97	99	100	95	96	96	95	96	98	98	100	98
% engage	21	16	6	28	31	31	30	30	21	24	1	11
Model Variables												
# variables indicative of net suppression	20	22	18	21	19	19	21	18	17	21	4	7

When examining independent variables/covariates, many correlation coefficients between an independent and the dependent variable had the opposite sign as the respective regression weight. This is reflective of net suppression. Suppression effects are common among complex models (Cohen, Cohen, West, & Aiken, 2003) and reflect that the predictor variables as a whole are more highly related than individually related to dependent variables. Thus, suppressor variables remove irrelevant variance that is not useful in predicting the dependent variable. Consequently, the relationship between some variables with the dependent variable is enhanced (Cohen et al., 2003; Tzelgov & Henik, 1991). Exclusion or combination of independent variables/covariates with a large correlation coefficient (i.e., 50 or greater; Cohen, 1992) and exclusion of variables with content similar to that examined by Developmental Quotient (i.e., items 2 and 3 of the *BISCUIT-Part 1*) yielded similar results. That is, there were still net suppression effects.

Given that the combination of the independent variables used in these analyses constitute a diagnostic construct (i.e., Autism Spectrum Disorder) it is not surprising that the independent variables share variance that is not necessarily shared with the dependent variables. This shared variance, depending on its size and comparison with the shared variance between the independent and dependent variables, suppress or enhance the effect of other variables in the model. That is, the effect of each independent variable/covariate alone was not clear as suppression effects lead to an underestimation of the relationship between an independent and dependent variable for those variables that are suppressed, but an overestimation of this relationship among other variables (Cohen et al., 2003). As such, suppressor variables can also be considered variables that mediate the relationship between two other variables (Cohen et al., 2003). With more than three independent variables it is difficult to determine which independent

variables are suppressor variables (Tabachnick & Fidell, 2007), thus hindering the interpretation of the B and ORs. Therefore, B and OR are not discussed for further analyses at the item level.

DISCUSSION

This study examined how core symptoms of ASD predict topographies of challenging behavior among toddlers at-risk for an ASD diagnosis. Researchers have established that those with a diagnosis of ASD and more severe symptoms of ASD are likely to engage in more challenging behavior at all ages compared to controls (e.g., Bodfish et al., 2000; Farmer & Aman, 2011; Fodstad, 2011; Matson et al., 2009; Matson et al., 2011; Rojahn et al., 2009). However, researchers have not previously examined how core symptoms of ASD predict engagement in specific topographies of challenging behavior above and beyond developmental functioning in an at-risk toddler population. For both typically and atypically developing populations, challenging behavior emerges in the toddler years (Alink et al., 2006; Fodstad, 2011). Thus, the relationship among symptoms of ASD and specific challenging behaviors in this young age group while controlling for developmental functioning potentially provides invaluable knowledge regarding risk factors that affect the development of challenging behavior.

When developmental functioning was included alone in logistic regression models it was significantly related to engagement in both Aggressive/Destructive Behavior and SIB for this at-risk toddler population. Albeit at low levels, developmental functioning significantly predicted engagement in challenging behavior such that those with lower developmental functioning were more likely to engage in Aggressive/Destructive Behavior and SIB. Thus, the hypothesis stating that toddlers at risk for ASD with more impaired developmental functioning would be significantly more likely to engage in overall topographies of challenging behavior when controlling for developmental functioning was upheld. Interestingly, when core symptoms of ASD were included in the model developmental functioning, at an individual level, no longer predicted engagement in challenging behavior. Both core symptoms of ASD and developmental

functioning are comprised, in part, of social and communication skills. Consequently, it is not surprising that when a similar construct that further encompasses characteristics related to challenging behavior was added into the model, developmental functioning at an individual level was not significant. When examining predictors at an item level, developmental functioning was not included in all analyses due to negligible correlation coefficients. Thus, for some forms of challenging behavior developmental functioning did not add any meaningful predictive value, regardless of the inclusion of symptoms of ASD.

Socialization skills and Repetitive Behavior/Restricted Interests (i.e., stereotypies) were implicated in Aggressive/Destructive Behavior when controlling for developmental functioning; yet, only stereotypies were significantly associated with engagement in SIB among toddlers at-risk for developing ASD. Greater impairment in overall socialization skills (indicated by higher scores on the Social/Nonverbal Communication factor score) was significantly related to engagement in Aggressive/Destructive forms of challenging behavior among toddlers, above and beyond developmental functioning. This finding further support researchers' who have found significant relationships between impaired socialization skills and challenging behavior without controlling for developmental functioning (Cook & Oliver, 2011; Chadwick et al, 2000; Murphy et al., 2005) and corroborates the hypothesis that greater impairment in socialization skills is significantly related to impairment in Aggressive/Destructive Behavior. These findings are in contrast to those found by Matson and Rivet (2008) when combining all severity levels of ASD into one group among adults with ASD and ID, and suggest the presence of some age differences in the association between core symptoms of ASD and topographies of challenging behavior. Given that items associated with socialization skills were not interpretable at an individual item level, there are other risk factors for engagement in Aggressive/Destructive Behavior not

accounted for in this model. Thus, the underlying link between socialization skills and challenging behavior has yet to be fully identified. However, it is likely that atypical interactions with the surrounding environment affect a person's ability to react and affect the environment using appropriate methods (e.g., verbal communication, physically getting the item oneself, and/or waiting). Thus, atypical methods, such as challenging behavior, are likely used due to deficits in using socially appropriate means.

Furthermore, stereotypies significantly predicted engagement in Aggressive/Destructive Behavior above and beyond developmental functioning. Although sparse, some researchers previously examined the above relationship without controlling for developmental functioning and found significant relations (Rojahn et al., 2009) whereas others have found no significant results (Aman et al., 1995). Matson and Rivet (2008) found that for adults with severe symptoms of ASD, stereotypies were significantly related to aggressive behavior; however, this did not hold up for those with mild symptoms of ASD. Unlike findings from this study, when those with all severity levels of ASD were combined, stereotypies did not significantly relate to aggressive behavior. Given the lack of specific hypotheses due to the mixed findings across a limited literature base, these results provide further evidence for the relation between stereotypies and Aggressive/Destructive Behavior even when controlling for developmental level. The lack of interpretable findings at the item level implicates other variables in the development of challenging behavior. Perhaps the rigidity associated with stereotypies as a whole, makes it more likely that a child will engage in Aggressive/Destructive Behavior as a means of coping with associated distress/discomfort or to attempt to affect change in the surrounding environment. Future studies should further investigate variables that mediate or moderate the relationship between stereotypies and challenging behavior.

Similar to other researchers who included toddler populations in their sample, significant relations between socialization or stereotypies and aggressive or destructive forms of challenging behavior were small (Fodstad, 2011; Hattier, 2011; Lowe et al., 2011). Socialization skills as well as stereotypies as a whole predicted engagement in Aggressive/Destructive Behavior when developmental functioning was controlled for; however, these core symptoms of ASD only predicted engagement at low levels for each increment in score on the corresponding factor of the *BISCUIT-Part 1*. Reflective of this were small odds ratios (OR). Small ORs of 1.03 and 1.11 indicated that an increase of one point on a factor score increased the likelihood of engaging in challenging behavior by 1.03 and 1.11, respectively. However, when impairments across a broad class of socialization skills or stereotypies emerged (represented by higher factor scores on the *BISCUIT-Part 1*) there were large ORs. Thus, as impairment becomes increasingly broad and severe, the likelihood of engaging in challenging behavior will be amplified.

Examination of ORs allows for using scores on a measure to examine the odds of a toddler engaging in a specific form of challenging behavior. For example, a score of 10 on the Socialization/Nonverbal Communication factor increases a toddler's odds of engaging in Aggressive/Destructive Behavior by 1.34 whereas a toddler with a score of 30 has a 2.43 increase in odds. Yet, a toddler with the most severe socialization impairment, represented by a score of 48 on Socialization/Nonverbal Communication factor of the *BISCUIT-Part 1*, had a 4.13 odds of engaging in Aggressive/Destructive Behavior. When examining a combination of symptoms reflecting stereotypies there were also higher odds in engaging in Aggressive/Destructive Behavior than with lower symptom endorsements. A toddler demonstrating the most impairment on stereotypies (i.e., factor score of 46) has a 121.58 odds of engaging in Aggressive/Destructive Behavior compared to toddlers without impairments on this

factor. These data indicate that socialization impairments can affect the odds of engaging in Aggressive/Destructive Behavior from 1.03 to 4.13 depending on the interplay of socialization impairment. Likewise, stereotypes affect the odds of engaging in Aggressive/Destructive Behavior from 1.11 to 121.58.

In contrast to some other researchers (Fodstad, 2011; Lowe et al., 2011), socialization skills did not significantly relate to SIB after controlling for developmental functioning. A limitation of previous researchers' methods has been that they did not tease apart the variance accounted for by developmental functioning. Perhaps correlations in other studies were enhanced by participants' developmental functioning as opposed to the unique contribution of socialization skills. The lack of statistically significant relations between socialization skills and SIB is consistent with findings from a study utilizing an adult sample with comorbid ASD and ID (Matson & Rivet, 2008). No specific hypotheses were generated regarding the relationship between socialization skills and engagement in SIB for this study due to inconsistent findings (Lowe et al., 2007; Matson, Neal, Fodstad, & Hess, 2010; Matson & Rivet, 2008). Regardless, this study extended previous researchers' finding of null relationships between socialization skills and SIB (e.g., Matson & Rivet, 2008) to an at-risk toddler population while controlling for developmental functioning.

Only stereotypic behavior was implicated in predicting engagement in SIB when developmental functioning was controlled for; however, these effects were small for individual increments in Repetitive Behavior/Restricted Interests. Nonetheless, similar to the relationship between socialization skills and Aggressive/Destructive Behavior, these effects were magnified when comparing those with no impairment on stereotypes to those with greater levels of impairment as represented by greater scores on the Repetitive Behavior/Restricted Interests

factor of the *BISCUIT-Part 1*. For example, a score of 10 on Repetitive factor of the *BISCUIT-Part 1* increased the odds of a toddler engaging in SIB by 2.84 with a toddler having even greater odds (i.e., OR = 22.89) of engaging in SIB with a score of 30. These findings extend findings from Matson and Rivet (2008; that stereotypies are significantly related to SIB among adults with dual ASD and ID diagnoses) to an at-risk for ASD toddler population. Many researchers conceptualize SIB as a form of stereotypy as it is repetitive in nature (e.g., Rojahn et al., 2008). Thus, it is likely that toddlers with a predisposition for engaging in repetitive motor movements or having odd responses to sensory input would be more likely to engage in challenging behavior that is repetitive and odd in nature. However, these results are correlational, and as such, this study was unable to tease out whether stereotypies or SIB occurred first, if they developed together, or if another variable affected the relationship between these two behaviors. Also, a natural confound likely exists between Repetitive Behavior/Restricted Interests and SIB factors. Perhaps the repetitiveness of SIB, which is odd and often aversive for others to observe, led to caregivers providing higher scores on the Repetitive Behavior/Restricted Interests factor of the *BISCUIT-Part 1*. Thus, longitudinal studies examining how stereotypies affect the presentation of SIB are warranted.

Interestingly, even with a large sample size, communication skills did not predict engagement in Aggressive/Destructive or SIB when developmental functioning was controlled for in this at-risk toddler sample. The communication hypothesis was neither upheld nor disconfirmed. Rather, findings provide further support for the lack of a meaningful relation between communication skills and specific forms of challenging behavior. Findings from this study are in contrast to researchers who argue that toddlers with ASD engage in challenging behavior as a form of communication; that is, they are unable to communicate so they hit others,

throw items, or hit themselves to inform others about their needs or to cause others to provide them activities or items of value to them (Durand, 2001; Hagopian et al., 1998). These researchers typically cite single subject design research, utilizing functional communication training to decrease challenging behavior.

In contrast, the majority of researchers utilizing group design methods have found no significant relation between communication skills and challenging behavior (Farmer, 2011; Lowe et al., 2011; Matson & Rivet, 2008; Matson et al., 2009, Matson et al., in press). Specific measurement techniques of communication skills and challenging behavior (i.e., report versus observational methods) likely affected results. This factor could lead to mixed findings across research designs. As discussed previously, during the infant and toddler years socialization and communication skills likely affect one another (Rutherford et al., 2007; Toth et al., 2006; Toder et al., 2009). Interestingly, results of this study as a whole indicate that engagement in aggressive and destructive forms of challenging behavior are not only more related to a toddler's broad interaction with society around him (e.g., use of gestures, interpreting others' body language, motivation to interact with others, interacting with others, recognizing and responding to other's emotional reactions) but to underlying rigidity and repetitiveness in behavior. However, engagement in SIB was only found to be more related to underlying rigidity and repetitiveness in behavior.

Findings from item analyses further suggest that it is not just one specific form of socialization skill or stereotypic behavior that contributes to the prediction of a topography of challenging behavior. Rather, the combination of various socialization deficits and/or various forms of stereotypies likely contributes to engagement in challenging behavior. This is highlighted by net suppression affects when examining the unique contribution of each item

comprising Social/Nonverbal Communication and/or Stereotypies with engagement in Aggressive/Destructive and/or SIB. The presence of suppression underscores that the collection of independent variables is more interrelated than each independent variable is individually related to a dependent variable. There is little unique variance between that independent and dependent variable. When examining the model as a whole, all independent variables/covariates are subsumed together. This total overlap with each dependent variable is attributed to the overall collection of variables in the model. In this study, this overlap that the collection of independent variables/covariates had on the dependent variables was significant in size. However, at an item level individual predictors, while holding variance from other independent variables/covariates constant, did not significantly overlap with the dependent variables. Rather, suppression effects were found indicating that the predictors were more related to each other and/or that independent variables mediated the relationship of other independent variables with the dependent variable. Thus, suppression also indicates that examining the prediction of challenging behavior at item level enhanced and curbed the relation between some independent variables/covariates and the dependent variable.

Thus, overall, examining items pertaining to socialization skills or stereotypies at an item level provided no added benefit in understanding prediction of challenging behavior. Rather, using a variable comprised of a subset of items reflecting core symptoms of ASD provided a more accurate depiction of how a core symptom predicts challenging behavior. As such, hypotheses purporting significant findings in regard to items comprising the *BISCUIT-Part 1* and *Part 3* factors were not upheld. Instead, results demonstrate that no core symptoms of ASD at an item level were useful in predicting specific forms of challenging behavior. That is, there was not

one specific form of socialization skill or stereotype that was uniquely implicated in engagement in behaviors reflective of Aggressive/Destructive Behavior or SIB.

As with any study, there were limitations. For example, this study examined core symptoms of ASD and challenging behavior at one point in time. Thus, this study is correlational in nature and does not imply causation. Furthermore, it was not possible to determine what came first: core symptoms of ASD or challenging behavior. Therefore, it is unclear whether challenging behavior predicts engagement in core symptoms of ASD or whether core symptoms of ASD predict engagement in challenging behavior. A substantial literature base supporting ASD as a neurodevelopmental disorder, present from birth, exists (Mundy & Burnette, 2005; Mundy & Neal, 2001) and a low prevalence of caregivers with newborns seeking services for Aggressive/Destructive Behavior or SIB. Thus, it is likely that core symptoms of ASD are present prior to the onset of challenging behavior. However, it is uncertain whether and how engagement in challenging behavior further affects the severity of ASD and vice versa. Moreover, given the correlational nature of this study coupled with the small effect size of current findings, it is likely that other variables affect the relationship between core symptoms of ASD and challenging behavior. Future studies should utilize prospective methods of examining the relation between core symptoms of ASD and challenging behavior.

The previous limitation brings to light another limitation of this study: that the model used to predict challenging behavior likely did not include all relevant variables. For example, variables reflecting learning theory were not included in the models. Researchers have consistently demonstrated that principles related to learning theory, especially operant theory, affect the presentation of challenging behavior in a variety of manners (e.g., frequency, severity). Researchers and clinicians adhering to operant theory examine antecedent and consequent events

in relation to challenging behavior to help determine variables that maintain challenging behavior. Antecedent variables, such as method of delivering a demand, task novelty, task difficulty and preference of task, have been found to affect the presentation of challenging behavior (Call, Wacker, Ringdahl, Cooper-Brown, & Boelter, 2004). Similarly, consequences, such as history of reinforcement, punishment, consistency of reinforcement and punishment, as well as schedules of reinforcement influence the likelihood of a person engaging in the same behavior under similar circumstances in the future (Cooper, Heron, & Heward, 2007; Matson & Minshawi, 2006).

Through functional assessment, researchers have successfully identified variables that maintain challenging behavior (e.g., Embregts et al., 2009; Nieuwenhuijzen, 2009; Hanley et al., 2003; Iwata et al., 1994; Najdowski, Wallace, Ellsworth, MacAleese, & Cleveland, 2008). Treatments developed based on these maintaining variables have been the most effective in decreasing the frequency and severity of various topographies of challenging behavior (e.g., Matson & Minshawi, 2006; Najdowski, Wallace, Ellsworth, MacAleese, & Cleveland, 2008). Treatment plans which incorporate reinforcement, extinction, punishment, and often skill building, alter a person's learning history. Thus, future group design studies of challenging behavior should include data that reflect individual learning history or results of functional assessment of challenging behavior in an effort to examine a more comprehensive model.

Another potential limitation to this study was that retrospective caregiver report was the sole method used to examine symptoms of ASD and challenging behavior. Although not ideal, researchers have found moderate concordance rates between retrospective caregiver report and actual language and other skills (Goldberg, Thorsen, Osann, & Spence, 2008; Majnemer, & Rosenblatt, 1994). Furthermore, when examining program outcomes for infants and toddlers

participating in an intervention program, Pratt, McGuigan, and Katzev (2001) found that retrospective caregiver report was more valid than other assessment methods. As only one measure each was used to evaluate symptoms of ASD and challenging behavior in this study there may have been aspects of each construct that were missed (Whitley, 2002). The measures used in the current study have psychometric viability for a toddler population; thus, these measures were appropriate to use and provided reliable and valid information. Regardless, the use of additional measures to assess each construct would have further increased the ability of the study to fully measure constructs (Whitley, 2002). Specifically, using different forms of measurement (e.g., caregiver report, behavioral observation, rating form, semi-structured interview) to quantify the same construct within the same study is beneficial as each form of measurement has its own strengths and weaknesses (Whitley, 2002). Thus, future studies should incorporate multiple assessments, optimally with at least one assessment based in behavioral observation for the independent and dependent variable, to further help delineate how core symptoms of ASD predict challenging behavior.

Despite these limitations, this study extends previous analyses by providing information on the extent to which specific core symptoms of ASD relate to specific topographies of challenging behavior among an at-risk toddler population above and beyond developmental functioning. Additionally, these results extend previous findings as this study used measures that are psychometrically sound to assess for symptoms of ASD and challenging behavior among a toddler population at-risk for developing ASD. Given that other researchers did not use measures solely designed to assess for how socialization skills, communication skills, and stereotypies manifest among those with ASD, results from this study may have differed due to the measurement of slightly differing constructs.

Although effects were small, there are still important implications. First, the interplay and additive effect of various symptoms reflective of socialization impairment and/or stereotypes significantly relate to engagement in challenging behavior. Communication skills did not significantly relate to engagement in any topography of challenging behavior whereas socialization skills only significantly predicted engagement in Aggressive/Destructive Behavior. Furthermore, discrete social skills (e.g., waving hello, using others' body language and facial features as social cues, eye contact) and behaviors subsumed under stereotypes (e.g., repetitive motor movements, rigidity with routine, odd reaction to sounds) were not useful in predicting engagement in challenging behavior. This finding is important for informing research on constructs at the item level. They are not likely to be useful for further predicting engagement in challenging behavior at meaningful levels. However, at an empirical level it would prove fruitful to examine the interrelations among core symptom of ASD and how they moderate/mediate the presentation and development of challenging behavior at an item level.

Information on ORs further extends the use of the *BISCUIT-Part 1*. This study provided information on how *BISCUIT-Part 1* scores can predict the odds of a toddler engaging in overall topographies of challenging behavior. By using scores from factors of the *BISCUIT-Part 1*, clinicians can determine the odds of a toddler engaging in specific forms of challenging behavior. This study was the first to examine the odds of engaging in challenging behavior based on factor scores of the *BISCUIT-Part 1*. Further studies corroborating these findings are warranted. Information regarding the likelihood of engaging in challenging behavior can help streamline the assessment process when time constraints are present and inform recommendations regarding service provision and treatment. When providing feedback to caregivers of toddlers with greater odds of engaging in challenging behavior, more time could be

spent on providing recommendations for prevention and intervention of challenging behavior. Moreover, future studies could examine whether caregivers with toddlers with greater odds of engaging in challenging behavior would benefit from more intensive preventative or intervention services focusing on challenging behavior than is typically provided. As challenging behavior costs an individual and his family greatly in terms of instructional time to increase skills and community involvement (Anderson et al., 1992; Matson & Wilkins, 2007; Sturmey et al., 2005), steps to further predict and implement prevention services for challenging behavior among this vulnerable population are advised.

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APPENDIX A

BISCUIT-PART 1 FACTORS AND ITEMS

Social/Nonverbal Communication (*n* = 24)

- 2. Intellectual abilities
- 3. Age appropriate self-help and adaptive skills
- 7. Ability to recognize the emotions of others
- 10. Social interactions with others his/her age**
- 12. Responds to others social cues
- 14. Peer relationships**
- 17. Shares enjoyment, interest, or achievement with others
- 18. Ability to make and keep friends
- 19. Interest in participating in social games, sports, and activities
- 20. Interest in another person's side of the conversation
- 21. Able to understand the subtle cues or gestures of others
- 22. Use of too few or too many social gestures.
- 23. Body posture and/or gestures
- 28. Motivated to please others
- 32. Facial expressions corresponds to environmental events
- 35. Plays appropriately with others**
- 36. Reads nonverbal cues of other people
- 45. Make-believe or pretend play
- 46. Understand of appropriate jokes, figures of speech, or sayings
- 47. Gives subtle cues or gestures when communicating with others
- 51. Responds to others
- 52. Socializes with other children**
- 59. Development of social relationships**
- 62. Participates in games or other social activities

Communication (*n* = 7)

- 1. Communication skills
- 5. Verbal Communication
- 9. Use of language to communicate
- 16. Use of language in conversations with others
- 24. Communicates effectively
- 50. Language Development
- 53. Use of non-verbal communication

Repetitive Behavior/Restricted Interests (*n* = 23)

4. Engages in repetitive motor movements for no reason
6. Prefers food of a certain texture or smell
8. Maintains eye contact
11. Reactions to normal, everyday sounds
13. Reaction to normal, everyday lights
26. Display a range of socially appropriate facial expressions
27. Restricted interests and activities
29. Eye-to-eye gaze
30. Reaction to sounds and sights
33. Sticking to odd routines or rituals that don't have a purpose of make a difference
34. Abnormal preoccupation with parts of an object or objects
38. Expects others to know their thoughts, experiences, and opinions without communicating
39. Interest is a highly restricted set of activities
41. Use of facial expressions
42. Abnormal fascination with the movement of spinning objects
43. Curiosity with surroundings
44. Saying words or phrases repetitively
48. Becomes upset if there is a change in routine
49. Needs reassurance, especially if events don't go as planned
55. Limited number of interests
57. Abnormal, repetitive hand or arm movements
58. Abnormal, repetitive motor movements involving entire body
61. Isolates self

Note: Bolded items were combined into one variable in some analyses due to correlation coefficients at .80 or greater.

APPENDIX B

***BISCUIT-PART 3* AGGRESSIVE/DESTRUCTIVE BEHAVIOR AND SELF INJURIOUS BEHAVIOR FACTOR ITEMS**

Aggressive/Destructive Behavior

3. Kicking Objects
4. Removal of clothing at inappropriate times
6. Playing with own saliva
7. Throwing objects at others
8. Banging on objects with hands
9. Leaving the supervision of caregiver without permission
10. Aggression toward others
11. Pulling others' hair
12. Yelling or shouting at others
13. Property destruction

Self Injurious Behavior

1. Poking him/herself in the eye
2. Harming self by hitting, pinching, scratching, etc.

APPENDIX C

STATE OF LOUISIANA DEPARTMENT OF HEALTH AND HOSPITALS INSTITUTIONAL REVIEW BOARD DOCUMENTATION

Bobby Jindal
GOVERNOR



Alan Levine
SECRETARY

State of Louisiana Department of Health and Hospitals Office of the Secretary

Louisiana Department of Health and Hospitals Institutional Review Board Notice of Review

Project Title: An Early Autism Screening Initiative within a State Early Intervention Program:
Description of Results and Comparison of Two Screening Instruments

Principal Investigator: Cheryl L. Knight, Ph.D., BCEA-D
Coordinator of Autism Initiatives
Office for Citizens with Developmental Disabilities

Date: June 10, 2010

X 1. In accordance with Louisiana Department of Health and Hospitals Institutional Review Board Guidelines and Practices the above research has been reviewed and has been APPROVED by DHH IRB on this date. The research is subject to continuing review and any conditions listed in the comments section below.

 2. In accordance with Louisiana Department of Health and Hospitals Institutional Review Board Guidelines and Practices the above research has been reviewed and found to be DEFICIENT for reasons listed in comments section below.

 3. In accordance with Louisiana Department of Health and Hospitals Institutional Review Board Guidelines and Practices the above research has been reviewed and APPROVED via Expedited Review procedures.

 4. In accordance with Louisiana Department of Health and Hospitals Institutional Review Board Guideline and Practice the above research has been reviewed and found to be EXEMP from further IRB review.

Comments:

We are continuing to request that any emergent problems or changes to protocol that may affect the status of this project be reported to this office and that no such changes be instituted prior to DHH IRB review, except where necessary in order to eliminate immediate hazards.

Sheila Bridgewater
Interim IRB Chairperson

Audrey Pugh
Program Manager
Bureau of Policy Research and Health System Analysis

Cc: Mary Johnson

6. DHH Facilities and location where research is to be conducted:
 - a. Administrative location for coordinating all research activities, which will consist solely of the extraction and analyses of de-identified information from the records of children served across the State by DHH/OCDD's EarlySteps:

Office for Citizens with Developmental Disabilities
628 North 4th St
Baton Rouge, LA 70821
 - b. Additional research analyses, following de-identification of data:

324 Audubon Hall
Department of Psychology
Louisiana State University
Baton Rouge, LA 70803

7. Requirements of research project from DHH:
 - a. number of subjects/time required:

The proposed research consists of the analysis of information extracted from the records of approximately 6000 children, ages 18-36 months, who receive Initial, Annual or Six-Month Reviews through EarlySteps. This number is an estimate based on enrollment from the fiscal year 07/08. This research project will not require any additional time from the children and families served by EarlySteps.
 - b. program support personnel/space/equipment:

Additional administrative time (e.g., project communication/coordination; procedures; tracking and monitoring; electronic and hardcopy data de-identification and management; etc.), training time, report-writing, dissemination is estimated at 0.5 FTE for an additional two years, to be incorporated within current TO (e.g., no new positions).

Total amount of program support from administrative assistant personnel is estimated as requiring only occasional time with printing-copying, training material assembly, some assistance with monitoring and tracking; and data de-identification and monitoring, which will not exceed current resources.

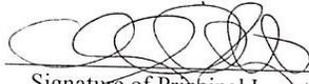
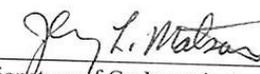
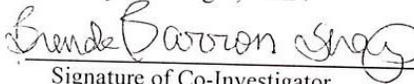
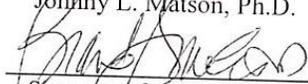
No additional office space is required for completing this research. Administrative space, regional team meeting space, or other space requirements are adequately addressed by existing resources.

No additional equipment is required for completing this research. Existing computer equipment, software, desk/office space and set-up and related materials are adequate for the needs of this project and are otherwise contained within the scope of current operations.
 - c. other needs (specify): None.

8. Attach Abstract of the Research Proposal. Attached.
9. Attach brief description of potential benefits of this research. Attached
10. Attach brief description of potential risks of physical or psychological harm or discomfort to participant (if any). Attached
11. Attach brief description of procedures to be used to establish informed consent of research participants (if applicable). Attach Informed Consent Form immediately after this page. If a waiver of any aspects of informed consent is requested, a statement of justification is required here. Detailed explanation that research consists solely of extraction and analysis of de-identified data from clients' clinical records is attached.
12. Will client personal-identifying information (e.g., name, address, Medicaid recipient number, Social Security Number, phone number) be collected in the course of this research project? NO; If yes, attach explanation why it is necessary to identify the clients.

RESEARCHER'S PLEDGE

I am applying to conduct the research project entitle above at the indicated DHH facilities/programs. I agree to conduct this research in an ethical and responsible manner and as stipulated by the proposal and this application. I agree to secure the approval of the DHH IRB for any modifications to the research protocol. I understand that I have an ethical and legal responsibility not to divulge the identity of any clients or any information about them as identifiable individuals, nor will the final compilation of results of this project contain any client identification information. As soon as the project is complete, all client-identifying information collected will be destroyed. I agree to keep the DHH IRB informed periodically of the progress of the project, and I will submit a report of the final results to the IRB and facilities/programs involved.

 Signature of Principal Investigator Cheryl L. Knight, Ph.D.	05.26.10 Date	 Signature of Co-Investigator Johnny L. Matson, Ph.D.	May 12, 2010 Date
 Signature of Co-Investigator Brenda Barron Sharp, M.A.	5/26/10 Date	 Signature of Co-Investigator Brandi Smiroldo, Ph.D.	5/26/10 Date

APPENDIX D

LOUISIANA STATE UNIVERSITY INSTITUTIONAL REVIEW BOARD DOCUMENTATION

ASD STUDY Consent Form

1. **Study Title:** Developing the Autism Spectrum Disorder (ASD)
2. **Performance Sites:** Louisiana State University Psychological Services Center, preschools, grade schools, churches, hospitals or outpatient clinics, organizations, and internet websites.
3. **Contacts:** Johnny L. Matson, Ph.D. (225) 578-8745 Mon-Fri
4. **Purpose of the Study:** Several diagnostic instruments exist that are designed to determine the presence of emotional difficulties and behavior problems in children and adults. Currently, there are no screening instruments that incorporate differential diagnosis of the developmental disorders. The purpose of this study is to develop assessment instruments designed to examine the social skills, challenging behaviors, and symptoms of emotional difficulties in children, as well as autistic traits in adults.
5. **Subjects: Inclusion Criteria:** Parents of children who are ≤ 18 years old receiving services at the Psychological Services Center; children who are receiving inpatient or outpatient medical/behavioral services, or currently attending preschools, grade schools, or church groups; children recruited via websites or organizations such as those for children with ASD or disabilities; and adults residing in the community. **Exclusion Criteria:** Parents, legal guardians, or informants unable or unwilling to provide informed consent or parental consent. **Maximum number of subjects:** 2000
6. **Study Procedures:** Assessment instruments designed to examine the social skills, challenging behaviors, and symptoms of emotional difficulties in individuals will be administered to the sample of 2000 adult participants (i.e., parents of child participants). Participants will receive information about the study and given an opportunity to volunteer through informational mail-outs at their child's school, church, or clinic, etc. or information given to them when calling about services at the Psychological Services Center. Once consent is granted, participants will be given assessment packets regarding the following either in person at the outpatient clinic, mail, or Internet link. Participants will provide information regarding the individual's: 1) demographics (e.g., age, gender, ethnicity, parents' names, number of siblings, etc.); 2) current psychotropic drug use and diagnoses; 3) developmental milestones; 4) social skills (e.g., turns head toward caregiver, initiates verbal communication, complains often, prefers to be alone, disturbs others, interacts positively with others, etc.); 5) challenging behavior (i.e., circumstances which the target behavior occurs); and 6) symptoms of other difficulties (e.g., tantrums, excessive worry or concern, initiates fights, fidgets or squirms excessively, stereotypies, intellectual disability, impaired social interactions, has odd gait when running, language delays, etc.). Participants who receive the packet via mail will receive a follow-up phone call to ensure that they have received the packet and have the opportunity to ask questions. This study will take approximately 1 hour to 1.5 hours for each participant. Additionally, children (recruited from the outpatient clinic) of a subset of the sampled adult participants (i.e., parents of child participants) will be administered an abbreviated assessment of intellectual functioning.
7. **Benefits:** Participants under the age of 18 years may benefit from this study by taking advantage of reduced price assessment services at the Psychological Services Clinic in Baton Rouge, Louisiana. If participants decide to take advantage of this offered benefit, participants will be required to come into the clinic to complete a parent interview and child observation session. If further assessment services are recommended, the participant may receive these services at half of the normal fee. All treatment services will be full price. Further, participants may benefit from professionals developing more reliable and valid assessment measures, suggesting improved diagnostic capabilities and more effective treatment interventions.
8. **Risks/Discomforts:** There is a small possibility of disclosure of personal information associated with this study. There are no other known risks resulting from participating in this study. Risks experienced should be those limited to those commonly experienced when receiving services from a public mental health clinic.
9. **Measures taken to reduce risk:** All participants will be given participant numbers. All data collected will be stored in reference to this number only. There will be one (1) master list which will list patient number by participant number to provide a means by which participants can choose to remove their data from the data set after participation. This list will be the only means by which data collected can be linked to personal information such as name or patient number. This list will be stored in a locked file cabinet, separately from the data collected.
10. **Right to Refuse:** Participation is voluntary. Participants may change their mind and withdraw from the study at any time before the conclusion of the study without penalty or loss of any benefit to which they may otherwise be entitled.
11. **Privacy:** This study is confidential. Data will be kept confidential unless release is legally compelled.
12. **Financial Information:** There is no cost to the participant and no payment will be provided for participation.
13. **Withdrawal:** There are no consequences for terminating participation in this study, which will last approximately 1 hour and 30 minutes in duration for each participant. To withdraw from the study, participants must inform the principle investigator of their desire to do so before the end date of the study.

14. **Removal:** A participant's data may be removed from the study if it is discovered that there were errors in the administration of any measure for that particular participant.

ASD Consent Form—Detach this page, Complete, and Return

The study has been described to me and all my questions have been answered. I may direct additional questions regarding study specifics to the investigators by contacting Megan Hattier at 225-578-1494 or asdsu@gmail.com.

If I have questions about subjects' rights or other concerns, I can contact Robert C. Mathews, Chairman, LSU Institutional Review Board, (225) 578-8692. I agree to participate in the study described above and acknowledge the researchers' obligation to provide me with a copy of this consent form if signed by me.

_____ Parent/Guardian/Informant Signature _____ Date

_____ (Please Print Name of Parent/Guardian/Informant)

_____ Signature of Adult Participant (if applicable) _____ Date

_____ (Please Print Name of Adult Participant if applicable)

The participant has indicated to me that he/she is unable to read. I certify that I have read this consent form to the participant and explained that by completing the signature line above he/she has given permission to participate in the study.

_____ Signature of Reader _____ Date

PLEASE FILL OUT THE FOLLOWING CONTACT INFORMATION:

(A research assistant will contact you to obtain additional information and answer any questions you may have before mailing questionnaires or sending email link to survey)

Telephone number(s) where informant can be reached: _____

Best time of day to be reached: _____

Mailing Address: _____

Email Address: _____

Circle to indicate your preference for the question below:

INTERNET (electronic)	MAIL (paper)	Would you prefer to be mailed the questionnaires in paper with a prepaid envelope included OR receive an Internet link via email to the questionnaires to complete the questionnaires electronically on the Internet.
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If you answered **MAIL (paper)**, please answer the following additional questions:

YES NO 1. Would you be willing to complete a shorter set of similar questions approximately 2 weeks after completing the first?

YES NO 2. Is there a second adult who knows your child well (other parent,

grandparent, etc.) who would be willing to complete the questionnaires for your child independently from yourself?

YES

NO

3. Do you consent to your child's teacher completing a similar set of questionnaires for your child?

Study Approved By:
Dr. Robert C. Mathews, Chairman
Institutional Review Board
Louisiana State University
203 B-1 David Boyd Hall
225-578-8692 | www.lsu.edu/irb
Approval Expires: 9-18-2022

VITA

Sara Mahan was born in Bryn Mawr, Pennsylvania in 1981. She earned her Bachelor of Science degree in psychology in 2005 from Pennsylvania State University in State College, Pennsylvania. After working with various clinical populations, including toddlers and children with developmental disabilities, Mrs. Mahan enrolled in the clinical psychology doctoral program at Louisiana State University. Through her tenure at Louisiana State University, her clinical and research endeavors focused on people with intellectual and developmental disabilities across the lifespan. Mrs. Mahan successfully completed her predoctoral internship at Marcus Autism Center in Atlanta, Georgia. She is currently a postdoctoral psychology fellow through Marcus Autism Center at Emory University School of Medicine in Atlanta, Georgia.