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Challenging behaviors in autism spectrum disorders : differences across childhood and the relationship with autism symptomatology

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CHALLENGING BEHAVIORS IN AUTISM SPECTRUM DISORDERS: DIFFERENCES
ACROSS CHILDHOOD AND THE RELATIONSHIP WITH AUTISM
SYMPTOMATOLOGY

A Dissertation

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Abstract

Challenging behaviors (CBs) are remarkably prevalent in individuals with autism spectrum disorders (ASDs) and can have a number of severe consequences. While it is believed that CBs reach their peak in childhood followed by a general abatement throughout adolescence and adulthood, the exact trend of CBs during childhood is unknown. Furthermore, the impact of changes in autism symptomatology on CBs during childhood has seldom been explored despite a positive correlation between autism symptomatology and CBs having been established. Therefore, the purpose of these studies was to determine where significant differences in both autism symptomatology and CBs occur throughout childhood, and to investigate how changes in the former variable may affect changes in the latter. It was determined that autism symptomatology and CBs both follow quadratic trends throughout childhood, with symptoms increasing over time prior to decreasing in adolescence. However, specific classes of CBs do not demonstrate as much variability. Furthermore, while changes in autism symptomatology do predict changes in overall CBs, this is not true for all classes of CBs, and changes in communication and socialization may not be as influential as believed. The implications of these findings are discussed.

Introduction

Autism spectrum disorders (ASDs), also known as pervasive developmental disorders, are currently comprised of a collection of five neurodevelopmental disorders (i.e., autistic disorder, Asperger's disorder, Rett's disorder, childhood disintegrative disorder, and pervasive developmental disorder-not otherwise specified [PDD-NOS]) characterized by deficits in socialization and communication skills, as well as by the marked presence of restricted repetitive behaviors and interests (RRBIs; Hattier & Matson, 2012; Leekam, Prior, & Uljarevic, 2011; Macintosh & Dissanayake, 2006; Nazeer & Ghaziuddin, 2012; Robertson, Tanguay, L'ecuyer, Sims, & Waltrip, 1999). It is currently estimated that as many as 1 in 88 individuals have an ASD (Centers for Disease Control and Prevention [CDC], 2012), which is a significant increase from estimates proposed only a few years to a decade ago (CDC, 2012; Fombonne, Simmons, Ford, Meltzer, & Goodman, 2001; Kogan et al., 2009; Nicholas et al., 2008). Assessment and treatment of this increasing population of individuals is critical because, in addition to the ailments characteristic of ASDs in and of themselves, individuals with ASDs are also prone to experience many other associated difficulties including comorbid intellectual disability (ID; Lo-Castro, Benvenuto, Galasso, Porfirio, & Curatolo, 2010; Matson & Shoemaker, 2009), comorbid psychiatric disorders (Bakken et al., 2010), a host of medical complications (Fombonne, du Mazaubrun, Cans, & Grandjean, 1997; Parmeggiani et al., 2010), and challenging behaviors (CBs; Bodfish et al., 2000; Murphy, Healy, & Leader, 2009). The last of these, CBs, is exceedingly common in individuals with ASDs and will be the focus of this paper.

CBs, also commonly referred to as maladaptive or problem behaviors, are defined as abnormal behaviors that deviate from one's culture in frequency, intensity, and/or duration and have the potential to cause harm to or pose significant hardship for the individual, those around

him/her, and/or the environment (Emerson, 2001; Emerson et al., 2000; Mudford et al., 2008).

CBs may threaten the physical safety of the person evincing the behaviors (Schroeder, Mulick, &

Rojahn, 1980), as is the case with self-injurious behaviors. In other cases, CBs may cause

physical harm to individuals in close proximity to the person evincing the behaviors (Mukaddes

& Topcu, 2006; Qureshi & Alborz, 1992), such as with physical aggression. This class of

behaviors may also result in damage to the individual's surrounding environment (e.g., property

destruction; Qureshi & Alborz, 1992). However, CBs do not necessarily solely affect, or even at

all affect, the physical safety of the individual, others, or the environment. CBs may also

significantly limit an individual's access to community facilities or activities (Emerson, 2001),

result in stigmatization (Luiselli & Slocumb, 1983), negatively impact stress levels of

parents/caregivers (Mandell & Salzer, 2007), require staff to intervene (Cuvo, Reagan,

Ackerlund, Huckfeldt, & Kelly, 2010), cause institutionalization (Antonacci, Manuel, & Davis,

2008), lead to loss of community placement (Gardner & Moffatt, 1990), increase the probability

of psychotropic medication or restraint use (Antonacci et al., 2008; Mudford et al., 2008), and

disrupt skill acquisition (Carr, Taylor, & Robinson, 1991; Qureshi & Alborz, 1992). Examples

of such CBs include self-stimulatory behaviors (e.g., playing with one's own saliva,

handflapping), noncompliance, inappropriate vocalizations, and out of seat behavior, as well as

the aforementioned aggressive and self-injurious behaviors.

Given the significant impact CBs may have upon the lives of the individuals evincing

them and those around them, and the higher prevalence of such behaviors being exhibited by

individuals with ASDs (Baghdadli, Pascal, Grisi, & Aussilloux, 2003; Holden & Gitlesen, 2006;

Jang, Dixon, Tarbox, & Granpeesheh, 2011; Matson, Wilkins, & Macken, 2009; McTiernan,

Leader, Healy, & Mannion, 2011; Murphy et al., 2009), it is necessary to understand the factors

affecting the presence of these behaviors in individuals with ASDs. Therefore, the current

research proposal will seek to elucidate some of these factors, first by investigating the

relationship between CBs and autism symptomatology across the lifespan using a cross-sectional

approach, and secondly by investigating the predictive relationship between changes in autism

symptomatology and CBs overtime in toddlers. Prior to these proposals, a literature review will

be presented outlining ASDs with respect to their symptomatology, current and proposed

diagnostic criteria, and factors affecting diagnoses and symptom presentation, followed by a

review of CBs evinced by individuals with ASDs in regard to topography, prevalence, and

associated factors.

<center>**Autism Spectrum Disorders**</center>

As mentioned previously, the diagnostic classification of ASDs currently includes five separate diagnoses (i.e., autistic disorder, Asperger's disorder, Rett's disorder, childhood disintegrative disorder, and PDD-NOS); however, the five diagnoses making up this class of disorders are soon to be collapsed into a single diagnosis in the upcoming *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (*DSM-5*; American Psychiatric Association [APA], 2012), which will be labeled autism spectrum disorder. Given this proposed re-organization of ASDs coinciding with the current investigation's timeline, the ASD diagnoses from the *DSM-IV-TR* that are applicable to the present study (i.e., autistic disorder and PDD-NOS) and the proposed ASD diagnostic criteria to appear in the upcoming *DSM-5* will be presented here. First, an overview of the core features characteristic of ASD will be reviewed in detail.

Current Core Features of Autism Spectrum Disorders

Socialization impairments. Social skills, conceptualized as a behavioral construct, are defined as situation-specific and observable discrete responses, consisting of both verbal and nonverbal behaviors, which are required for an individual to effectively adapt to their environment through interaction and communication with others (Bellack, 1979; Matson & Wilkins, 2007; Stella, Mundy, & Tuchman, 1999). Social skills deficits are commonly believed to be the hallmark feature of ASDs (Rutter, 1968; Sevin, Knight, & Braud, 2007; Volkmar et al., 1987), with evidence of impairments arising by as early as 6 months of age (Maestro et al., 2005; Maestro et al., 2002; Muratori, Apicella, Muratori, & Maestro, 2011) and becoming inarguably apparent by 2 to 3 years old (Tager-Flusberg, 2010; Werner & Dawson, 2005). Researchers have consistently found that individuals with ASDs present with significantly greater social skills

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impairments compared to typically developing age-matched peers (Matson, Kozlowski, Neal, Worley, & Fodstad, 2011; Volkmar et al., 1987)

Eye contact or eye-to-face gaze, eye gaze direction, and joint attention behaviors are amongst the most distinctive social skills impaired in individuals with ASDs (Clifford & Dissanayake, 2008; Klein, MacDonald, Vaillancourt, Ahearn, & Dube, 2009; Senju & Johnson, 2009). Typically developing children engage in reciprocal eye contact and are able to shift visual attention back and forth between a person and a shared stimulus of interest early in life (Arnold, Semple, Beale, & Fletcher-Flinn, 2000); however, children with ASDs often lack these skills and may fail to make consistent eye contact with other persons, sometimes focusing instead on the person's mouth or other nearby stimuli (Neumann, Spezio, Piven, & Adolphs, 2006). In line with these impairments, whereas typically developing individuals demonstrate a preference in attending to socially relevant stimuli (e.g., other persons), individuals with ASDs often do not (Maestro et al., 2002; Osterling & Dawson, 1994). Additionally, individuals with ASDs may be much less likely to respond to their name when it is called (Osterling & Dawson, 1994; Trillingsgaard, Sørensen, Němec, & Jørgensen, 2005), exhibit impaired proto-declarative pointing/gesturing (i.e., gesturing to indicate interest; Camaioni, Perucchini, Muratori, Parrini, & Cesari, 2003; Clifford, Young, & Williamson, 2007), demonstrate imitation skill delays (Vanvuchelen, Roeyers, & De Weerdt, 2011; Williams, Whiten, & Singh, 2004; Young et al., 2011), lack the ability to engage in pretend play (Rutherford, Young, Hepburn, & Rogers, 2007; Lam & Yeung, 2012), and fail to engage in syntony (i.e., reading and attending to others affective states and expressing oneself through affect; Muratori et al., 2011), among other social skills deficits.

While most social skills deficits are not unique to ASDs, as similar impairments are also present in individuals with other intellectual and/or developmental disabilities or delays, many of these deficits are more pronounced within the ASD population. For example, although individuals with other intellectual and or developmental disabilities may present with many social impairments, including impairments in eye contact, response to name, empathy, joint attention, imitation skills, and the ability to form friendships, researchers have shown that these deficits are significantly more severe in individuals with ASDs (Charman et al., 1997; Lincoln, Searcy, Jones, & Lord, 2007; Matson, Dempsey, & LoVullo, 2009; Werner, Dawson, Munson, & Osterling, 2005). Likewise, researchers have also found that social skills impairments differ within ASD diagnoses, with individuals with autistic disorder generally presenting with a greater breadth and severity of social skills impairments compared to those with PDD-NOS (Hattier & Matson, 2012; Pearson et al., 2006).

Communication impairments. Strongly related to socialization impairments, communication impairments are also a core feature of ASDs (Lord et al., 2000; Rutter & Bartak, 1971). In fact, many times researchers will combine the two domains of impairment (e.g., social communication, socio-communication) or differ as to which domain a specific behavior belongs (e.g., joint attention; Chiang, Soong, Lin, & Rogers, 2008; Robertson et al., 1999). In its most basic sense, communication impairments refer to the lack of or significant delay or impairment in using verbal and/or nonverbal language to appropriately and effectively converse with others, both expressively and receptively (Charman, 2005). Communication impairments are evident in individuals with ASDs very early in life, and are often the first reported concern by parents (Kozlowski, Matson, Horovitz, Worley, & Neal, 2011; Volkmar & Pauls, 2003). Deficits are present prior to 3 years of age, with many impairments emerging within the first 6 to 18 months

of life (Bolton, Golding, Emond, & Steer, 2012; Horovitz & Matson, 2010; Mitchell et al., 2006).

Children with ASDs significantly differ from typically developing children in both their expressive and receptive communicative abilities (Bolton et al., 2012; Jones & Schwartz, 2009; Landa, 2007; Mitchell et al., 2006; Stone, Ousley, Hepburn, Hogan, & Brown, 1999). Development of speech is often significantly delayed or absent in comparison to typically developing individuals, with noted differences being found during toddlerhood in babbling, age at which first words are spoken, and the use of single words (Howlin, 2003; Werner & Dawson, 2005). Approximately 30% to 50% of individuals with ASDs never acquire functional verbal communication skills (Anderson et al., 2007; Noens & Van Berckelaer-Onnes, 2004; Wetherby, Prizant, & Schuler, 2000), and the use of alternative modes of communication to compensate for lack of speech are largely absent without extensive teaching. When compared to typically developing peers, individuals with ASDs use significantly fewer gestures to communicate (Mitchell et al., 2006), are more likely to use neologisms when speaking (Volden & Lord, 1991), have pronounced difficulty with pronoun reversals (Kanner, 1943; Lee, Hobson, & Chiat, 1994), engage in immediate and delayed echolalia (Folstein, 1999; Noens & Van Berckelaer-Onnes, 2005; Young, Brewer, & Pattison, 2003), and display impairments in prosody of speech (Diehl & Paul, 2012; Grossman, Bemis, Skwerer, & Tager-Flusberg, 2010), among other impairments. Expressive communication impairments vary drastically across individuals with ASDs, but it has been established that intellectual impairment plays a major role in its severity (Kjellmer, Hedvall, Fernell, Gillberg, & Norrelgen, 2012). Some examples of receptive communication difficulties include understanding significantly fewer phrases (Mitchell et al., 2006) and challenges with processing figurative language (Happé, 1995; Rundblad & Annaz, 2010).

However, in contrast to intellectual impairment being a significant contributor to expressive language impairment, it has been found that autism symptomatology severity and adaptive functioning have a greater impact on receptive communication skills (Kjellmer et al., 2012). Overall, it is believed that when individuals with ASD use communication, it is used as a means of regulating one's environment as opposed to socially interacting with others (Wetherby, 1986).

While differences in communication deficits between toddlers with ASDs and other atypically developing toddlers are not as common (Kozlowski et al., 2011; Veness et al., 2012), some researchers report that the frequency and severity of overall communication difficulties are greater in those with ASDs (Horovitz & Matson, 2010; Fodstad, Matson, Hess, & Neal, 2009). More specifically, researchers have found that while children with ASDs engage in verbal and nonverbal elicited communication (i.e., communication prompted by another individual) at rates similar to typically and other atypically developing children, their rates of verbal and nonverbal spontaneous communication are significantly lower than those exhibited by their age-matched typically and atypically developing peers (Chiang & Carter, 2008; Forde, Holloway, Healy, & Brosnan, 2011; Stone, Ousley, Yoder, Hogan, & Hepburn, 1997). Children with ASDs have also been found to verbally and nonverbally initiate requests significantly less frequently than typically and atypically developing peers, even when compared to typically developing children chronologically younger than them (Chiang et al., 2008).

RRBIs. The third and final core feature of ASDs, RRBIs, has been given the least attention by researchers (Honey, McConachie, Randle, Shearer, & Le Couteur, 2008). In the realm of ASDs, RRBIs are presently said to include the following behaviors: abnormal preoccupation with stereotyped and restricted patterns of interest (i.e., circumscribed interests); preoccupation with parts of objects; stereotyped and repetitive motor movements (i.e.,

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stereotypy); and inflexible adherence to specific, nonfunctional routines/rituals (Charman, 2005).

In recent literature, researchers have frequently made the argument for a subdivision of RRBIs

into two categories – lower-order and higher-order behaviors (Georgiades, Papageorgiou, &

Anagnostou, 2010; Mooney, Gray, Tonge, Sweeney, & Taffe, 2009; Szatmari et al., 2006;

Turner, 1999). While lower-order RRBIs consist of stereotyped motor movements, repetitive

manipulation of objects or parts of objects, unusual sensory interests, and self-injurious

behaviors, higher-order RRBIs encompass compulsions, rituals, insistence on sameness, and

restricted behaviors. Other researchers have suggested that greater than a two-factor solution

may exist for RRBIs in ASDs (Bodfish, Symons, Parker, & Lewis, 2000; Lam, Bodfish, &

Piven, 2008); these researchers point out that various RRBIs are excluded from the lower- and

higher-order factors that may actually be most characteristic of ASDs (e.g., circumscribed

interests).

Although typically developing individuals, particularly toddlers, may engage in a variety

of RRBIs (Carcani-Rathwell, Rabe-Hasketh, & Santosh, 2006; MacDonald et al., 2007), the rate

and intensity of RRBIs in individuals with ASDs are above and beyond that which would be

encountered in typically developing individuals (Bodfish et al., 2000; MacDonald et al., 2007;

Turner-Brown, Lam, Holtzclaw, Dichter, & Bodfish, 2011). More specifically, individuals with

ASDs evince stereotypy at a significantly greater frequency than their age-matched peers, with

the disparity in frequencies increasing as the individuals age due to typically developing

individuals ceasing to engage in stereotypy around 3 to 4 years of age (Leekam et al., 2007;

MacDonald et al., 2007). Turner-Brown et al. (2011) examined another form of RRBIs,

circumscribed interests, in children with ASDs and their age-, sex-, and IQ-matched typically

developing peers ($M = 11.00$ years). They concluded that while children with ASDs did not

differ in number of interests, they did demonstrate significantly different types of interests (i.e., more non-social interests) and significant functional impairments (e.g., high frequency, interference, resistance when interrupted) associated with their interests.

Differences in exhibited RRBIs are not as clear when comparing individuals with ASDs to individuals with atypical development/developmental delay, ID, genetic syndromes, and anxiety disorders (Leekam et al., 2011). However, evidence does exist suggesting that there are significant differences to at least some degree. Matson, Dempsey, and Fodstad (2009) found that toddlers with autistic disorder exhibited significantly more RRBIs when compared to toddlers with PDD-NOS, and that both groups exhibited significantly more RRBIs than atypically developing toddlers without an ASD. Gal, Dyck, and Passmore (2009) investigated differences in RRBIs between children with ASDs and those with ID, vision impairments, hearing impairments, or typical development ($M = 9.40$ years). Of the 25 RRBIs assessed, children with ASDs exhibited significantly more impairments in eight of the behaviors compared to all other groups (i.e., arranging objects, hitting head, biting hands, mouthing objects, vocal stereotypies, arm/hand/finger movements, touching body, and pacing). With respect to one form of RRBIs, stereotyped and repetitive motor movements, Goldman et al. (2009) found that among children with ASDs, ID, and developmental language disorder ($M = 4.50$ years), children with ASDs evinced more motor stereotypies. They also noted that hand/finger stereotypies (e.g., tapping, clapping, waving) and stereotyped gait patterns (e.g., skipping, spinning, jumping) differentiate individuals with ASDs from atypically developing individuals.

Current Diagnostic Criteria According to the *DSM-IV-TR*

Autistic disorder. A diagnosis of autistic disorder, which is often considered classical autism and to be most consistent with Kanner's original conceptualization of early infantile

autism (Kanner, 1943, 1944; Sevin, Knight, & Braud, 2007; Tidmarsh & Volkmar, 2003), is warranted when an individual presents with significant impairments in all three of the core feature domains associated with an ASD (i.e., socialization impairments, communication impairments, and presence of RRBI) by meeting criteria for a minimum of 6 out of the 12 possible diagnostic symptoms (APA, 2000). At least two of these symptoms must be in the socialization domain and a minimum of one symptom must be endorsed in each of the other two symptom domains.

Items in the socialization domain include impairment in multiple nonverbal behaviors (e.g., eye-to-eye gaze, social gestures, facial expression); lack of spontaneous seeking to share enjoyment, interests, or accomplishments with others; failure to develop developmentally appropriate peer relationships; and lack of social or emotional reciprocity (APA, 2000, p. 75). Communication impairments are represented by a significant delay in or lack of developing spoken language without compensation through other means of functional communication; impairment in conversational abilities in individuals with adequate speech; stereotyped and repetitive use of language (e.g., vocal stereotypy, idiosyncratic language); and the absence of developmentally appropriate varied pretend play or social imitative play (APA, 2000, p. 75). Lastly, RRBIs related to ASDs include abnormal preoccupation with at least one stereotyped and restricted pattern of interest; apparently inflexible adhere to nonfunctional routines/rituals; motor stereotypies; and preoccupation with parts of objects (APA, 2000, p. 75). In addition, in order to meet diagnostic criteria for autistic disorder, there needs to be impairment in social interaction, functional language in social interactions, or pretend play by 3 years of age (APA, 2000, p. 75). Furthermore, the individual's abnormal functioning cannot be better accounted for by Rett's disorder or CDD. Because of the flexibility in symptomatology required to meet criteria for a

diagnosis, autistic disorder is considered to be a heterogeneous disorder (Yates & Le Couteur, 2008).

PDD-NOS. In many cases an individual may meet many but not all of the criteria for autistic disorder or another ASD, but he/she still presents with impairments that are deemed significant enough to warrant an ASD diagnosis and require treatment. In such cases, a diagnosis of PDD-NOS is often given and has thus earned its title as a catch-all diagnosis (Lord & Risi, 1998; Matson & Boisjoli, 2007; Tidmarsh & Volkmar, 2003). Criteria for a PDD-NOS diagnosis are comparably much more lenient than for the other ASD diagnoses, partially due to their vague description. To meet criteria for a diagnosis of PDD-NOS, the individual only needs to demonstrate significant and pervasive impairment in reciprocal social interaction coupled with impairments in communication or the presence of RRBIs while not meeting diagnostic criteria for any other ASD, schizophrenia, schizotypal personality disorder, or avoidant personality disorder (APA, 2000, p. 84).

Unlike with the other ASD diagnoses, specific symptoms within each of the core feature domains are not provided for a diagnosis of PDD-NOS, nor are a minimum number of symptoms needed. Therefore, an individual is commonly diagnosed with PDD-NOS if he/she presents with numerous symptoms of autistic disorder but does not meet the symptom number criteria overall or within each of the three core feature domains; impairment in social interaction, functional language in social interactions, or pretend play is not evident by 3 years of age (i.e., the age criterion for autistic disorder); autism symptomatology is subthreshold; or autism symptomatology is present but the individual's symptoms do not fall neatly into any other ASD diagnostic category (Mahoney et al., 1998; Walker et al., 2004; Willemsen-Swinkels & Buitelaar, 2002). Some researchers have proposed more specific criteria for a diagnosis of PDD-

NOS based on empirical investigations (e.g., Buitelaar & van der Gaag, 1998) by requiring a minimum number of symptoms to be present; however, strict criteria have rarely been employed when diagnosing PDD-NOS and there still remains little consensus regarding diagnosis of the disorder (Buitelaar & van der Gaag, 1998; Mahoney et al., 2008). Yet, PDD-NOS is the most prevalent of all of the ASD diagnoses (Chakrabarti & Fombonne, 2001, 2005; Fombonne, 2005; Howlin, 2006).

Proposed Diagnostic Criteria According to the *DSM-5*

The proposed changes to the ASD diagnostic criteria to appear in *DSM-5* are plentiful. Rett's disorder will be removed from the ASD classification as it clearly differs in etiology from the remaining four ASDs (APA, 2012); Rett's disorder has been determined to have a clear genetic etiology (i.e., gene mutations encoding the X-linked gene, methyl-CpG-binding protein 2 [MeCP2]; Amir et al., 1999). The remaining four ASDs will be collapsed into a single diagnosis, to be referred to as autism spectrum disorder (APA, 2012). With this combining of disorders, significant changes will occur in diagnostic criteria with more stringent requirements needing to be met in order to qualify for a diagnosis. Rather than three core features existing, socialization and communication impairments will be combined into one domain – social communication and social interaction. Three symptoms will be represented in this domain: social-emotional reciprocity deficits; impairment in nonverbal communication in social interactions; and deficits in forming and maintaining developmentally appropriate relationships. The reasoning behind combining these two core features into one domain is two-fold. Firstly, as was mentioned previously, there already exists significant overlap between the two domains and ongoing controversy as to which specific behaviors belong to which domain (Prelock & Nelson, 2012). Secondly, since the language impairments commonly considered to fall under the

communication impairments domain are not unique to ASDs, it is believed that combining social and communication impairments into one domain will more accurately capture the clinical picture of ASDs (Demouy et al., 2011; Prelock & Nelson, 2012). The RRBIs domain will remain largely consistent with current criteria with the following symptoms falling under this category: stereotyped or repetitive speech, motor movements, or use of objects; excessive adherence to rituals/routines, ritualized patterns of verbal or nonverbal behavior, or resistance to change; highly restricted, fixated interests that are abnormal in focus or intensity; and hyper- or hypo-reactivity to or abnormal interest in sensory stimuli (APA, 2012). The last of these, related to sensory interests, is a new addition to the RRBIs domain; however, its presence in the literature has been noted since the inception of ASDs as a diagnostic group (Kanner, 1943) and it has been found to be closely linked to the other RRBIs (Gabriels et al., 2008).

In an attempt to influence these highly contested proposed changes, researchers have begun empirical investigations of the changes in prevalence of ASDs as well as the sensitivity and specificity of diagnoses if the *DSM-5* criteria are published as they have been put forth. Across a variety of age ranges, approximately 30% to 50% of individuals currently meeting ASD criteria according to the *DSM-IV-TR* will no longer qualify for an ASD diagnosis if the proposed *DSM-5* ASD criteria are accepted (Matson, Belva, Horovitz, Kozlowski, & Bamburg, 2012; Matson, Kozlowski, Hattier, Horovitz, & Sipes, 2012; Mattila et al., 2011; McPartland, Reichow, & Volkmar, 2012; Worley & Matson, 2012). However, this is not to say that those individuals will cease to evince significant impairments in autism symptomatology. In fact, the opposite is true – these same researchers have found that those who will no longer meet diagnostic criteria for an ASD will continue to exhibit significant impairments above and beyond those experienced by their typically and atypically developing peers.

Matson, Hattier, and Williams (2012) have attempted to alleviate potential problems with the upcoming *DSM-5* criteria by proposing modifications to the ASD diagnostic criteria. In their study, they used the same sample that had previously been used in the Matson, Kozlowski, et al. (2012) study, in which it was found that 47.79% of toddlers previously diagnosed with an ASD using *DSM-IV-TR* criteria would continue to meet diagnostic criteria in *DSM-5*. The researchers proposed two modified diagnostic criteria and examined how adopting these criteria in lieu of the proposed *DSM-5* criteria would lessen the *DSM-5*'s decreasing prevalence impact. The first criteria investigated were identical to the proposed *DSM-5* criteria except that rather than requiring all three social communication and social interaction symptoms, only two of the three were necessary to qualify for an ASD diagnosis. The second set of criteria relaxed the first set of modified criteria even further by requiring only one of the four as opposed to two of the four RRBIs, in addition to only necessitating that two of the three social communication and social interaction symptoms. These adjustments to the proposed *DSM-5* criteria resulted in 33.77% and 17.98% of toddlers previously meeting *DSM-IV-TR* criteria for an ASD to no longer meet criteria, respectively. However, at present, the *DSM-5* proposed criteria for ASD remain as they are, though there is some indication that modifications may be made based upon empirical investigations (APA, 2012).

Factors Associated with Autism Spectrum Disorders and Symptomatology

Many factors have been investigated which influence a diagnosis of ASD and severity of autism symptoms identified. Some popular factors that have been investigated include age, sex, race, and ID; however, other factors have also been examined, though to a somewhat lesser extent. For example, socioeconomic status (King & Bearman, 2011; Rai et al., 2012), parents' immigration status (Haglund & Källén, 2011; Keen, Reid, & Arnone, 2010), parents' highest

level of education (Bhasin & Schendel, 2007;), comorbid genetic syndromes (Zafeiriou, Ververi, & Vargiami, 2007), premature birth (Johnson et al., 2010), and familial history of ASDs and other intellectual and developmental disabilities (Kozlowski, Matson, & Worley, 2012; Stilp, Gernsbacher, Schweigert, Arneson, & Goldsmith, 2010) have all been examined to some degree in individuals with ASDs. However, these latter factors are beyond the scope of this paper. Herein, only the effects of the primary researched factors (i.e., age, sex, race, and ID) will be focused on, with the acknowledgment that other factors certainly do exist and impact a diagnosis of and symptomatology of ASDs.

Age. ASDs can be reliably diagnosed by 2 to 3 years of age (Lord & Luyster, 2006). Some researchers suggest that diagnoses may be made at as early as 12 months (Matson & Tureck, 2012). These disorders then persist across the lifespan. Despite the persistence of the disorder, it has repeatedly been shown that autism symptomatology actually abates overtime (Charman et al., 2005; Seltzer et al., 2003; Shattuck et al., 2007).

The youngest large sample of toddlers ($N = 114$) with ASDs and atypical development to have been assessed over two assessment periods were a mean of 22.94 months at the time of the first assessment and a mean of 30.95 months at the time of the second assessment (Matson, Worley, Mahan, Kozlowski, & Neal, 2011). On the *Baby and Infant Screen for Children with aUtIsm Traits-Part 1* (*BISCUIT-Part 1*; Matson, Boisjoli, & Wilkins, 2007), 71.69% of toddlers diagnosed with an ASD at time 1 retained an ASD diagnosis at time 2, and 80.33% of toddlers diagnosed with atypical development at time 1 retained that classification. More specifically, 74.07% of toddlers initially diagnosed with autistic disorder retained that specific diagnosis while 30.77% of toddlers previously diagnosed with PDD-NOS retained that diagnosis at follow-up. Of those toddlers who switched between ASD diagnoses, the majority changed from PDD-

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NOS to autistic disorder, indicating an increase in symptom severity overtime. However, many children also experienced decreases in symptomatology by switching from autistic disorder or PDD-NOS to atypical development, or from autistic disorder to PDD-NOS.

Using the *Autism Diagnostic Interview-Revised* (*ADI-R*; Lord, Rutter, & Le Couteur, 1994), autism symptoms were also assessed in a sample of slightly older children, who were diagnosed with an ASD at an average of 26 months of age and re-assessed at an average of 45 months of age (van Daalen et al., 2009). Over that period of time, the stability of an ASD diagnosis in general was 87%, whereas the stability of specific diagnoses of autistic disorder and PDD-NOS were 63% and 54%, respectively. In general, increases in cognitive ability and expressive language were most predictive of improvements in ASD symptomatology overtime.

Moore and Goodson (2003) also examined the stability of early diagnoses of ASDs ($M = 2.83$ years) to pre-school age ($M = 4.42$ years) using the *ADI-R* and clinical judgment. In this slightly older sample of children, they found that 100.00% of the children who met criteria for an ASD at 2 years continued to meet criteria at 4-5 years, though there was similarly some within spectrum diagnostic changes. More specifically, autistic disorder remained stable 87.50% of the time while atypical autism diagnoses remained stable 66.67% of the time, following the same pattern as in the van Daalen et al. (2009) study. Overall, socialization and communication impairments did not significantly change between the assessments; however, RRBIs significantly increased with age. Although overall socialization impairments did not significantly change overtime, the specific socialization impairment of a failure to develop peer relationships did significantly increase. Given the normal social developmental trajectory of children, it is understandable that this would become more of a concern toward the pre-school years, whereas

its presence may have gone unnoticed at 2 years of age because of fewer opportunities for social engagement.

The *ADI-R* has also been used to examine the symptom stability of children longitudinally between a mean of 3.50 years (pre-school age) to a mean of 10.50 years (elementary school age; Moss, Magiati, Charman, & Howlin, 2008). It was concluded that, while 80% of the children continued to meet cutoff criteria for a diagnosis of autistic disorder according to the *ADI-R*, there were significant improvements in overall autism symptomatology, nonverbal communication scores, and reciprocal social interaction scores. Additionally, improvements in verbal communication scores approached significance, whereas no significant differences were noted with respect to repetitive behaviors and stereotyped patterns. Several significant items improved overtime. In the reciprocal social interaction domain, interest in other children, response to children's approaches, use of other's body to communicate, and inappropriate facial expressions significantly improved; in the nonverbal communication domain, gestures, nodding, and social play significantly improved; and in the repetitive behavior domain, repetitive use of objects significantly improved. No individual items in the verbal communication domain significantly improved. Yet, while significant improvements were noted in the group for item and domain scores, individual differences were much less prominent. In general, minimal or no improvement was made in each of the domains individually. Notably, initial communication, socialization, IQ, and symptom severity scores were significantly correlated with autism symptomatology at follow-up, which is similar to the findings from the van Daalen et al. (2009) study.

Another study using the *ADI-R* to track ASD symptoms across time examined symptom presentation at 2, 3, 4-5, and 7 years of age in children diagnosed with autistic disorder

(Charman et al., 2005). These authors found that the percentage of children meeting cutoff for a diagnosis of autistic disorder on the *ADI-R* followed a decreasing trend over time with 88.77% meeting criteria at 2 years of age, 84.62% at 3 years, 73.08% at 4-5 years, and 46.15% at 7 years. However, it should be noted that children frequently switched between meeting and not meeting criteria across time so that if a child did not meet criteria at 3 years, this does not mean that the same child did not meet criteria at 4-5 or 7 years. Yet, it does give some indication of a decreasing level of severity of autism symptoms between 2 and 7 years, in general. While meeting cutoff criteria on the *ADI-R* at age 2 was not predictive of meeting cutoff at age 7, meeting cutoff at 3 years old was. Charman et al. (2005) also explored the trajectory of the three core feature symptom domains from 2 through 7 years of age; each domain's trajectory was unique. In the socialization domain, mean scores were stable from 2 through 4-5 years of age, but then significantly improved at 7 years of age. With respect to nonverbal communication (verbal communication scores could not be compared across time because not all children were scored in this area), scores significantly improved at each assessment, indicating steady improvement during the early childhood years. Lastly, in the repetitive and stereotyped behaviors domain, scores were stable from ages 2 to 3 years, worsened by 4-5 years, and then improved by 7 years. However, individual scores were variable over time, and in general there was more variability between children as they aged.

Matson, Hess, Neal, Mahan, and Fodstad (2010) examined a slightly older group of children with autistic disorder using *Autism Spectrum Disorder – Diagnostic for Children* (Matson & González, 2007a). They found that no significant differences existed with respect to autism symptomatology between children in young childhood (3-5 years), childhood (7-8 years), and young adolescence (9-11 years). Also, a non-significant linear trend was noted, indicating

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that autism symptoms remained stable throughout childhood. The difference in results from this study may be due to the truncated age span of 3 to 11 years as well as due to the specific ages assessed. Mayes and Calhoun (2011) compared autism symptoms across a larger age range of children from 1 through 17 years (*M* = 6.5 years) using the *Checklist for Autism Spectrum Disorder* (*CASD*; Mayes & Calhoun, 1999). Though the correlation was small when IQ was accounted for, the researchers did note a decreasing trend in autism symptomatology as age increased, suggesting the abatement of autism symptoms overtime. Ten items on the *CASD* were significantly predicted by the participants' ages; repetitive play, crave movement (e.g., jumping), fascinating with repetitive movements (e.g., fans), abnormal sensory inspection (e.g., smelling, mouthing), being a picky eater, language regression, and delayed developmental milestone attainment were predicted by younger age. On the other hand, being hypersensitive to sounds/smells/lights and difficulty with empathy or expressing emotions was predicted by older age.

Piven, Harper, Palmer, and Arndt (1996) analyzed autistic symptom change in adolescents and adults (*M* = 17.60 years) by assessing current functioning and functioning at 5 years of age based on parental report using the *Autism Diagnostic Interview* (*ADI*; Le Couteur et al., 1989). Overall, significant improvements in the socialization and communication domains were noted while RRBIs remained stable. A total of 82% of participants showed improvement in socialization and communication impairments whereas 55% improved in RRBIs. Furthermore, while all individuals met criteria for autistic disorder at age 5, 13.16% no longer met criteria in adolescence or adulthood. No significant differences in symptom changes overtime were noted between sexes.

Shattuck et al. (2007) also examined the trajectory of autism symptomatology in adolescents and adults (M = 22.00 years), but chose to use a prospective approach over a span of 4.5 years using the *ADI-R*. The authors reported significant decreases in the percentage of individuals endorsing more than half of the communication and socialization impairments and RRBI symptoms measured (e.g., pointing to express interest, reciprocal conversation, social smiling, friendships, circumscribed interests, unusual sensory interests). Furthermore, significant increases in the percentage of individuals endorsing the remainder of symptoms did not occur. Shattuck et al. (2007) also found that adults experienced greater improvement overtime than adolescents.

In another sample of adolescents and adults ages 10 through 53 years (M = 21.74 years), Seltzer et al. (2003) found that the prevalence of autistic disorder significantly decreased in the total sample when comparing lifetime symptoms (that is, the worst symptoms had been previously during the individuals' lifetimes) and symptoms at the time of assessment – 96.5% of the sample met criteria for autistic disorder at some point previously in their lifetime whereas only 54.8% met criteria at the time of assessment in either adolescence or adulthood, thereby indicating a significant decrease in autism symptomatology over time. Significant decreases in the percentage of participants meeting cutoff based on each of the three symptom domains were also found. Lifetime cutoff scores in the communication, reciprocal social interaction, and RRBIs domains were met by 99.5%, 100%, and 97.0% of the sample, respectively; however, current cutoff scores in those same domains were only met by 67.9%, 85.4%, and 87.7% of the participants, respectively. The individuals were then divided into two groups – an "adolescent" group ages 10 through 21 years (M = 15.71) and an "adult" group ages 22 through 53 years (M = 31.57) in order to compare autism symptomatology over time using the *ADI-R*. The adolescent

and adult groups did not differ in percentage of participants who currently met cutoff criteria for the communication and RRBIs domains, but they did differ in the reciprocal social interaction domain, with fewer adolescents meeting cutoff than adults. Furthermore, adolescents were more likely to not currently meet diagnostic criteria for autistic disorder as compared to adults. With respect to severity of symptoms in each of the domains, the adult cohort exhibited significantly greater impairments than the adolescent cohort with respect to overall language level, nonverbal communication, and reciprocal conversations; however, the adolescent cohort displayed significantly more impairment in verbal communication. Also, while autistic symptoms tended to abate in both groups overtime, the adult cohort's improvement in overall language was greater than the adolescent cohort's. Similar to symptoms of communication difficulties, socialization impairments also abated overtime in both cohorts while adolescents displayed less impairment than adults. A different pattern emerged in the RRBIs domain. The adult cohort displayed less impairment than the adolescent cohort overall, and while an abatement of symptoms occurred overtime in both cohorts, the adult cohort exhibited a greater decline with respect to two behaviors (i.e., unusual preoccupations and complex mannerisms).

Esbensen, Seltzer, Lam, and Bodfish (2008) further corroborated the general findings of autism symptomatology abatement over time by analyzing changes in RRBIs across the lifespan, specifically. These researchers assessed varying topographies of RRBIs in individuals with ASDs aged 2 to 62 years ($M = 19.60$), and they found that total RRBIs and all subdomains of RRBIs assessed (i.e., stereotyped movements, self-injurious behaviors, compulsive behaviors, ritualistic/sameness behaviors, and restricted interests) followed a downward trend for both presence and severity as age increased, even after accounting for the effects of gender, ID, and psychotropic medications. Chowdhury, Benson, and Hillier (2010) also investigated changes in

RRBIs by examining the RRBIs in adults ($M = 22.50$ years) with ASDs who did not have comorbid diagnoses of ID. In this study, the researchers assessed the current presence of RRBIs in each individual as well as the retrospective report of the individuals' RRBIs at age 4 to 5 years based on parental report. Chowdhury et al. found that on one measure of RRBIs, 24.50% of the sample previously exhibiting RRBIs as a child no longer evinced such behaviors as an adult. Additionally, on another measure of RRBIs, significant reductions in all but one RRBI domain were noted with increasing age – the participants exhibited significantly fewer stereotyped, compulsive, ritualistic, sameness, restricted, and overall RRBI behaviors in adulthood as compared to childhood. Self-injurious behaviors were the only set of RRBIs that did not significantly differ with age, though it should also be noted that nearly half of the sample never manifested such behaviors.

Overall, it is agreed that the trajectory of autism symptomatology over the lifespan appears to reach its peak in early childhood, sometimes following a period of regression (Hansen et al., 2008), and then follows a downward trend in adolescence and adulthood. However, within the toddler and early childhood years, researchers have found that there continues to be great variability in individual symptomatology over time, sometimes causing children to either worsen or improve to the point of losing or acquiring a diagnosis of an ASD at a later age (Matson, Worley, et al., 2011; Moore & Goodson, 2003; van Daalen et al., 2009). Symptoms then gradually decrease throughout adolescence and adulthood, though the exact point at which this shift in trend occurs is unknown, as is its cause.

With respect to individual changes overtime, it has been shown that cognitive ability and expressive language skills are the best predictors of outcome in individuals with ASDs (Howlin, Goode, Hutton, & Rutter, 2004; Mawhood, Howlin, & Rutter, 2000; Nordin & Gillberg, 1998;

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Seltzer et al., 2004). Additionally, it is hypothesized that children diagnosed with autistic

disorder as opposed to PDD-NOS are more likely to retain their specific diagnoses due to the

more stringent criteria of receiving such a diagnosis and more severe symptomatology overall,

thus making their symptoms less amenable to change over time (van Daalen et al., 2009).

However, this does not speak to the general abatement of symptomatology seen over time in the

overall ASD population. A hypothesis that has been put forth with respect to this issue is that

symptom abatement co-occurs with developmental changes that occur throughout the aging

process (Seltzer et al., 2003). In line with this hypothesis, research is beginning to emerge that

denotes differences in the anatomical structure of the brains of individuals with ASDs and

differences in the changes of these anatomical structures over time (e.g., Courchesne, Campbell,

& Solso, 2011). However, researchers have not yet investigated the anatomical changes of the

brain specifically in relation to autism symptomatology changes over time. Another hypothesis

that has been put forth is that autism symptoms may be abating overtime due to treatments

delivered throughout the individuals' lives (e.g., Seltzer et al., 2003). Although this has not yet

been formally controlled for in age studies, the same pattern of abatement can be found in

various cohorts, many of which did not receive treatment or received treatments lacking

effectiveness.

     Sex. Members of both sexes are affected by ASDs, though not equally. It is currently

estimated that ASDs occur in males at four to six times the rate that they occur in females

(Fernell & Gillberg, 2010; Hsu, Chiang, Lin, & Lin, 2012; Lin, Lin, & Wu, 2009). Despite this

significant difference in prevalence between the two sexes, the presence of differences in autism

symptomatology between sexes is controversial. On the one hand, many researchers have failed

to find significant differences between males and females in autism symptom presentation when

assessing individuals with ASDs as young as 17 months and as old as 88 years with and without comorbid ID (Hsu, Pickles, Cook, Risi, & Lord, 2007; Kopp & Gillberg, 2011; Mayes & Calhoun, 2011; Mazefsky, Goin-Kochel, Riley, & Maes, 2008; Pilowsky, Yirmiya, Shulman, & Dover, 1998; Rivet & Matson, 2011; Solomon, Miller, Taylor, Hinshaw, & Carter, 2012). However, other researchers contest that there are some notable differences in autism symptomatology between the groups.

In the general non-clinical population, significant differences have been found between males and females on measures of autism symptomatology, with males exhibiting greater endorsements of impairment. For example, on the *Childhood Autism Spectrum Test* (*CAST*; Scott, Baron-Cohen, Bolton, & Brayne, 2002), boys had a significantly higher median score than girls in a sample of typically developing children ages 4 through 10 years (Williams et al., 2008). Posserud, Lundervold, and Gillberg (2006) also found that, when using the *Autism Spectrum Screening Questionnaire* (*ASSQ*; Ehlers, Gillberg, & Wing, 1999) to measure autism symptomatology in a group of children 7 to 9 years of age, boys had significantly higher mean scores than girls, indicating greater impairment. Similar results were found by Constantino and Todd (2003) using the *Social Responsiveness Scale* (*SRS*; Constantino & Gruber, 2005) in a sample of children ages 7 through 15 years; on average, boys scored 25% higher than girls on the measure, indicating more severe impairments in autism symptomatology. Taken together, these researchers suggest that, in the general population, boys evince more autistic symptoms than girls.

In addition to the differences that have been found in the general non-clinical population between sexes, some researchers have offered support for sex differences within the autism spectrum. Park et al. (2012) compared age- and IQ-matched boys and girls with ASDs between

the ages of 4 and 15 years on the core symptom domains of ASDs. They found that, in this non-intellectually disabled sample, males demonstrated significantly more severe deficits than females with respect to social-communication problems, nonverbal communication deficits, and the presence of RRBIs. Amr, Raddad, El-Mehesh, Mahmoud, and El-Gilany (2011) also noted some differences between males and females with ASDs in a sample of Arabian children ($M =$ 8.20 years); they found that males demonstrated more deficiencies than females with respect to emotional responsiveness to others. Hartley and Sikora (2009) compared a group of males and females with ASDs ($M = 2.97$ years) on autism symptomatology using the *Autism Diagnostic Observation Schedule-Generic* (*ADOS-G*; Lord et al., 2000), and they found that males evinced more RRBIs than females while females exhibited greater communication deficits than males. No differences in socialization impairments were noted between sexes. In contrast to these studies, Lai et al. (2011) found that retrospective reports of adults with ASDs without comorbid ID indicated the absence of sex differences on the *ADI-R*, aside from females exhibiting significantly higher scores on unusual sensory responses. However, in adulthood ($M = 26.95$ years), the women in the study were noted to evince less autistic-like social-communication and RRBIs than the males.

Overall, while it is now widely accepted that ASDs occur in males at significantly higher rates than they occur in females, differences in behavioral manifestations of the disorder between the sexes are undecided. However, if differences do exist, the data presented thus far coincides with the hypothesis that, similar to the pattern seen in the general population and in corroboration with the male to female ratio of ASDs, males are likely to evince greater autism symptomatology than females. Yet, even if this is true, it is still unknown in which specific domains males exhibit

greater symptomatology because the majority of research to date has solely examined overall symptomatology as opposed to each of the core features of ASDs.

Race. ASDs exist worldwide across many different races and cultures, with similar diagnostic criteria being agreed upon and utilized by clinicians and researchers across the globe (Cohen & Volkmar, 1997). However, this is not to say that ASDs present themselves identically across races and cultures, or that symptoms are interpreted equally. Research in this domain is scant and findings are commonly controversial. While some researchers report that children of one racial group are more likely to have an ASD, other researchers refute this finding with evidence supporting that the opposite is true or that no differences exist. To date, the majority of research on differences in ASD diagnoses and autism symptomatology among races has been between Caucasian and African American individuals, though Hispanic and Asian individuals have been represented minimally. The largest study to look at differences in the prevalence of ASDs between races was conducted by the CDC (2012). They found that the prevalence rate of ASDs was highest among Caucasian children, followed by African American, Hispanic, and then Asian children; however, Fombonne (2005) previously reported that there is insufficient evidence to support significant differences between any races. Other researchers examining prevalence differences have reported that Caucasian individuals are more likely to receive an ASD diagnosis than African Americans (Kogan et al., 2009), while others contest that African Americans are more at risk for ASDs (Dealberto, 2011; Keen et al., 2010) or that there are no notable differences (Liptak et al., 2008). Race differences have also been found in the prevalence of ASDs between Caucasian and Hispanic individuals, with a higher prevalence being reported in Caucasian individuals (Chaidez, Hansen, & Hertz-Picciotto, 2012; Liptak et al., 2008; Palmer, Walker, Mandell, Bayles, & Miller, 2010).

In regard to domain-specific impairments, researchers have also found significant differences between Caucasians and African Americans with ASDs based on a review of diagnostic evaluations (Sell, Giarelli, Blum, Hanlon, & Levy, 2012). While no significant differences between Caucasians and African Americans with ASDs existed with respect to the presence of the socialization impairment criteria outlined in the *DSM-IV-TR*, African Americans tended to be more likely to have qualitative impairments in spoken language, as this difference approached significance. Additionally, many differences were found in the RRBIs domain. Caucasians were significantly more likely to exhibit nonfunctional routines/rituals and to have a preoccupation with parts of objects. Tek and Landa (2012) also examined differences in autism symptomatology between Caucasian and minority (i.e., a combination of African American, Hispanic, and Asian) toddlers with ASDs, with race having been identified by each toddler's parents. In this particular study, differences in socioeconomic status between racial groups did not exist, thereby eliminating the possibility of this factor being a confounding variable. Minority children performed significantly lower than Caucasian children on measures of expressive and receptive language skills. An additional assessment was conducted by dividing the children according to socioeconomic status; no significant differences in autism symptoms between groups of differing socioeconomic status were found.

However, reported differences in prevalence rates of ASD diagnoses and autism symptomatology among races may not necessarily reflect true differences due to confounding issues. Graham (2011) proposed that different underlying factor structures of autism symptomatology exist between Caucasian and African American toddlers. While a triad of autism symptoms currently exists according to the *DSM-IV-TR*, two- and four-factor solutions were best able to capture the behavioral symptoms expressed by Caucasian and African

American toddlers with ASDs, respectively. The two factors accounting for 32.83% of the variance for the Caucasian toddlers were named ASD Features, which encompassed socialization impairments and RRBIs, and Communication, whereas four factors (i.e., Socialization, Repetitive Behavior/Restricted Interests, Nonverbal Communication, and Communication) accounted for 41.49% of the total variance for the African American toddlers with ASDs.

Other confounding issues exist with respect to potential differences in ASD diagnoses and autism symptomatology between races. Graham (2011) found that parents of Caucasian toddlers report more autism symptoms than parents of African American toddlers overall, which could be attributable to either the toddlers' true autism symptoms or the parents' perception of their toddlers' symptoms. Due to cultural differences, symptoms of autism may be interpreted differently by parents (e.g., in some cultures a lack of eye contact may be preferred) or there may be a delay in symptom recognition (Mandell, Ittenbach, Levy, & Pinto-Martin, 2007). Diagnostic and treatment services are often delayed in lower socioeconomic status communities (Tek & Landa, 2012), which may contribute to differences seen between races. It has also been found that of those children who are eventually diagnosed with an ASD, African American children are more likely to be misdiagnosed initially compared to Caucasian children (Mandell et al., 2007), thereby delaying accurate diagnosis and prevalence estimates. In fact, professionals are less likely to diagnose an ASD in minority children as compared to Caucasian children regardless of symptom presentation (Begeer, El Bouk, Boussaid, Terwogt, & Koot, 2009). Therefore, at present, based on a lack of research, inconsistent findings, and confounding variables, it cannot definitively be said whether there are differences in autism symptomatology or diagnoses between races.

ID. Also known as mental retardation, ID is characterized by an IQ score, as measured

by a standardized individually administered intellectual assessment, of 70 or below with

associated deficits in at least two major areas of adaptive functioning (e.g., communication,

social/interpersonal skills, functional academic skills, self-care, health, safety) and an onset prior

to 18 years of age (APA, 2000, p. 49). This definition provided by the APA is one of the most

widely used for ID (DeMatteo, Marczyk, & Pich, 2007); any deviations from this definition by

alternate organizations are slight, if at all (Jacobson & Mulick, 1996; Luckasson et al., 2002). In

the upcoming *DSM-5*, the name is to be changed to intellectual developmental disorder and a

modification in the classification of severity levels is scheduled to occur (APA, 2012); however,

the disorder itself will remain largely the same. ID affects approximately 1% of the general

population (Hagberg & Kyllerman, 1983; Szymanski & King, 1999); however, the prevalence of

comorbid ID in individuals with ASDs is decidedly greater. Yet, estimates of comorbidity of ID

in individuals with ASDs are quite discrepant, with anywhere from approximately 10% to 90%

of individuals with an ASD also having a comorbid ID diagnosis (Goin-Kochel, Peters, &

Treadwell-Deering, 2008; Hewitt et al., 2012; LaMalfa, Lassi, Bertelli, Salvini, & Placidi, 2004;

Nicholas et al., 2008; Totsika, Hastings, Emerson, Lancaster, & Berridge, 2011). Several factors

contribute to the discrepancies in comorbidity rates found, including differing ASD criteria used

for the analyses (e.g., specific ASD diagnoses, diagnostic criteria), ID sometimes not being

assessed in individuals with ASDs, and sex of the individuals. For example, whereas ASDs are

more commonly diagnosed in males than females, more females with ASDs have comorbid ID

diagnoses as compared to males with ASDs (Banach et al., 2009; Nicholas et al., 2008).

Given the adaptive functioning impairments characteristic of a diagnosis of ID, autism

symptomatology does overlap to a certain degree between ASDs and ID. Impairments in all

three of the core feature domains characteristic of ASDs (i.e., socialization, communication, and

RRBIs) can be found in many individuals with ID in the absence of an ASD (de Bildt et al.,

2005; Hattier, Matson, Tureck, & Horovitz, 2011). However, individuals with ASDs with or

without comorbid ID evince greater autism symptomatology than individuals solely with ID

(Matson, Dempsey, LoVullo, & Wilkins, 2008; Matson, Wilkins, & Ancona, 2008). Yet, the

overlap in symptomatology between the two disorders, and the high comorbidity rates of the two

disorders, calls into question how IQ impacts the severity of autism symptomatology in

individuals with ASDs. Surprisingly, research in this area is not as readily available as might be

assumed.

In general, it has been found that the severity of autism symptomatology increases as IQ

decreases (Mayes & Calhoun, 2011; Pilowsky et al., 1998). Pilowsky et al. (1998) examined the

effects of mental age on autism symptomatology in a group of children ($M = 11.85$ years) by

using the *Childhood Autism Rating Scale* (*CARS*; Schopler, Reichler, & Rocher-Renner, 1988).

The authors concluded that children with mild to moderate autism symptomatology according to

the *CARS* had significantly higher mental ages than the children with severe autism

symptomatology. Mayes and Calhoun (2011) also investigated autism symptomatology in a

group of children; the sample consisted of children ages 1 through 17 years who had IQ scores

ranging from 9 through 146. Children were categorized as either high-functioning autism (HFA;

IQ $\geq$ 80) or low-functioning autism (LFA; IQ $<$ 80). The authors found that the severity of

autism symptomatology increased with decreasing IQ.

Matson, Dempsey, et al. (2008) explored the effects of intellectual functioning on autism

symptomatology in a group of adults ($M = 52$ years) with severe to profound ID who had

diagnoses of autistic disorder and ID, PDD-NOS and ID, or ID alone. Level of intellectual

impairment was categorized as high or low with the participants' IQs falling in the top 50th percentile of the group labeled as high and those falling in the bottom 50th percentile labeled as low. Social skills and RRBIs were significantly affected by level of intellectual impairment, with those with low IQ exhibiting more socialization impairments than those with high IQ. However, an interaction existed such that, while those with PDD-NOS or ID alone evinced greater impairments in these domains if they had low IQ as opposed to high IQ, no differences were noted between the high and low IQ groups in those with autistic disorder. With respect to communication, individuals with low IQ exhibited more impairment; however, when taking diagnosis into account, this relationship no longer existed in either ASD group. Therefore, the authors suggested that, while lower IQ is associated with greater autism symptomatology in those individuals with ID alone or PDD-NOS, it does not impact symptomatology in those with autistic disorder, at least when only the most severe forms of intellectual impairment are examined.

In a study focusing on communication skills in pre-school children with ASDs, Kjellmer et al. (2012) found that IQ significantly contributes to children's expressive communication skills; higher intelligence is correlated with greater skills in this area. With respect to RRBIs specifically, it has been found that differential effects of IQ exist dependent on which form of RRBI is assessed. Nonverbal IQ (NVIQ) is negatively correlated with self-injurious behavior, unusual preoccupations, repetitive use of objects, unusual sensory interests, hand/finger movements, and complex mannerisms, whereas it is positively correlated with circumscribed interests (Bishop, Richler, & Lord, 2006).

More in depth investigations have sought to determine whether there may be a relationship between autism symptoms and IQ splits (i.e., discrepancies between verbal IQ [VIQ]

and NVIQ). In a sample of school-age children with ASD and no comorbid ID, Black, Wallace, Sokoloff, and Kenworthy (2009) found that children with discrepantly higher NVIQ experienced more ASD-specific socialization symptoms than individuals with discrepantly higher VIQ, but that no differences in ASD-specific communication impairments or RRBIs were present. On the other hand, with respect to adaptive functioning skills, the researchers noted that the NVIQ > VIQ group demonstrated worse communication skills than the VIQ > NVIQ group, with no differences in adaptive socialization skills being found. Identical patterns were found for comparisons between the collapsed IQ split groups and the equivalent IQ groups – those with discrepant IQs demonstrated more ASD-specific socialization impairments than individuals with equivalent IQs while adaptive communication abilities were stronger.

Challenging Behaviors in Autism Spectrum Disorders

CBs are remarkably prevalent in individuals with ASDs, though they are not exclusive to this diagnostic class. Current estimates of the prevalence of CBs within the ASD population range from 35% to 94% (Baghdadli et al., 2003; Bodfish et al., 2000; Holden & Gitlesen, 2006; Jang et al., 2011; Matson, Wilkins, & Macken, 2009; McTiernan et al., 2011; Murphy et al., 2009), with the majority of researchers finding that more than half of the ASD population exhibit CBs. A variety of behaviors can be classified as CBs, but in most cases each behavior will fall under one of three classes based on factor analyses (Matson, Boisjoli, Rojahn, & Hess, 2009). These three classes are aggressive/disruptive behaviors, stereotypies, and self-injurious behaviors.

The first class of behaviors, aggressive/disruptive behaviors, includes behaviors such as physical aggression toward others (e.g., hitting with open or closed hand, biting, kicking, scratching, pulling hair, pinching; Alink et al., 2006), property aggression (e.g., throwing objects, hitting or kicking objects, urinating or defecating on objects; Crocker et al., 2006; Matson, Boisjoli, et al., 2009), verbal aggression (e.g., yelling at others, cursing at others, threatening to harm others, bullying; Hemmings, Gravestock, Pickard, & Bouras, 2006), and sexual aggression (e.g., masturbating in public, inappropriately touching others; Crocker et al., 2006). While this class of CBs is also exhibited by typically developing individuals (Miller, Grabell, Thomas, Bermann, & Graham-Bermann, 2012; Ostrov & Bishop, 2008), its prevalence in individuals with ID alone (Crocker et al., 2006; Hemmings et al., 2006) and those with ASD with and without comorbid ID (Hartley, Sikora, & McCoy, 2008; Kozlowski & Matson, 2012; Matson, Wilkins, & Macken, 2009) is significantly greater than that found in the general population.

The second class of CBs, stereotypies, is most commonly defined as nonfunctional repetitive motor and/or vocal behaviors (MacDonald et al., 2007). Motor stereotypies, which are the form generally associated with ASDs, consist of involuntary and patterned handflapping, body rocking, repetitive finger/arm movements, repetitive whole body movements, staring, spinning, the holding of bizarre body positions, and other similar behaviors (Mahone, Bridges, Prahme, & Singer, 2004; McDonald et al., 2007). Vocal stereotypies include the repetition of words, phrases, or sounds in a context where repetition is not necessary and immediate or delayed echolalia (Lanovaz & Sladeczek, 2011; MacDonald et al., 2007). Once again, much like with aggressive/disruptive behaviors, stereotypies are not exclusive to individuals with ASDs. Typically developing children also engage in stereotypies, although these behaviors often dissipate as the child ages or are associated with other conditions, such as attention-deficit/hyperactivity disorder or anxiety disorders (MacDonald et al., 2007; Mahone et al., 2004). Overall, stereotypies are more prevalent in individuals with ASDs than in those with solely ID or those who are typically developing (Carcani-Rathwell et al., 2006; Goldman et al., 2009; MacDonald et al., 2007).

Lastly, self-injurious behavior is defined as physical aggression toward oneself that results in tissue damage (Schroeder et al., 1980). Examples of self-injurious behaviors include self-hitting with an open or closed hand, self-biting, self-scratching, banging one's head against another part of one's body or another surface, poking oneself in the eye, ingesting inedible objects (i.e., pica), self-kicking, and hair pulling (Iwata et al., 1994; Schroeder et al., 1980). These behaviors have also been noted to occur in the general population and in individuals with ID or other developmental disabilities (Kravitz & Boehm, 1971; Murphy, Hall, Oliver, & Kissi-Debra, 1999); however, similar to both aggressive/disruptive behaviors and stereotypies, their

prevalence in individuals with ASDs is notably higher (Baghdadli et al., 2003; Bodfish et al., 2000).

Factors Associated with Challenging Behaviors

Due to the severe consequences often endured when CBs are exhibited, it is important to understand factors which may be associated with or increase the likelihood of an individual with ASD evincing such behaviors. To date, numerous factors have been investigated in this respect. These include but are not limited to autism symptomatology, presence and severity of intellectual disability, age, sex, and race.

Autism symptomatology. Since CBs are common in individuals with ASDs, and ASDs are a heterogeneous group of disorders with varying levels of symptom severity, it is only practical to inspect the effect autism symptomatology and severity may have on (CB) presentation. Researchers have provided support for the hypothesis that a diagnosis of an ASD increases CB presentation in individuals with and without ID (Fodstad, Rojahn, & Matson, 2012; Holden & Gitlesen, 2006; Kozlowski & Matson, 2012; McCarthy et al., 2010; McClintock, Hall, & Oliver, 2003; Poon, 2012; Rojahn, Wilkins, Matson, & Boisjoli, 2010). Therefore, it stands to reason that the next step would be to examine how autism symptomatology impacts CB presentation, more specifically.

By using specific ASD diagnoses (i.e., autistic disorder or PDD-NOS) as indicators of autism symptomatology/severity in toddlers ($M = 26.19$ months), Kozlowski and Matson (2012) found that toddlers with greater autism symptomatology evinced more CBs overall. This significant difference between toddlers with autistic disorder and PDD-NOS was also observed across all three CB classes (i.e., aggressive/disruptive, stereotypic, and self-injurious behaviors). In fact, of the 18 problem behaviors assessed, only three (i.e., removal of clothing at

inappropriate times, pulling others' hair, and playing with own saliva), which all fell under the aggressive/disruptive class of behavior, were not displayed significantly more in the group of toddlers with autistic disorder versus PDD-NOS. For these three behaviors, no significant differences were noted between the groups.

Fodstad (2011) also examined the risk of increased autism symptomatology on CBs in toddlers (M = 25.68 months). Aggressive/disruptive, stereotypic, and self-injurious behaviors were assessed. Each class of CBs was found to be positively correlated with overall autism symptomatology; that is, greater autism symptomatology was associated with greater amounts of CB in each class. The correlations were small for aggressive/disruptive and self-injurious behaviors, while they were moderate for stereotypic behaviors.

Matson, Wilkins, and Macken (2009) found that in a group of children (M = 8.49 years) with ASDs, autism symptomatology was positively correlated with CB frequency and severity for total CBs exhibited, and similarly for internalizing and externalizing CBs. The researchers divided the children with ASDs into three groups according to autism severity (i.e., mild, moderate, and severe), and found significant differences with respect to 13 of the 18 CBs measured (e.g., repeated and unusual body movements, aggression toward others, property destruction, poking himself/herself in the eye), with at least two of the three groups differing from one another.

Jang et al. (2011) conducted a similar investigation in a group of children with ASDs (M = 7.85 years) receiving applied behavior analysis services to assist in increasing functional skills while simultaneously decreasing CBs. The researchers found that autism severity accounted for 22% of the observed variance in CBs. In fact, when dividing participants into three groups according to autism severity (i.e., mild, moderate, and severe) similarly to Matson, Wilkins, and

Macken's (2009) study, there were significant differences between at least two of the groups on nearly half of the measured CBs: unusual play with objects, playing with own saliva, smearing or playing with feces, aggression toward others, property destruction, repeated and unusual vocalizations, and repeated and unusual body movements.

Matson and Rivet (2008) examined the relationship between autism symptomatology and CBs in adults (M = 52.03 years) with mild to profound intellectual disability; approximately half of the sample had a comorbid ASD. The adult participants were divided into two groups according to autism symptomatology – mild or severe symptomatology. The two groups were then compared on the presence of aggressive/destructive behaviors, disruptive behaviors, and self-injurious behaviors. Significant differences were found between the mild and severe autism symptomatology groups on disruptive behaviors and self-injurious behaviors, with the severe autism symptomatology group having higher scores. No group differences were noted in regard to aggressive/destructive behaviors.

Baghdadli et al. (2003) investigated the relationship between autism symptomatology and self-injurious behaviors, specifically, in children (M = 5.00 years) with autistic disorder. Autism symptomatology was rated using the *CARS* (Schopler et al., 1988). The researchers found that increased autism symptomatology predicted self-injurious behaviors. However, this finding has not been consistent across studies; Richards, Oliver, Nelson, and Moss (2012) did not find a significant relationship between autism symptomatology and self-injurious behavior in individuals with ASDs. These researchers did note that increased autism symptomatology was associated with increased rates of self-injurious behavior in individuals without ASD who had Down syndrome or Fragile X syndrome.

Overall, researchers have provided a wealth of support indicating that a diagnosis of an ASD is correlated with increased rates of CBs (e.g., Fodstad, Rojahn, & Matson, 2012; Holden & Gitlesen, 2006; Kozlowski & Matson, 2012; McCarthy et al., 2010; McClintock et al., 2003; Rojahn et al., 2010). Other researchers have investigated this relationship further by examining how increasing autism symptomatology is related to CB presentation. With respect to general CBs, researchers have consistently found that greater autism symptomatology is associated with higher rates of CBs (e.g., Fodstad, 2011; Jang et al., 2011; Kozlowski & Matson, 2012). When examining individual classes of CBs, some researchers have found that autism symptomatology does affect all CBs (e.g., Fodstad, 2011; Kozlowski & Matson, 2012), while others contest that increased autism symptomatology is not related to all classes of CBs (e.g., Matson & Rivet, 2008, Richards et al., 2012). Therefore, at this time, while it is agreed that the severity of autism is associated with increased CBs in general, there may or may not be a significant relationship between autism severity and specific classes of CBs.

Communication impairments. Of all of the impairments associated with ASDs, communication impairments are likely given the most attention as a contributing factor to CB presentation. A high proportion of individuals with ASDs and other intellectual and developmental disabilities, especially those with significant speech and other communication impairments, use CBs as a means to expressively communicate with others (Chiang, 2008). Therefore, it is hypothesized that deficits in communication correlate with the presence of CBs.

Sigafoos (2000) examined the relationship between communication abilities and CB (e.g., hyperactivity, irritability, stereotypic behavior) severity in preschool children with a variety of developmental disabilities, including ASDs. He found a significant inverse relationship between overall communication abilities and the severity of CB across multiple assessments.

Upon further examination, he concluded that receptive communication abilities were consistently inversely related to CBs, but that this relationship did not always exist with expressive communication.

Hartley, Sikora, and McCoy (2008) also found that, in a sample of children ($M = 3.51$ years) with ASDs, expressive language was significantly negatively correlated with both internalizing and externalizing behavior problems. Baghdadli et al. (2003) examined the connection between self-injurious behaviors, specifically, and communication deficits, using an expressive speech item from the *ADI-R* (Lord et al., 1994) and the communication domain from the *Vineland Adaptive Behaviors Scales, Second Edition* (Sparrow, Cicchetti, & Balla, 2005), in children ($M = 5.00$ years) with autistic disorder. The researchers noted a significant relationship between self-injurious behaviors and both variables related to communication abilities; self-injurious behaviors corresponded with impairments in communication.

Matson and Rivet (2008) examined the relationship between communication impairments associated with ASDs and aggressive/destructive, disruptive, stereotypic, and self-injurious behaviors in a sample of adults ($M = 52.03$ years) with mild to profound intellectual disability, of which approximately half had a comorbid diagnosis of ASD. They found that communication impairments predicted the presence of aggressive/destructive CBs, but not disruptive, stereotypic, or self-injurious behaviors. However, communication impairments were still significantly correlated with disruptive and self-injurious behaviors even though they did not predict the presence of such behaviors. Yet, no significant relationships were found between communication impairments and stereotypic behaviors.

Additional support for the inverse relationship between CBs and communication abilities is actually found in the treatment literature. Prior to implementing treatment for CBs, a

functional behavioral assessment is often conducted to determine the function, or purpose, the

CB is serving (Matson & Kozlowski, 2011). For example, it may be determined that the

environmental variable maintaining the CB is escape; when the individual engages in the CB,

he/she is allowed to escape or avoid the demand, situation, person, or other stimuli being

presented. The CB then becomes reinforced so that it continues to occur. In many cases, as with

the function of escape, the function of the behavior is some form of communicative intent.

Functional communication training (FCT) is commonly employed as an intervention to

simultaneously increase communication skills and decrease maladaptive behaviors (Carr &

Durand, 1985). It teaches individuals to use an appropriate means of communication (e.g.,

speech, Picture Exchange Communication System, sign language) to express oneself in order to

attain the desired outcome the CB had previously accomplished for the individual. It has proven

effective countless times for both children and adults with ASDs and other developmental

disabilities in alleviating CBs (Kurtz, Boelter, Jarmolowicz, Chin, & Hagopian, 2011), thus

providing evidence of a strong association between communication deficiencies and CBs.

On the other hand, some researchers have found the opposite relationship between

communication abilities and CBs. While examining specific domains of developmental

functioning, Medeiros, Kozlowski, Beighley, Rojahn, and Matson (2012) inspected the

relationship between communication and CBs in toddlers ($M = 25.70$) with autistic disorder,

PDD-NOS, and atypical development without an ASD. For children with autistic disorder,

communication abilities were positively correlated with aggressive/destructive, stereotypic, and

self-injurious behaviors; those children with greater communication skills displayed greater

amounts of CB across all three CB classes. An identical pattern was found for children with

PDD-NOS, except that there was no relationship between communication abilities and

stereotypic behaviors. However, for children with atypical development without an ASD, communication abilities were significantly negatively correlated with aggressive/destructive behaviors with no other relationships being significant. The findings from this study are intriguing as they are the opposite of the authors' hypotheses and contradict the findings from other researchers; however, it may be hypothesized that the young age of the individuals in the sample played a role in the discrepant findings. As communication is just beginning to develop in the early years of life, the inverse relationship between communication abilities and CBs may not be present or as strong.

Other evidence of a positive correlation between communication abilities and CBs in the early years was reported by Matson, Boisjoli, and Mahan (2008). They found that in a sample of toddlers ($M = 26.50$ months) with ASDs, deficits in expressive and receptive communication were correlated with low levels of aggressive/disruptive and self-injurious behavior. However, when looking at only the relationship between receptive communication and aggressive/destructive, stereotypic, and self-injurious behaviors, there was an inverse relationship. That is, receptive communication skills negatively correlated with these groups of CBs.

Overall, while a limited amount of research has been conducted on the relationship between communication skills and CBs in individuals with ASDs, the evidence to date strongly supports an inverse relationship. Greater impairments in communication are associated with increasing amounts of CBs, while intact communication skills are linked to low levels of CBs. This information has proven useful in the treatment of CBs in children with ASDs by guiding treatment plans in the direction of increasing communication skills to simultaneously decrease CBs. However, there is some discrepancy regarding this relationship in very young children that

needs to be examined further. Also, changes in communication skills and CBs over time have rarely been examined except through single-case designs.

Socialization impairments. Although it may be difficult to tease apart which impairments in individuals with ASDs are communication deficits versus socialization deficits, some researchers have also analyzed the relationship between CBs and the latter. For example, in a sample of toddlers ($M = 28.48$ months) with ASDs, Matson, Neal, Fodstad, and Hess (2010) found that peer and adult interactions were significantly inversely related to CBs. That is, low levels of peer and adult interactions were associated with high levels of aggressive/destructive, self-injurious, and stereotypic behavior.

Matson, Fodstad, and Rivet (2009) investigated the relationship between CBs and social skills in a sample of adults ($M = 49.78$ years) with ASDs and severe ID using the *Autism Spectrum Disorder – Problem Behavior for Adults* (Matson, Terlonge, & González, 2006) and the *Matson Evaluation of Social Skills in Individuals with sEvere Retardation* (Matson, 1995). They found that the presence of negative social skills (i.e., general, verbal, and nonverbal) was positively correlated with aggressive/destructive, stereotypic, disruptive, and total CB presentation, but not with self-injurious behavior. All positive social skills (i.e., general, verbal, and nonverbal) were also positively correlated with aggressive/destructive and total CB presentation, whereas stereotypic behavior was not associated with positive social skills and self-injurious and disruptive behaviors were only positively correlated with positive nonverbal social skills. As such, in those with ASDs and greater intellectual impairment, while negative social skills are strongly associated with CBs, the ability to socially interact with the environment in a positive manner is also linked to greater CBs.

Much like with communication deficits being targeted in individuals to concurrently reduce CBs, social impairments have also been targeted in the treatment of CBs. In accordance with the theory that deficits in social skills may impact the presence of CBs in individuals with ASDs, social stories have recently been utilized as an intervention to reduce CBs. Social stories are short, individualized narratives that outline specific situations and the behaviors that are expected and unexpected in those situations (Gray & Garand, 1993). They were originally designed to provide information to individuals with ASDs about different social situations they were about to experience as a means of improving social skills in these situations. However, many researchers have found them to be successful in decreasing a variety of CBs for some individuals (Adams, Gouvousis, VanLue, & Waldron, 2004; Beh-Pajooh, Ahmadi, Shokoohi-Yekta, & Asgary, 2011; Chan et al., 2011).

Overall, the exact relationship between CBs and socialization impairments in the ASD population is relatively unknown due to a lack of research. While interventions targeting social skills deficits have aided in the alleviation of CBs and some researchers have suggested a positive correlation between socialization impairments and CBs, other researchers have suggested otherwise. In the realm of socialization impairments, skills are commonly measured as positive or negative social skills. Therefore, the relationship between social skills and CBs may be more complex, as some authors have identified different trends when referencing positive versus negative social skills. The confounding effect intellectual functioning may have upon these relationships is also an unanswered question.

RRBIs. Perhaps because RRBIs are a symptom domain of ASDs and include stereotypic behaviors, which are a class of CBs, the relationship between RRBIs and CBs has seldom been investigated and is therefore ambiguous. One group of researchers did examine the relationship

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between RRBIs and CBs in children with severe ID, though whether any of the children also had a comorbid diagnosis of an ASD was not reported. Oliver, Petty, Ruddick, and Bacarese-Hamilton (2012) found that high rates of RRBIs were associated with increased presence and severity of aggressive, destructive, and self-injurious behaviors. However, no other research on this topic has been found by this researcher. Therefore, the relationship between RRBIs and CBs is an area that needs to be explored before any conclusions can be made. Yet, given that stereotypic behaviors are under the umbrella category of RRBIs, one can say with some confidence that RRBIs are at least positively correlated with stereotypic behaviors.

ID. The impact of ID on CBs has been documented in individuals with and without ASDs; however, the majority of research focuses on individuals solely with ID. Due to the limited research that has been conducted focusing on the effect of level of ID on CBs in individuals with ASD specifically, findings from research conducted on individuals solely with ID is also presented herein. A review of the research conducted with individuals with only ID will be reviewed first, followed by research conducted with individuals with ASDs.

In a meta-analysis examining the effect of level of ID on CBs in individuals with ID, McClintock et al. (2003) concluded that individuals with severe to profound levels of ID were more likely to engage in self-injurious and stereotypic behaviors than individuals with mild to moderate ID, but that level of ID did not have an impact on aggressive behaviors. Other research that has been conducted in more recent years has corroborated some of the findings from the McClintock et al. (2003) meta-analysis. For example, in a sample of children, adolescents, and adults with mild to profound ID ranging from 0 to 89 years of age, Holden and Gitlesen (2006) also found that the relationship between IQ and frequency of CBs differed according to type of CB. In accordance with the findings from McClintock et al., those with severe to profound ID

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were more likely to engage in self-injurious behaviors. However, individuals with mild to moderate ID were more likely to engage in aggressive/destructive behaviors. Cooper et al. (2009) investigated the effect level of ID had on self-injurious behaviors, specifically, in individuals 16 years and older with ID living in a region of Scotland; these authors also concluded that greater degrees of ID were associated with greater rates of self-injurious behavior.

Other researchers have made different conclusions regarding the impact of level of ID on CBs in individuals with ID. Csorba, Radvanyi, Regenyi, and Dinya (2011) found that, in a sample of adults with borderline to profound ID, there was a linear trend for all CBs (i.e., aggressive/destructive, stereotypic, and self-injurious behaviors), indicating that the frequency and severity of each type of CB increased as IQ decreased. However, this trend was only significant for stereotypic behaviors.

To date, very few studies have focused on the effect of level of ID on CBs in individuals with ASDs. While one might assume that the pattern is identical to those found in individuals solely with ID, the research conducted at present challenges this idea. McTiernan et al. (2011) provided some support for similar patterns between those individuals with solely ID and those with ASD and ID. They investigated the effect of IQ on the frequency and severity of aggressive, stereotypic, and self-injurious behaviors in children with ASD ages 3 to 14 years (M = 8.00). The authors found that IQ was positively correlated with the frequency of aggressive behavior and both the frequency and severity of stereotypic and self-injurious behaviors; that is, higher IQ was associated with lower frequency and/or severity of these behaviors. However, far fewer individuals fell in the lower range of intellectual functioning than in the average functioning to moderate impairment level, with only 1.81% of the sample reportedly having profound ID.

On the other hand, some researchers have provided evidence for a different effect of level of ID on CBs in individuals with comorbid ASD. Murphy et al. (2009) examined the effect of level of ID on presence and severity of aggressive, self-injurious, and stereotypic behaviors in children ages 3 through 14 years ($M = 8.50$ years) with an ASD. While no effect of level of ID was found for the presence or severity of aggressive and stereotypic behaviors, these researchers did find that individuals with severe ID exhibited a greater severity of self-injurious behavior than individuals with any other level of ID. Medeiros et al. (2012) examined the effect of developmental quotient (DQ) on CBs according to diagnostic category (i.e., autistic disorder, PDD-NOS, or atypically developing without ASD) in toddlers ages 17 to 36 months ($M = 25.70$). The authors found that the effect of DQ varied depending on the toddlers' diagnoses. While higher DQ was associated with fewer aggressive/destructive, stereotypic, and self-injurious behaviors in atypically developing toddlers without ASD, the opposite was true for toddlers with autistic disorder and PDD-NOS – for these toddlers, higher DQ was actually associated with more aggressive/destructive, stereotypic, and self-injurious behaviors.

Overall, while many people believe greater impairment in intellectual functioning to be associated with greater amounts of CBs in individuals with only ID and those with ID and comorbid ASDs, this is not necessarily the case. Self-injurious behaviors are the only CBs that appear to have a clear relationship with level of ID; greater impairment in intellectual functioning is significantly associated with greater rates of self-injurious behaviors in both individuals with only ID and in those with comorbid ASDs. With respect to aggressive/destructive behaviors, the relationship is less clear. In individuals with only ID, researchers have either concluded that there is no relationship or that individuals with greater intellectual impairment exhibit less aggressive/destructive behaviors. In individuals with a

comorbid ASD, the relationship between level of ID and aggressive/destructive behaviors is unknown. Some researchers have found that no relationship exists, while others have found that a linear relationship does exist in one direction or another. Lastly, in regard to stereotypic behaviors, greater intellectual impairment is associated with greater amounts of these behaviors in individuals with only ID. In individuals with comorbid ASDs, findings have been controversial. Some researchers have indicated that no relationship exists, while others have found that a linear relationship does exist although agreement on the direction of the relationship has not occurred. Therefore, at present, the relationship between level of ID and CB presentation in individuals with ASDs is largely unknown; we only know that self-injurious behaviors are correlated with level of ID such that individuals with greater intellectual impairment are more likely to evince self-injurious behaviors. Additionally, studies of individuals with only ID cannot be used to determine the relationship between CBs and level of ID in individuals with ASDs as of yet since researchers have shown that these populations may not follow identical trends.

  Age. Since ASD is a neurodevelopmental and lifelong disorder with onset often believed to occur at birth (Lo-Castro et al., 2010), individuals of all ages may be affected by this disorder. However, the youngest a child will typically be formally diagnosed is at 18 months of age (Twyman, Maxim, Leet, & Ultmann, 2009). Researchers have most commonly found that there is a tendency for CBs to increase during the course of childhood with an abatement of CBs occurring during adulthood (Emerson et al., 2001). While this appears to be the most agreed upon trend, controversy remains regarding the age ranges at which CBs are at their peaks and lows.

Fodstad et al. (2012) examined aggressive/destructive, self-injurious, and stereotypic CBs in atypically developing toddlers ages 12 through 39 months, with and without ASDs. These researchers divided the children into age groups using a span of 6 months: 12-18 months, 19-25 months, 26-32 months, and 33-39 months. Of the toddlers diagnosed with an ASD, significant differences existed between age groups with respect to stereotypic and aggressive/destructive behaviors, but not with regard to self-injurious behaviors. For the former two classes of CBs, the 12-18 month and 19-25 month old groups significantly differed in aggressive/destructive behaviors from the 26-32 month and 33-39 month old groups, with a significant increase in these behaviors occurring in the older groups. For stereotypic behaviors, the 12-18 month old and 19-25 month old groups significantly differed from the 33-39 month old group, with an increase in stereotypies occurring in the older group.

Holden and Gitlesen (2006) assessed the percent of children and adults 0 to 79 years old with mild to profound ID, of whom 6.4% also had a comorbid diagnosis of an ASD, who engaged in CBs. Individuals were divided into groups according to age using a span of 10 years: 0-9 years, 10-19 years, 20-29 years, etcetera. The prevalence of individuals who engaged in CBs followed a downward trend from 0-9 years to 70-79 years. About 20% of individuals engaged in CBs in the 0-9 years age group, and less than 5% engaged in CBs in the 70-79 years age group. The sharpest decline in CBs occurred between the 10-19 years and 20-29 years age groups, with an increase occurring between the 20-29 years and 30-39 years age groups. The percentage of individuals who engaged in CBs remained relatively stable during middle adulthood, with a significant decline occurring in the 60-69 years age group.

With respect to specific classes of CBs, Poon (2012) concluded that, in a sample of children ($M = 9.47$ years old) with ASD and/or ID, age was positively correlated with

disruptive/antisocial behavior. However, the age range of children included in the sample was not reported. Therefore, the exact relationship between age and disruptive/antisocial behavior cannot be determined. Esbensen et al. (2008) examined RRBIs specifically, a group of autism symptoms that are often considered to be CBs as well, in individuals with ASDs ages 2 through 62 years ($M = 19.60$). These researchers found that overall RRBIs and all subdomains (i.e., stereotyped movements, self-injurious behaviors, compulsive behaviors, ritualistic/sameness behaviors, and restricted interests) followed a downward trend for both presence and severity as age increased, even after accounting for the effects of gender, ID, and psychotropic medications.

In a study of adolescents and adults with ASDs ($M = 22.0$ years) whose CBs were assessed over a 4.5 year period, Shattuck et al. (2007) found that the proportion of individuals who had CBs significantly decreased for the majority of behaviors examined (e.g., hurtful to self, hurtful to others, property destruction, unusual or repetitive habits). There was only one CB assessed that did not significantly decrease (i.e., disruptive behaviors), but it, too, followed a decreasing trend overtime.

Murphy et al. (2005) assessed changes in CB presentation over a 12-year time period in individuals with ID and/or an ASD. The individuals ranged in age from 2.2 to 18.1 years ($M = 8.9$) at the time of the initial assessment, and the participants were 13.5 to 30.4 years ($M = 20.9$) at the time of the second assessment. The authors analyzed the data in three different ways – they examined the cross-sectional age effects at the initial assessment, the cross-sectional age effects at the second assessment, and the longitudinal age effects across the 12-year period. Behaviors were grouped into eight categories, three of which represented groups of CBs as described earlier – abnormal interest in sensory stimulation (e.g., self-injurious behavior, mouthing, tapping), abnormal body movements (i.e., motor stereotypies), and behavior problems

with limited social awareness (e.g., physical aggression, property destruction, temper tantrums). At the time of the initial assessment, there was an association between age and all three groups of CBs, such that as age increased, CB presentation decreased. However, at the time of the second assessment, age was not found to be related to any group of CBs. Longitudinally, abnormal interests in sensory stimulation and abnormal body movements improved over time, whereas behavior problems with limited social awareness remained relatively stable. Additionally, across all CBs, those individuals presenting with greater difficulties in CBs at the initial assessment generally continued to present with greater difficulties than their peers at the second assessment.

In a retrospective study of adults ($M = 22.50$ years) with ASDs without comorbid ID, Chowdhury et al. (2010) examined the current presence of RRBIs and the presence of RRBIs at 4 to 5 years of age based on parental report. They found that 24.50% of individuals who had previously evinced RRBIs as 4 to 5 year olds no longer exhibited such behaviors. Overall, significant decreases in stereotyped, compulsive, ritualistic, sameness, restricted, and overall RRBI behaviors were seen between childhood and adulthood. Self-injurious behaviors did not significantly differ between childhood and adulthood; however, almost half of the sample never engaged in self-injurious behaviors.

On the other hand, some researchers have failed to find significant differences with respect to age in CB presentation among certain age cohorts or by specific types of CBs. Murphy and colleagues (2009) examined the presence and severity of aggressive, self-injurious, and stereotypic behaviors in children ages 3 through 14 years ($M = 8.50$ years) with an ASD, with results yielding no relationship between age and any class of CB. Matson, Mahan, Hess, Fodstad, and Neal (2010) similarly investigated the CB presentation of children with ASDs (i.e., autistic disorder, PDD-NOS, or Asperger's disorder) ages 3 through 14 years, and they found no

significant differences in any of the CBs examined (e.g., physical aggression, self-injurious behavior). McTiernan and colleagues (2011) found that age did not significantly predict the presence of self-injury, stereotypies, or aggressive/destructive behavior in children ages 3 through 14 years ($M = 8.00$ years). Farmer and Aman (2011) examined aggressive behaviors in children with ASDs across three age groups – 3 to 9 year olds, 10 to 13 year olds, and 14 to 20 year olds. No significant differences were found. In a study examining only RRBIs in adults 20 through 78 years ($M = 49.28$ years), Hattier and colleagues (2011) likewise found that no differences in RRBI presentation existed with respect to age.

Overall, while it is generally agreed that CBs increase to their peak in childhood and then follow a decreasing trend into adulthood, it is not yet known at what point these changes in direction occur. Also, do all classes of CBs follow the same trend? For aggressive/destructive and stereotypic behaviors, increases have been shown to occur in the toddler years (Fodstad, 2011), whereas increases in self-injurious behaviors are not evident until later in childhood (Murphy et al., 2005). Once the childhood to adolescent years are reached, it is unclear what trend exists. While an abatement of CBs occurs at some point in time, this point is unknown despite it being generally understood that it occurs after young childhood. Additionally, it could be that changes in CBs over time are more complex and do not follow a linear trend. Few studies have examined CBs across the entire lifespan, leaving many questions unanswered.

Sex. While it is commonly believed that males engage in greater rates of CBs than females, the empirical support for this typecast is scant, at least in regard to individuals with ASDs. Most researchers have found a lack of support for significant differences in individuals with ASDs between males and females for CBs overall, and specifically for the presence and severity of stereotypic behaviors, aggressive behaviors, and self-injurious behaviors (Baghdadli

et al., 2003; Kane & Mazurek, 2011; McTiernan et al., 2011; Murphy et al., 2009; Poon, 2012; Rojahn, Matson, Lott, Esbensen, & Smalls, 2001). For example, in a sample of toddlers ($M =$ 26.19 months) with autistic disorder, PDD-NOS, or atypical development, Kozlowski and Matson (2012) found no significant effects of gender on any of the CBs assessed, including aggressive/disruptive, stereotypic, and self-injurious behaviors. Kozlowski, Matson, and Rieske (2012) also investigated the effect of sex on rates of CBs (e.g., property destruction, physical aggression, elopement) in children and adolescents with ASDs ($M = 8.10$ years); they reported that differences between sexes largely did not exist, and that when differences were present, the magnitude of the differences was minimal.

However, other researchers have provided minimal support toward sex differences in CBs of individuals with ASDs. While Hartley et al. (2008) also found that, overall, a relationship between CBs and sex did not exist in young children with ASDs, they further examined specific behaviors and found that males with ASDs were more likely to be emotionally reactive than females. Hattier and colleagues (2011) found that, in a sample of adults ($M = 49.28$ years) with ASDs and comorbid severe to profound ID, males exhibited higher rates of stereotypic behaviors than females. Similarly, sex was a significant predictor for repetitive behaviors (e.g., lining up items) in children with and without ASDs ages 8 through 56 months ($M = 28.37$), but not for any other RRBIs (Kim & Lord, 2010). Overall, though some researchers have provided support for some sex differences in CBs in individuals with ASDs, research in the direction of sex differences is quite limited in numbers and in topography of CBs. Therefore, it is hypothesized that sex does not have a significant impact on the presence of CBs in individuals with ASDs.

Race. Race is rarely examined as a factor contributing to the presence or severity of CBs in individuals with ASDs (McClintock et al., 2003). In fact, in many studies on CBs, race of the participants is not even reported (Horovitz, Matson, Rieske, Kozlowski, & Sipes, 2011). Therefore, the impact this demographic variable may have upon CBs in individuals with ASDs is relatively unknown.

Some researchers have provided evidence that no significant differences exist with respect to aggressive behaviors between Caucasian and non-Caucasian (i.e., African American, Hispanic, Asian/Pacific Islander, and Other) children with ASDs (Hartley et al., 2011), while others have found some evidence for differences. For example, Horovitz et al. (2011) examined aggressive/destructive, stereotypic, and self-injurious behaviors in Caucasian and African American toddlers ages 17 through 39 months who either had an ASD diagnosis or were atypically developing without an ASD diagnosis. The authors found that the African American toddlers with and without ASD diagnoses engaged in significantly more aggressive/destructive behaviors than the Caucasian toddlers with and without ASD diagnoses, but that the groups did not differ with respect to stereotypic or self-injurious behaviors.

Furthermore, in a group of Caucasian and African American adults with ID in which a portion of the sample also had ASDs, it was found that while race in and of itself did not have a significant impact on CBs, there was an interaction of diagnosis and race (Horovitz, Matson, Hattier, Tureck, & Bamburg, 2013). Overall, Caucasian adults with ID and ASDs evinced more CBs than African American adults with ID and ASDs; however, the opposite pattern occurred for adults with ID alone. After breaking down the CBs by class, no relationship was found between race and self-injurious, aggressive/destructive, or disruptive behaviors regardless of diagnosis. However, the authors did report that although there was no relationship between

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stereotypies and race alone, there was a race by diagnosis interaction. Caucasian adults with ID

and ASDs exhibited more stereotypies than African American adults with ID and ASDS, while

the opposite was found for adults with solely ID. However, because of the small number of

studies conducted to date, lack of variety in classes of CBs assessed, restriction of age range

within the studies, and the lack of consistency in findings, the effect of race on CBs in

individuals with ASDs remains inconclusive.

Purpose

Due to the high rates of CBs occurring in the ASD population (Baghdadli et al., 2003; Bodfish et al., 2000; Holden & Gitlesen, 2006; Jang et al., 2011; Matson, Wilkins, & Macken, 2009; McTiernan et al., 2011; Murphy et al., 2009), and the severe negative consequences these behaviors can have (Antonacci et al., 2008; Cuvo et al., 2010; Emerson, 2001; Mandell & Salzer, 2007; Mudford et al., 2008; Qureshi & Alborz, 1992), it is imperative that the factors associated with the presence of these CBs are investigated so that this information may both predict the occurrence of CBs over time and guide treatment. An abundance of factors have been linked to CB presentation in those with ASDs thus far; however, many questions remain unanswered.

Although numerous studies have been conducted to examine the effect of age on CB presentation in individuals with ASDs, as well as in those with ID, the results to date remain somewhat ambiguous. The general consensus is that CBs reach their peak in childhood, and then an abatement of CBs occurs in adulthood (Emerson et al., 2001). However, the exact trend remains uncertain. The vast majority of researchers have only looked at a snapshot of the lifespan, even when using a cross-sectional approach (e.g., Fodstad et al., 2012; Murphy et al., 2005; Shattuck et al., 2007). Furthermore, when the relationship of age with CBs in individuals with ASDs has been examined, it has often been done in isolation without consideration of other factors that may be concurrently affecting changes in CBs throughout the lifespan. It is critical to, at the very least, consider these other factors when assessing the influence of age on CBs. Although many of these other factors, such as race, intellectual functioning, and sex, remain constant across the lifespan, others, like autism symptomatology, are not necessarily stable. Because researchers have provided support for a positive correlation between overall autism symptomatology and CB presentation (e.g., Fodstad, 2011; Jang et al., 2011; Kozlowski &

Matson, 2012), and other researchers have produced evidence of an abatement of autism symptomatology over time (e.g., Charman et al., 2005; Seltzer et al., 2003; Shattuck et al., 2007), an examination of this relationship would greatly assist in the prediction and treatment of CBs over the lifespan. Additionally, although a relationship between autism symptomatology and overall CBs has been established, few researchers have examined the relationship between autism symptomatology and specific classes of CBs. Therefore, the purpose of Study 1 will be to clarify these unanswered questions.

Study 1 will include children ages 18 months through 17 years who meet criteria for an autism spectrum disorder according to the *DSM-IV-TR* (APA, 2000). Participants will be assigned to one of the following developmental age groups according to age at the time of assessment (CDC, 2011; Kail, 2011): Toddlers (18 months through 2 years, 11 months), Preschoolers (3 through 5 years), School-Aged Children (6 through 11 years), and Adolescents (12 through 17 years). The following assessments will then be conducted:

1. The influence of age on autism symptomatology will be assessed. Although it has been repeatedly established that symptom abatement is seen over time, it is relatively unknown when symptoms increase and/or decrease. It is hypothesized that there will be significant differences between the four age groups. More specifically, it is hypothesized that the Preschooler group will have significantly greater autism symptomatology than the Toddler group; the School-Aged Children will not have significantly different autism symptomatology from the Preschoolers, but will have significantly greater autism symptomatology than the Toddlers; the Adolescent group will have significantly less autism symptomatology than the Preschooler and School-Aged Children groups; and the Adolescent group will not have significantly different

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autism symptomatology than the Toddler group. The significant increase in autism symptomatology between the Toddler and Preschooler/School-Aged Children groups is suspected because many researchers have noted that symptoms worsen for a brief period of time during the early childhood years (e.g., Matson, Worley, et al., 2011; Moore & Goodson, 2003; van Daalen et al., 2009). The significant decrease in autism symptomatology in the Adolescent group is expected based on prior research that there is a general abatement of autism symptoms over time, and that significant decreases in autism symptomatology have been found across adolescence and adulthood (e.g., Mayes & Calhoun, 2011; Moss et al., 2008; Piven et al., 1996; Shattuck et al., 2007). Therefore, overall, a quadratic trend is expected to emerge across the lifespan.

2. The effect of both age and autism symptomatology on overall CBs will be examined, while taking other potentially influencing factors (i.e., ID, sex, and race) into consideration in the statistical analyses. It is hypothesized that significant differences in CBs will be noted across the developmental age groups in children with ASDs. It is expected that the Preschooler group will display significantly more CBs than the Toddler group because, although differences between these two age groups have not explicitly been examined before, Fodstad et al. (2012) did find a significant increase in CBs toward the end of the toddlerhood years. Based on previous findings that significant differences do not occur during the middle childhood years (Matson, Mahan, et al., 2010; McTiernan et al., 2011; Murphy et al., 2009), it is hypothesized that the School-Aged Children group will not significantly differ from the Preschooler group, but that the School-Aged Children will exhibit more CBs than the

Toddler group. Because researchers have also found that a significant decrease in CBs occurs during adolescence and adulthood (e.g., Murphy et al., 2005; Shattuck et al., 2007), it is predicted that the Adolescent group will display significantly less CBs than both the Preschooler and School-Aged Children groups, but exhibit no significant differences when compared to the Toddler group. Therefore, it is hypothesized that CBs will also follow a quadratic trend, similar to autism symptomatology across youth. Furthermore, it is hypothesized that those individuals with greater autism symptomatology will display significantly more CBs than those with less autism symptomatology because it is believed that impairments associated with autism symptomatology (e.g., communication deficits, socialization impairments) are associated with CBs (e.g., Chiang, 2008; Matson, Fodstad, & Rivet, 2009). However, a significant interaction of age and autism symptomatology is not expected; it is hypothesized that individuals with high and low autism symptomatology will exhibit similar patterns of CB presentation across the lifespan, albeit the levels of CB will differ.

3. The effect of both age and autism symptomatology on each of the three classes of CBs (i.e., aggressive/disruptive, stereotypic, and self-injurious behaviors) will be examined, also while taking the potential effects of other factors into consideration. It is hypothesized that significant differences between age groups in each class of CBs (i.e., aggressive/disruptive, stereotypic, and self-injurious behaviors) will be found. With respect to aggressive/disruptive behaviors and stereotypic behaviors, it is expected that the Preschooler group will have significantly higher scores than the Toddler group based on prior research by Fodstad et al. (2012) noting an increase in

aggressive/disruptive and stereotypic behaviors toward the end of the toddler years.

It is then predicted that the School-Aged Children will not significantly differ from

the Preschoolers, but will display significantly more aggressive/disruptive and

stereotypic behaviors than the Toddlers (Murphy et al., 2005). Lastly, Adolescents

are expected to display significantly less aggressive/disruptive and stereotypic

behaviors than the Preschoolers and School-Aged Children groups (Murphy et al.,

2005), but to not differ from the Toddler group. This is predicted because some

researchers have found that these classes of CBs reach their peak in childhood and

then decrease in adulthood (e.g., Chowdhury et al., 2010; Shattuck et al., 2007). As

for self-injurious behaviors, significant differences are not hypothesized to exist

between the Toddlers, Preschoolers, or School-Aged Children (e.g., Fodstad et al.,

2012; Matson, Mahan, et al., 2010; McTiernan et al., 2011; Murphy et al., 2009), but

it is expected that the Adolescents will display significantly less CBs than any of the

other groups (e.g., Shattuck et al., 2007; Murphy et al., 2005). Overall, a quadratic

trend is expected for aggressive/disruptive behaviors and stereotypic behaviors while

a linear trend is expected for self-injurious behaviors. Furthermore, it is hypothesized

that individuals with greater autism symptomatology will have higher CB scores in

each of the classes of CBs. An interaction between age and autism symptomatology

is not expected.

Whereas Study 1 will aim to determine the relationship between age and autism

symptomatology, and both age and autism symptomatology's impact on CBs, a Study 2 will be

conducted to examine the ability of changes in overall autism symptomatology and specific

autism symptomatology domains (i.e., communication impairments, socialization impairments,

and RRBIs) to predict changes in overall CBs and specific classes of CBs. This will be completed as a follow-up to Study 1 because, if autism symptomatology and CBs follow similar trends, it stands to reason that a change in autism symptomatology may predict a change in CBs, regardless of what brought about the change in the first variable. Furthermore, as there are many facets to autism symptomatology and multiple classes of CBs exhibited by individuals with ASDs, Study 2 will also be used to determine which domains of ASDs (i.e., socialization impairments, communication impairments, and RRBIs) best predict specific classes of CBs. Being privy to this information would greatly assist in guiding treatment planning for CBs in individuals with ASDs. The following hypotheses are proposed for Study 2:

1. It is hypothesized that differences in total autism symptomatology score will significantly predict differences in total CB scores, such that increases over time in autism symptomatology will be predictive of increases over time in CBs whereas decreases in autism symptomatology overtime will be predictive of decreases in CBs over time. This hypothesis is based on previous research indicating that autism symptomatology and CBs are correlated (e.g., Jang et al., 2011; Kozlowski & Matson, 2012; Matson, Wilkins, & Macken, 2009), and that treatment of impairments associated with ASDs can assist in alleviating CB presentation (e.g., Kurtz et al., 2011).

2. It is hypothesized that differences in total autism symptomatology score will significantly predict changes in each of the classes of CBs (i.e., aggressive/disruptive behaviors, stereotypic behaviors, and self-injurious behaviors; Fodstad, 2011; Kozlowski & Matson, 2012; Matson & Rivet, 2008; Matson, Wilkins, & Macken, 2009). That is, increases and decreases in autism symptomatology over time will

correspond with increases and decreases in each of the three types of CBs (i.e., aggressive/disruptive behavior, stereotypic behavior, and self-injurious behavior) over time.

3. It is hypothesized that differences in communication, socialization/nonverbal communication, and repetitive behavior/restricted interests factor scores will each significantly predict differences in overall CBs (Hartley et al., 2008; Matson, Neal, et al., 2010; Matson & Rivet, 2008; Oliver et al., 2012; Sigafoos, 2000), such that as impairments in one area increase, CBs will also increase.

4. Lastly, it is hypothesized that differences in communication and socialization/nonverbal communication factor scores will each significantly predict differences in aggressive/disruptive behavior and self-injurious behavior scores (Baghdadli et al., 2003; Hartley et al., 2008; Matson, Neal, et al., 2010; Matson & Rivet, 2008). It is not expected that differences in communication and socialization/nonverbal communication factor scores will predict differences in stereotypic behaviors (e.g., Matson & Rivet, 2008); however, it is hypothesized that differences in repetitive behavior/restricted interests factor scores will significantly predict all classes of CBs (e.g., Oliver et al., 2012).

Study 1 Method

Participants

The participants for Study 1 were selected from a pre-existing database. Individuals between ages 18 months through 17 years who met research diagnostic criteria for ASD based on the *DSM-IV-TR/ICD-10 Checklist* (see Measures section) served as the participants. Additionally, all participants were required to have all measures containing the dependent variables completed in their entirety as well as have an indication of whether they had an IQ score corresponding to ID or not. Due to the limited number of individuals who were not Caucasian or African American, only individuals of those two races were studied. Participants were recruited from a variety of sources including Early Steps (Early Steps is Louisiana's Early Intervention System under the Individuals with Disabilities Education Act, Part C, which provides services to infants/toddlers, and their families, from birth to 36 months), outpatient clinics, schools, church groups, organizations for individuals with ASDs and other similar disabilities, and the internet.

For all participants aside from those recruited through Early Steps, level of intellectual ability (i.e., ID versus non-ID) was previously determined by a licensed clinical psychologist based on a standardized assessment of intellectual functioning (e.g., *Stanford-Binet Intelligence Scales, Fifth Edition*; Roid, 2003) and of adaptive behavior (e.g., *Vineland Adaptive Behavior Scales, Second Edition*; Sparrow et al., 2005), in addition to clinical expertise. Children recruited through Early Steps had been administered the *Battelle Developmental Inventory, Second Edition* (*BDI-2*; Newborg, 2005), which provides the assessor with a standardized developmental quotient (DQ) score. Although DQ is not synonymous with IQ, because IQ scores are deemed unreliable within the first several years of life, DQ scores were used to

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approximate IQ of the individuals. This method has been utilized previously in the literature for children who are deemed too young to have a reliable IQ assessment conducted (e.g., Davis et al., 2011). Therefore, those individuals scoring ≤70 on the *BDI-2* were identified as having ID for the purposes of the current study, while those scoring >70 were considered to not have ID.

A total of 726 individuals were eligible to participate in the study. Participants were divided into one of four groups according to developmental age (CDC, 2011; Kail, 2011): Toddlers (ages 18 through 35 months), Preschoolers (ages 3 through 5 years), School-Age Children (ages 6 through 11 years), and Adolescents (ages 12 through 17 years). Due to sample sizes being significantly different between groups, participants were randomly selected for inclusion in the study to ensure that no group was 1.5 times larger than any other group (Leech, Barrett, & Morgan, 2008). Therefore, a total of 244 participants were included in the final study sample. Participants were also grouped according to autism symptomatology as a second independent variable for a portion of the analyses. The median of the total autism symptomatology score for all included participants was calculated, and participants were assigned to either the Low Autism Symptom or High Autism Symptom group. The median was 38; those with scores 38 and lower were in the Low Autism Symptom group and those with scores of 39 and higher were in the High Autism symptom group. Characteristics of the study sample according to age group are presented in Table 1.

Table 1. Characteristics of Study 1 sample according to age group.

	Age Groups			
	Toddlers (*n* = 72)	Pre-Schoolers (*n* = 52)	School-Age Children (*n* = 72)	Adolescents (*n* = 48)
Sex, %				
Male	70.8%	65.4%	81.9%	77.1%
Female	29.2%	34.6%	18.1%	22.9%
Race, %				
Caucasian	58.3%	92.3%	91.7%	72.9%
African American	41.7%	7.7%	8.3%	27.1%
Autism Symptomatology, %				
High	37.5%	61.5%	52.8%	47.9%
Low	62.5%	38.5%	47.2%	52.1%

Measure of ASD Classification

In order to participate in Study 1, each participant had to meet research diagnostic criteria for autistic disorder or PDD-NOS. The *DSM-IV-TR/ICD-10 Checklist* was used to determine whether each participant met eligibility. This checklist was completed using information collected through the comprehensive assessment completed by Early Steps (please see Procedures section) for children recruited through Early Steps. For all other children, the checklist was completed by parents/caregivers. If information was unavailable to complete the checklist in its entirety, the child was still considered eligible for the study if they met research criteria for autistic disorder or PDD-NOS based on the portion which was completed.

DSM-IV-TR/ICD-10 Checklist. The *DSM-IV-TR/ICD-10 Checklist* is a 19-item checklist consisting of items related to the criteria for ASDs taken from the *DSM-IV-TR* (APA, 2000) and the *International Classification of Diseases, Tenth Revision* (*ICD-10*; World Health Organization [WHO], 1992). Items are divided into sections related to socialization impairments, communication impairments, and RRBI, as well as the age of onset of such

difficulties. The checklist is completed by parents/caregivers or interviewers by writing "yes" or "no" in response to whether the ASD symptom listed is applicable to the child in question. To meet research diagnostic criteria for an ASD, respondents must endorse a minimum of two socialization impairments and at least one other impairment in the remaining two domains (i.e., communication impairments or RRBI) – this cutoff was chosen during the development of the *DSM-IV-TR/ICD-10 Checklist* so as to include individuals with PDD-NOS in addition to those with autistic disorder (González, 2008; Matson, González, et al., 2008). Inter-rater reliability (*r* = .89), test-retest reliability (*r* = .97), and internal consistency (*α* = .95) of the *DSM-IV-TR/ICD-10 Checklist* are all strong (González, 2008; Matson, González, et al., 2008). Additionally, as the checklist is based on the diagnostic criteria from the two most popular manuals currently in use, the face validity of the measure is excellent.

Measures of Autism Symptomatology

Based on each participant's age at the time of assessment, one of two different but similar instruments was used to assess autism symptomatology in the participant. This was done because of the specified age restrictions of each measure, though it should be noted that the measures overlap in the ages for which they are intended. Therefore, it is possible that an individual of an overlapping age (e.g., 2 years old) would have been eligible to have been administered more than one of the autism symptomatology instruments. In these cases, only one measure was selected and administered with the decision being based on availability of the measure. The *Baby and Infant Screen for Children with aUtIsm Traits-Part 1 (BISCUIT-Part 1)* was used for participants ages 17 through 37 months and the *Autism Spectrum Disorder-Diagnostic for Children (ASD-DC)* was used for participants ages 2 through 18 years. Both of these autism symptomatology assessment instruments were created by the same lead

psychologist using the same techniques. The instruments were developed by conducting a

comprehensive review of relevant research literature, already existing ASD diagnostic

instruments, and currently accepted diagnostic criteria for ASDs as outlined in the *DSM-IV-TR*

(APA, 2000) and *ICD-10* (WHO, 1992) was conducted. Additional items were also added to the

item pool based on the lead psychologist's over 30 years of experience assessing and treating

individuals with ASDs and other intellectual and developmental disabilities.

   BISCUIT-Part 1. The *BISCUIT-Part 1* is one part of a three part assessment battery

designed to assess autism symptomatology, comorbid psychopathology, and CBs in children

ages 17 through 37 months (Matson, Boisjoli, & Wilkins, 2007). The battery is read aloud to the

parent/caregiver and takes approximately 20 to 30 minutes to complete. The first part of the

battery, which assesses autism symptomatology, asks the parent/caregiver to compare the child

in question to his/her same-aged typically developing peers in the community. This section

contains 62 items which are rated as "0" to indicate "not different; no impairment," "1" to

indicate "different; mild impairment," or "2" to indicate "very different; severe impairment."

The item scores are then summed to arrive at a total score, ranging from 0 to 124, for which

cutoffs have been established to determine whether the child meets criteria for an ASD. A score

of 0 through 16 corresponds to having no ASD/being atypically developing, a score of 17

through 38 is indicative of possible ASD/PDD-NOS, and a score of 39 and higher is indicative of

probable ASD/autistic disorder (Matson, Wilkins, Sharp, et al., 2009). In addition to a total

score, three factors have been empirically established through an exploratory factor analysis:

socialization/nonverbal communication, repetitive behavior/restricted interests, and

communication (Matson, Boisjoli, Hess, & Wilkins, 2010).

The *BISCUIT-Part 1* has been found to have excellent internal consistency with an alpha value of .97 (Matson, Wilkins, Sevin, et al., 2009). Through convergent and divergent validity comparisons with the *Modified Checklist for Autism in Toddlers* (Robins, Fein, Barton, & Green, 2001) and different domains of the *Battelle Developmental Inventory, Second Edition* (Newborg, 2005), the *BISCUIT-Part 1* has been deemed a valid measure of autism symptomatology (Matson, Wilkins, & Fodstad, 2011). Its sensitivity and specificity are 93.4% and 86.6%, respectively, with an overall correct classification rate of 88.8% (Matson, Wilkins, Sharp, et al., 2009), thereby making it one of the most psychometrically sound instruments for assessing autism symptomatology in toddlers.

ASD-DC. The *ASD-DC* is similar to the *BISCUIT-Part 1*; it is one part of a three part battery designed to assess for autism symptomatology, comorbid psychopathology, and CBs in children ages 2 through 18 years (Matson & González, 2007a). The ASD-DC, the part that assesses autism symptomatology, contains 40 items. The battery is read and completed independently by the parent/caregiver, with trained staff available to answer any questions the informant may have. Informants are asked to rate each item by comparing their child to typically developing peers of the same age with "0" indicating "not different; no impairment," "1" indicating "somewhat different; mild impairment," and "2" indicating "very different; severe impairment." The scores are then summed to reach a total score of 0 to 80. The following cutoff scores have been established: 0-8 designates typical development, 9-32 designates atypical development, 33-39 designates Asperger's disorder, 40-52 designates PDD-NOS, and 53 and higher designates autistic disorder (Matson, González, & Wilkins, 2009). Based on these cutoffs, the sensitivity, specificity, and overall correct classification rate for identifying ASD versus non-ASD children was 84.3%, 98.2%, and 91.3%, respectively. A factor analysis has also

been completed for the *ASD-DC*, with a four factor solution being the best fit (i.e., nonverbal communication/socialization, verbal communication, social relationships, and insistence of sameness/restricted interests; Matson, Boisjoli, & Dempsey, 2009).

Measures of Challenging Behaviors

One of two similar instruments was used to assess CBs in the participant based on the participant's age at the time of the assessment. Different instruments were administered to different age groups due to the age restrictions of each measure; however, it was possible that an individual met age eligibility for more than one instrument. In such cases, only one measure was selected and administered with the decision being based on availability of the measure. The two CB measures were the *Baby and Infant Screen for aUtIsm Traits-Part 3 (BISCUIT-Part 3)* for individuals ages 17 through 37 months and the *Autism Spectrum Disorder – Problem Behavior for Children (ASD-PBC)* for individuals ages 2 through 18 years. Both of these CB assessment instruments were created by the same lead psychologist using the same techniques.

BISCUIT-Part 3. The *BISCUIT-Part 3* is the third part of a three part battery designed to assess autism symptomatology, comorbid psychopathology, and CBs in children ages 17 through 37 months (Matson, Boisjoli, & Wilkins, 2007). The battery is read aloud to the parent/caregiver and takes approximately 20 to 30 minutes to complete in its entirety. The third portion, which assesses for CBs, asks the informant to rate a set of 15 CBs to the extent that they have been a recent problem, with "0" corresponding to "not a problem or impairment; not at all," "1" corresponding to "mild problem or impairment," and "2" corresponding to "severe problem or impairment." The measure has excellent internal consistency reliability (Matson, Wilkins, Sevin, et al., 2008) and excellent face validity. An exploratory factor analysis has been conducted with results yielding a three factor solution: aggressive/disruptive behavior,

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stereotypic behavior, and self-injurious behavior (Matson, Boisjoli, Rojahn, & Hess, 2009). The factors contain 10, 3, and 2 items, respectively. Although the authors found that the internal consistency for the aggressive/disruptive behavior factor was excellent ($\alpha = .88$), the internal consistency for the stereotypic behavior factor ($\alpha = .72$) and self-injurious behavior factor ($\alpha = .51$), was below the desired reliability level. However, the authors attribute these lower internal consistencies to the small number of items on each of the latter two factors.

Cutoff scores have also been established for children with ASDs for the *BISCUIT-Part 3* to denote areas of concern among the three CB factors as well as total CBs. For aggressive/disruptive behavior, a score of 0-9 is considered to be of "no/minimal impairment," a score of 10-13 is considered "moderate impairment," and a score of 14 and above is considered "severe impairment." For stereotypic behavior, a score of 0-3 is considered to be of "no/minimal impairment" and a score of 4 and above is considered "severe impairment." Within the Stereotypic Behavior factor, a score of 4 was found to be the cutoff for both moderate and severe impairment; therefore, a moderate impairment classification does not exist for this factor. For self-injurious behavior, a score of 0-1 is considered to be of "no/minimal impairment," a score of 2 is considered "moderate impairment," and a score of 3 and above is considered "severe impairment." Lastly, for total CBs, a score of 0-12 is considered to be of "no/minimal impairment," a score of 13-18 is considered "moderate impairment," and a score of 19 and above is considered "severe impairment."

ASD-PBC. The *ASD-PBC* is the third part of a three part assessment battery designed to assess for autism symptomatology, comorbid psychopathology, and CBs in children ages 2 through 18 years (Matson & González, 2007b). The *ASD-PBC* contains 18 problem behavior items that are rated by parents/caregivers as 0 (not a problem or impairment; not at all), 1 (mild

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problem or impairment), or 2 (severe problem or impairment), as to the extent that they have each been a recent problem. Matson, González, and Rivet (2008) found that the *ASD-PBC* has good to excellent inter-rater and test-retest reliability for the majority of items, with some infrequently endorsed items having lower inter-rater and test-retest reliability. An exploratory factor analysis yielded a two-factor solution: internalizing and externalizing behaviors. Self-injurious and stereotypic behaviors are on the internalizing behaviors factor while aggressive and disruptive behaviors are on the externalizing behaviors factor. Convergent and divergent validity have both been established with comparisons to sections of the *Behavioral Assessment System for Children, Second Edition* (Reynolds & Kamphaus, 2004), with results yielding a moderately high correlation for convergent validity and a non-significant correlation for divergent validity (Mahan & Matson, 2011).

Procedure

For participants recruited through Early Steps, all participants received a comprehensive assessment battery typically offered by the Early Steps program, with the addition of the *BISCUIT*. Assessments were conducted in the child's home or day care setting with the parent/caregiver and child both present. Assessors were mental health professionals ($N = 175$) possessing bachelor to doctoral level degrees, and they were trained on the administration of the *BISCUIT* battery and symptoms of ASD in general. The assessors were certified or licensed in their respective disciplines (e.g., psychology, early childhood development, social work, special education, and speech/language pathology). Measures were read aloud to the parents/caregivers of the children by interviewers, and parents/caregivers were given the opportunity to ask questions.

Child participants not recruited through Early Steps were recruited from a variety of sources including outpatient clinic, schools, church groups, organizations for individuals with ASDs and other similar disabilities, and the internet. Paper-and-pencil measures with printed directions were administered to the parents/legal guardians to complete, with doctoral graduate students available to clarify and answer any questions that the parents/legal guardians might have had during completion of the measures.

This study was approved by the Louisiana State University and Louisiana's Office for Citizens with Developmental Disabilities Institutional Review Boards (IRBs). Informed consent was obtained from parents/caregivers, with child assent obtained when age-appropriate.

Because both of the autism symptomatology assessments and CB assessments were created by the same lead psychologist using the same techniques of creating items, identical items are found across the sets of measures. Therefore, in order to derive an identical set of items pertaining to autism symptomatology and CBs across all ages so that comparisons would be possible, identical items were pulled from each set of measures. Similar methods have been used elsewhere (e.g., Davis et al., 2011). As a result, for the autism symptomatology assessments, a total of 38 items were deduced. Twenty-four items from the *BISCUIT-Part 1* and two items from the *ASD-DC* were not included in the cross-sectional autism symptomatology score. Cronbach's alpha was calculated to determine the internal consistency of the newly created autism symptomatology assessment. With an alpha value of 0.94, the scale demonstrated high internal consistency.

Identical methodology was used for the CB assessments. A total of 15 items were deduced from both measures; this comprised all of the items on the *BISCUIT-Part 3* whereas three items on the *ASD-PBC* (i.e., "mouthing or swallowing objects causing bodily harm,"

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"inappropriate sexual behavior," and "smearing or playing with feces") were eliminated. Please refer to the Appendix for a list of CBs. Cronbach's alpha was calculated to determine the internal consistency of the newly created CB assessment. With an alpha value of 0.85, the scale demonstrated high internal consistency.

Prior to conducting analyses, participants were removed from the study if they had any data missing from the autism symptomatology measure or the CB assessment.

Statistical Analyses

Effects of age on autism symptomatology. The first main analysis sought to determine the effects of age on autism symptomatology. First, a priori chi-square tests were conducted to examine differences between the age groups with respect to sex and race. If significant differences arose, an a priori analysis of variance (ANOVA) was computed with the demographic variable (i.e., sex or race) as the independent variable and total autism symptomatology, calculated as the sum of the autism symptomatology items, as the dependent variable to determine if the demographic variable was significantly related to the outcome variable (i.e., autism symptomatology). If the demographic variable was related, it then served as a covariate in the main analysis. Next, an analysis of covariance (ANCOVA) was computed with age group as the independent variable, ID and any other demographic variables found to be significantly related to the outcome variable as the covariate variables, and total autism symptomatology score as the dependent variable. A significant ANCOVA was followed with Bonferroni post hoc tests to find where the differences lied while controlling for inflation of familywise error. Additionally, a curve estimation was run to determine the trend of autism symptomatology across age groups.

Effects of age and autism symptomatology on total challenging behaviors. The

second main analysis was conducted to determine the effects of age and autism symptomatology

on total CBs. A priori chi-square tests were conducted to examine differences between the two

levels of autism symptomatology (i.e., High Autism Symptoms versus Low Autism Symptoms)

with respect to sex and race. If significant differences on either demographic variable were

found, an a priori ANOVA was computed with the demographic variable (i.e., sex or race) as the

independent variable and total CB score (the outcome variable for the main analysis) as the

dependent variable to determine if the demographic variable was significantly related to total

CBs. Additionally, because chi-square analyses were already conducted to determine if there

were differences between age groups on sex and race, if differences did exist, a priori ANOVAs

were also computed with the demographic variable as the independent variable and total CB

score as the dependent variable. In the case that either demographic variable significantly

differed among the levels of the independent variables and was found to be related to total CBs,

it served as a covariate in the main analysis. For the main analysis, an ANCOVA was run with

age and autism symptomatology as the independent variables, presence of ID as the covariate

along with any demographic variables determined to be related to the outcome variable, and total

CB score as the dependent variable. A significant ANCOVA was followed with Bonferroni post

hoc tests to find where the differences lied while controlling for inflation of familywise error.

These same analyses were also conducted using a summation of the presence or absence of each

of the 15 CBs to determine the effects of age and autism symptomatology on the presence of

CBs; that is, each CB was scored as present or absent as opposed to taking into consideration the

severity of the CB. In addition, a curve estimation was run to determine the trend of total CBs

across age groups.

Effects of age and autism symptomatology on classes of challenging behaviors. Next, additional statistical analyses were conducted to determine which CB classes, specifically, were affected by age and autism symptomatology. In order to accomplish this, because the CB items had been collapsed across two different assessments with different factor structures, for the purposes of this study CB items were assigned to one of three classes of CBs based on groupings found within the research literature: aggressive/disruptive, stereotypic, and self-injurious behaviors. However, it should also be noted that these groupings are identical to those found during the exploratory factor analysis for the *BISCUIT-Part 3* (Matson, Boisjoli, Rojahn, & Hess, 2009). Please refer to the Appendix for a breakdown of CBs by class. Prior to conducting the main analysis, based on the a priori chi-square analyses conducted prior to the previously computed ANCOVA, ANOVAs were run for any significant differences that had previously been found on either demographic variable (i.e., sex or race) for either independent variable (i.e., age group or autism symptom group). For these ANOVAs, the significantly different demographic variable (i.e., sex or race) was entered as the independent variable and each of the CB class scores (the outcome variable for the main analysis) was entered as a dependent variable to determine if the demographic variable was significantly related to the outcome variables. In the case that the demographic variable was related, it then served as a covariate in the main analysis.

For the main analysis, a MANCOVA was computed with age and autism symptomatology as the independent variables, presence of ID as the covariate along with any demographic variables determined to be related to any of the outcome variables, and the three classes of CBs as the dependent variables. If the MANCOVA was significant, three follow-up ANCOVAs were run. Next, any significant ANCOVAs were followed with Bonferroni post hoc

tests to find where the differences lied while controlling for inflation of familywise error. These same analyses were also conducted using a summation of the presence or absence of each of the CBs in each category of CB to determine the effects of age and autism symptomatology on the presence of CBs in each category; that is, each CB was scored as present or absent as opposed to taking into consideration the severity of the CB. Curve estimations were also utilized to determine the trends of the specific classes of CBs across age groups.

Study 1 Results

Effects of Age on Autism Symptomatology

No significant differences were found between age groups with respect to gender [$\chi^2(3) =$ 4.99, $p = .172$], but significant differences were found between age groups with respect to race [$\chi^2(3) = 31.27$, $p = <.001$]. Therefore, an ANOVA was computed with race as the independent variable and total autism symptomatology score as the dependent variable. Because Levene's test of homogeneity of variances was violated, $F(3, 240) = 7.86$, $p < .001$, the Welch F-ratio was used. A significant effect of race on total autism symptomatology score was found, $F(2, 121) =$ 7.47, $p < .001$; therefore, race was included as a categorical covariate in the main analyses. An ANCOVA with age group as the independent variable, presence of ID and race as the covariates, and total autism symptomatology score as the dependent variable was computed. Levene's test of homogeneity of variances was once again violated, $F(3, 240) = 4.79$, $p = .003$; however, ANCOVAs are considered robust against such violations when group sizes are relatively equal. The main effect of age group, $F(3, 238) = 7.56$, $p < .001$, was significant. The observed power for the analysis was .986, and there was a medium effect size of .087 (partial η^2). The covariates of ID [$F(1, 238) = 7.13$, $p = .008$] and race [$F(1, 238) = 4.42$, $p = .037$] were also significant. Individuals with ID had greater total autism symptomatology scores ($M = 41.16$, $SD = 14.77$) than individuals without ID ($M = 40.65$, $SD = 15.76$). Caucasian individuals had greater total autism symptomatology scores ($M = 42.16$, $SD = 15.70$) than African American individuals ($M =$ 35.85, $SD = 13.62$). Post hoc analyses were conducted for the significant main effect of age group using the Bonferroni post hoc test. Results are presented in Table 2 for the post hoc analyses for age groups.

Table 2. Bonferroni post-hoc analyses for age groups.

	Age Group			
	Toddlers $n = 72$	Preschoolers $n = 52$	School-Aged Children $n = 72$	Adolescents $n = 48$
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*
Total Autism Symptomatology Score	34.70 (1.83)[b, c]	48.27 (2.09)[a]	42.13 (1.76)[a]	39.82 (2.12)[b]

*Using an alpha value of .05, based on Bonferroni post hoc analyses, significantly different from the Toddlers Group ([a]), Preschoolers Group ([b]), School-Aged Children Group ([c]), and Adolescents Group ([d]).

A curve estimation was also conducted to test the hypothesis that autism symptomatology followed a quadratic trend across age groups. Age group served as the independent variable and total autism symptomatology score as the dependent variable. The quadratic trend was significant, $F(2, 241) = 8.76$, $p = <.001$.

Effects of Age and Autism Symptomatology on Total Challenging Behaviors

No significant differences were found between autism symptom groups with respect to gender [$\chi^2(1) = 1.381$, $p = .240$] or race [$\chi^2(1) = 2.475$, $p = .116$]. However, because significant differences were previously found between age groups with respect to race, an ANOVA was computed with race as the independent variable and total CBs score as the dependent variable. Levene's test of homogeneity of variances was not violated, $F(1, 242) = 2.61$, $p = .107$. There was a non-significant effect of race on total CBs score, $F(1,242) = .02$, $p = .900$; therefore, race was not included as a covariate in the main analyses. A factorial ANCOVA with age group and autism symptom group as the independent variables, presence of ID as a categorical covariate, and total CB score as the dependent variable was computed. Levene's test of homogeneity of variances was violated, $F(7, 236) = 2.62$, $p = .013$; therefore, an alpha value of .01 as opposed to .05 was used for testing of significance to control for Type I errors (Mooi & Sarstedt, 2011).

The main effect of age group, $F(3, 235) = 0.53$, $p = .662$, was not significant, but the main effect of autism symptom group was significant, $F(1, 235) = 15.79$, $p < .001$. The observed power for the significant main effect was .977, and there was a medium effect size of .063 (partial η^2). Individuals with high autism symptomatology had greater total CB scores ($M = 8.37$, $SD = 6.26$) than individuals with low autism symptomatology ($M = 5.17$, $SD = 4.79$) after controlling for ID. The interaction effect of age group and autism symptom group was not significant, $F(3, 235) = 0.78$, $p = .505$. The covariate of presence of ID was also not significant, $F(1, 235) = 0.02$, $p = .891$.

A curve estimation was also conducted to test the hypothesis that CBs followed a quadratic trend across age groups. Age group served as the independent variable and total CB score as the dependent variable. The quadratic trend was not significant, $F(2, 241) = 1.93$, $p = .148$. Because the quadratic trend was not significant, a curve estimation was also conducted to determine whether CBs followed a linear or cubic trend across age groups. Once again, age group served as the independent variable and total CB score as the dependent variable. Neither the linear [$F(1, 242) = 0.58$, $p = .449$] nor cubic trends [$F(1, 240) = 1.36$, $p = .255$] were significant. Therefore, total CB score remained stable across age groups.

The same statistical analyses were conducted with the rescored dependent variable. The presence of each of the 15 CBs was measured. Because significant differences were previously found between age groups with respect to race, an ANOVA was computed with race as the independent variable and total CBs score as the dependent variable. Levene's test of homogeneity of variances was not violated, $F(1, 242) = 1.62$, $p = .205$. There was a non-significant effect of race on total autism symptomatology score, $F(1, 242) = 0.50$, $p = .479$; therefore, race was not included as a covariate in the main analyses. A factorial ANCOVA with

age group and autism symptom group as the independent variables, presence of ID as a categorical covariate, and total CB score as the dependent variable was computed. Levene's test of homogeneity of variances was not violated, $F(7, 236) = 1.04$, $p = .404$. The main effects of age group [$F(3, 235) = 3.00$, $p = .031$] and autism symptom group [$F(1, 235) = 8.38$, $p = .004$] were both significant. The observed power for the main effect of age group was .704, and there was a medium effect size of .037 (partial η^2). The observed power for the main effect of autism symptom group was .822, and there was a medium effect size of .034 (partial η^2). Individuals with high autism symptomatology had significantly greater total CB scores ($M = 6.00$, $SD = 3.78$) than individuals with low autism symptomatology ($M = 4.32$, $SD = 3.40$).

Post hoc analyses were conducted for the significant main effect of age group using the Bonferroni post hoc test. Results are presented in Table 3 for the post hoc analyses for age groups.

Table 3. Bonferroni post hoc analyses for age groups.

	Age Group			
	Toddlers $n = 72$	Preschoolers $n = 52$	School-Aged Children $n = 72$	Adolescents $n = 48$
	M (SD)	M (SD)	M (SD)	M (SD)
Total CB Score	4.07 (0.45)[c]	5.79 (0.52)	5.81 (0.42)[a]	5.04 (0.51)

*Using an alpha value of .05, based on Bonferroni post hoc analyses, significantly different from the Toddlers Group ([a]), Preschoolers Group ([b]), School-Aged Children Group ([c]), and Adolescents Group ([d]).

The interaction effect of age group and autism symptom group was not significant, $F(3, 235) = 0.71$, $p = .547$. The covariate of presence of ID was also not significant, $F(1, 235) = 0.01$, $p = .952$.

A curve estimation was also conducted to test the hypothesis that the modified total CB score followed a quadratic trend across age groups. Age group served as the independent

variable and total autism symptomatology score as the dependent variable. The quadratic trend was significant, $F(2, 241) = 7.03$, $p = .001$.

Effects of Age and Autism Symptomatology on Classes of Challenging Behaviors

Because significant differences were previously found between age groups with respect to race, a MANOVA was computed with race as the independent variable and each of the CB factor scores as the dependent variables. There was a non-significant effect of race on CB scores, Wilks' $\Lambda = .998$, $F(3, 240) = 0.20$, $p = .899$; therefore, race was not included as a covariate in the main analyses. A factorial MANCOVA was computed with age group and autism symptomatology group as the independent variables, presence of ID as the categorical covariate, and the three CB factor scores (i.e., aggressive/destructive behaviors, stereotypic behaviors, and self-injurious behaviors) as the dependent variables. Box's test of equality of covariance matrices was violated, Box's M = 128.81, $F(42, 61716) = 2.93$, $p < .001$; however, MANCOVA is quite robust to such violations given relatively equal sample sizes (Leech et al., 2008). The main effect of age group on CBs was not significant, Wilks' $\Lambda = .934$, $F(9, 567) = 1.79$, $p = .067$. The main effect of autism symptomatology group on CBs was significant, Wilks' $\Lambda = .838$, $F(3, 233) = 14.96$, $p < .001$. The observed power for the significant main effect was 1.000, and there was a large effect size of .162 (partial η^2). The interaction effect of age group and autism symptom group was not significant, Wilks' $\Lambda = .964$, $F(9, 567) = 0.97$, $p = .467$. The main effect of the covariate, presence of ID, was not significant, Wilks' $\Lambda = .983$, $F(3, 233) = 1.32$, $p = .269$.

The significant main effect of autism symptom group was followed with three ANCOVAs to determine in which CB factor(s) significant differences were evident. The main effects of autism symptom group on aggressive/disruptive behaviors [$F(1, 235) = 5.38$, $p = .021$],

stereotypic behaviors [$F(1, 235) = 40.80$, $p < .001$], and self-injurious behaviors [$F(1, 235) = 11.54$, $p = .001$] were all significant. On average, individuals in the high autism symptomatology group exhibited significantly more aggressive/disruptive ($M = 5.14$), stereotypic ($M = 2.02$), and self-injurious ($M = 0.80$) behaviors than individuals in the low autism symptomatology group ($M = 3.91$, 1.17, and 0.56, respectively).

A curve estimation was also conducted to test the hypothesis that each class of CBs followed a quadratic trend across age groups. Age group served as the independent variable and each of the CB factor scores as the dependent variables. The quadratic trend was significant for stereotypic behaviors [$F(2, 241) = 7.17$, $p = .001$], but it was not significant for aggressive behaviors [$F(2, 241) = 0.58$, $p = .558$] or self-injurious behaviors [$F(2, 241) = 0.87$, $p = .419$]. Because the quadratic trend was not significant for aggressive or self-injurious behaviors, curve estimations were also conducted to determine if either class of CBs followed a linear or cubic trend. Aggressive behaviors did not follow a linear [$F(1, 242) = 0.02$, $p = .898$] or cubic trend [$F(3, 240) = 0.39$, $p = .760$]. Self-injurious behaviors also did not follow a linear [$F(1, 242) = 0.26$, $p = .608$] or cubic trend [$F(3, 240) = 0.58$, $p = .628$]. Therefore, both aggressive and self-injurious behaviors remained stable across age groups.

As was done previously with the total CB score, the same statistical analyses were conducted with the rescored dependent variables denoting either the presence or absence of each CB within its class. Because significant differences were previously found between age groups with respect to race, a MANOVA was computed with race as the independent variable and each of the CB factor scores as the dependent variables. A non-significant effect of race on CB scores was found, Wilks' $\Lambda = .994$, $F(3, 240) = 0.51$, $p = .679$; therefore, race was not included as a covariate in the main analyses. A factorial MANCOVA was computed with age group and

autism symptomatology group as the independent variables, presence of ID as the categorical covariate, and the three CB factor scores (i.e., aggressive/destructive behaviors, stereotypic behaviors, and self-injurious behaviors) as the dependent variables. Box's test of equality of covariance matrices was violated, Box's M = 72.07, $F(42, 61716) = 1.64$, $p = .006$; however, MANCOVA is quite robust to such violations given relatively equal sample sizes (Leech et al., 2008). After controlling for ID, the main effect of age group on CBs was significant, Wilks' $\Lambda = .914$, $F(9, 567) = 2.36$, $p = .013$. The observed power for the significant main effect was .836, and there was a medium effect size of .029 (partial η^2). The main effect of autism symptomatology group on CBs was significant, Wilks' $\Lambda = .878$, $F(3, 233) = 10.78$, $p < .001$. The observed power for the significant main effect was .999, and there was a medium effect size of .122 (partial η^2). The interaction effect of age group and autism symptom group was not significant, Wilks' $\Lambda = .952$, $F(9, 567) = 1.28$, $p = .247$. The main effect of the covariate, presence of ID, was not significant, Wilks' $\Lambda = .985$, $F(3, 233) = 1.22$, $p = .303$.

The significant main effects of age group and autism symptom group were followed with ANCOVAs to determine in which CB factor significant differences were evident. The main effects of age group on aggressive/disruptive behaviors [$F(3, 235) = 0.78$, $p = .505$], and self-injurious behaviors [$F(3, 235) = 0.60$, $p = .681$] were not significant, but the main effect of age group on stereotypic behaviors was significant [$F(3, 235) = 6.65$, $p < .001$]. Post hoc Bonferroni tests were conducted to find where the significant differences between age groups on stereotypic behaviors lied. The results of the post hoc Bonferroni analysis are presented in Table 4.

Table 4. Bonferroni post hoc analyses for age groups.

	Age Group			
	Toddlers $n = 72$	Preschoolers $n = 52$	School-Aged Children $n = 72$	Adolescents $n = 48$
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*
Stereotypic Behaviors Score	1.26 (0.21)[b, c]	2.36 (0.24)[a]	2.07 (0.19)[a]	1.88 (0.23)

*Using an alpha value of .05, based on Bonferroni post hoc analyses, significantly different from the Toddlers Group ([a]), Preschoolers Group ([b]), School-Aged Children Group ([c]), and Adolescents Group ([d]).

The main effect of autism symptom group on aggressive/disruptive behaviors [$F(1, 235) = 1.12, p = .291$] was not significant, but the main effects of autism group on stereotypic behaviors [$F(1, 235) = 23.85, p < .001$] and self-injurious behaviors [$F(1, 235) = 11.71, p = .001$] were significant. On average, individuals in the high autism symptomatology group exhibited more stereotypic ($M = 1.81$) and self-injurious ($M = 0.52$) behaviors than individuals in the low autism symptomatology group ($M = 0.99$ and 0.25, respectively).

A curve estimation was also conducted to test the hypothesis that aggressive/disruptive behaviors and stereotypic behaviors followed a quadratic trend across age groups and self-injurious behaviors followed a linear trend across age groups with the modified scoring. Age group served as the independent variable and each of the CB factor scores as the dependent variables. The quadratic trend was significant for stereotypic behaviors [$F(2, 241) = 11.09, p < .001$], but it was not significant for aggressive behaviors [$F(2, 241) = 1.97, p = .142$]. The linear trend was not significant for self-injurious behaviors, [$F(1, 242) = 0.82, p = .365$]. Because the quadratic trend was not significant for aggressive/disruptive behaviors, curve estimations were also conducted to determine if aggressive/disruptive behaviors followed a linear or cubic trend. Aggressive/disruptive behaviors did not follow a linear [$F(1, 242) = 0.53, p = .468$] or cubic

trend [$F(3, 240) = 1.36, p = .255$]. Because the linear trend was not significant for self-injurious

behaviors, curve estimations were also conducted to determine if self-injurious behaviors

followed a quadratic or cubic trend. Self-injurious behaviors did not follow a quadratic [$F(2,$

$241) = 1.57, p = .210$] or cubic trend [$F(3, 240) = 1.05, p = .372$]. Therefore, both

aggressive/disruptive and self-injurious behaviors remained stable across age groups.

Study 1 Discussion

As had been hypothesized, autism symptomatology scores differed between groups based on age. Additionally, the majority of the predicted specific differences between age groups were supported. In accordance with the researcher's hypothesis, the Preschoolers and School-Aged Children had significantly greater autism symptomatology scores than the Toddlers, indicating a worsening of autism symptomatology in the early childhood years. As was expected, the Preschoolers and School-Aged Children did not significantly differ in their level of autism symptomatology. Furthermore, as predicted, the Adolescents had significantly lower autism symptomatology scores than the Preschoolers, and their scores did not significantly differ from the Toddlers. However, contrary to the researcher's hypothesis, the Adolescents and School-Aged Children also did not differ with respect to autism symptomatology scores, while it had been predicted that the Adolescents would have lower autism symptomatology scores than the School-Aged Children. Overall then, although a quadratic trend had emerged as was predicted, given that autism symptomatology increased from toddlerhood to preschool/school-age and then decreased during adolescence, the trend was slightly different than expected. Gradual decreases in autism symptomatology, though non-significant, had already occurred by school-age and then continued into adolescence, causing the adolescents to have significantly lower autism symptomatology scores than the Preschoolers but not the School-Aged Children. Though this was not hypothesized, it is not surprising to find that decreases in autism symptomatology during late childhood and adolescence are not instantaneous, but rather occur much more gradually.

With respect to the second set of hypotheses, predicting that overall CB scores would significantly differ between age groups, the hypothesis was not supported when scores also indicated severity. However, significant differences were noted when a summation of only

presence or absence of each CB was used as the total CB score. Yet, even then, only some of the specific differences predicted between age groups were supported. As was predicted, the Toddler and School-Aged Children groups significantly differed from one another, with the School-Aged Children group having higher CB scores than the Toddler group. Additionally, the Preschooler and School-Aged Children groups did not significantly differ from one another, nor did the Toddler and Adolescent groups differ from one another. While these predictions were supported, it had also been hypothesized that that the Preschooler group would have significantly higher CB scores than the Toddlers, which was not found. Rather, the Preschooler and Toddler groups did not significantly differ from one another. Adolescents were also expected to have significantly lower CB scores than both the Preschoolers and School-Aged Children, whereas no significant differences were actually found. Therefore, although a significant quadratic trend emerged as was hypothesized, differences in CBs were more gradual over time so that specific significant differences did not exist between all predicted groups. It was interesting to find that although autism symptomatology and CBs follow quadratic trends throughout childhood, these trends are not identical. However, both trends are similar in that symptoms increase during childhood and then follow a gradual decrease in adolescence.

Lastly, the third set of hypotheses was largely unsupported. Similar to the findings of the analyses investigating differences between age groups in total CB scores, this researcher also did not find significant differences between age groups in the three classes of CBs when using scores incorporating severity of problem behaviors within the classes. However, significant differences were found between age groups with respect to stereotypic behaviors when only the presence or absence of each CB within the stereotypic behavior class was considered. As was hypothesized, the Preschoolers and School-Aged Children exhibited significantly higher stereotypic behavior

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scores than the Toddlers, but they did not significantly differ from one another. Additionally, the Adolescents did not differ from the Toddlers. However, the Adolescents also did not significantly differ from the Preschoolers and School-Aged Children, which was not expected. Therefore, as was the case with overall CBs, although a significant quadratic trend emerged as was hypothesized, decreases in stereotypic behaviors during the adolescent, and hypothetically the adulthood, years were more gradual over time so that specific significant differences did not exist between the Adolescents and any other age group.

No significant differences were found between age groups in aggressive/disruptive behaviors or self-injurious behaviors. This lack of differences was unexpected for aggressive/disruptive behaviors because previous researchers have found an increase in aggressive/disruptive behaviors during the early childhood years (e.g., Fodstad et al., 2012) and others have noted a decrease in aggressive/disruptive behaviors in adolescence and adulthood (e.g., Chowdhury et al., 2010; Murphy et al., 2005; Shattuck et al., 2007). However, since several researchers have failed to find differences throughout the middle of childhood (e.g., Farmer & Aman, 2011; Murphy et al., 2009; Matson, Mahan, et al., 2010; McTiernan et al., 2011), it was expected that there would not be any differences between the Preschoolers and School-Aged Children.

The lack of differences between age groups with respect to self-injurious behaviors is more understandable. The only differences that had been expected were that significant decreases in self-injurious behaviors would occur in the Adolescent group (e.g., Shattuck et al., 2007; Murphy et al., 2005). However, while Shattuck and colleagues (2007) and Murphy and colleagues (2005) had found decreases in self-injurious behaviors in late adolescence and adulthood, others had not found significant differences in early adolescence (Murphy et al.,

2009; Matson, Mahan, et al., 2010; McTiernan et al., 2011). Therefore, the individuals included in the Adolescent group may have been too young to capture the significant decrease in self-injurious behaviors during adolescence, especially if the decrease in adolescence is more gradual. Furthermore, similar to the study conducted by Chowdhury and colleagues (2010), over half of the sample never engaged in self-injurious behaviors.

It was interesting to note that no significant differences emerged when the severity of CBs was included in the dependent variable, but that some differences did exist when only looking at the combined presence of CB topographies. This may indicate that, while the topography of CBs changes some over time, the overall severity of the collective grouping of CBs remains relatively stable. Because scores were based on caregiver report and determined in relative terms, this may have also influenced the current findings, both those including severity and those not including severity, so that some of the expected significant differences were not found. Rather than the CB assessment reflecting the frequency and/or specific intensity of each CB, each CB was rated with respect to how it compared to those typically seen in the community by children of the same age. Use of this type of scoring may limit the findings due to the limited variability in scoring available and caregivers perceiving the relative presence of CBs differently. Therefore, future studies may account for this possible limitation by using alternate methods of measurement of CBs. However, it should be noted that parental report of the frequency and/or specific intensity of CBs may also contain inaccuracies.

Another limitation of the current study, which could be corrected for in future studies, is the manner in which participants were selected for inclusion in the study. Although the *DSM-IV-TR/ICD-10 Checklist* was used to determine eligibility for the current study, its completion varied minimally across participants. For the majority of children, caregivers completed the

questionnaire; however, for children recruited through Early Steps, doctoral-level graduate

students completed the questionnaire by using information taken from the comprehensive Early

Steps assessment (e.g., parent interview, other measures). Although this is undoubtedly a

limitation, it is believed that the effects of differing methodology in completion of the *DSM-IV-*

TR/ICD-10 Checklist were minimal. The information used to complete the questionnaire came

directly from parent report regardless of the person completing the measure.

It should also be noted that, although the current study aimed to detect differences in CBs

across childhood, the possible treatment of CBs was not included in the analyses. Whether any

of the children had received treatment to reduce CBs at any point, and the success or failure of

said treatments, was not assessed. This factor could most certainly have affected the results, as

the likelihood of receiving treatments to target CBs increases over time due to a general increase

in knowledge regarding the availability of treatments and opportunities to receive treatments.

Despite these limitations, the current study provided a wealth of information that may be

beneficial to parents of children with ASDs and those individuals who work with children with

ASDs. The trends of autism symptomatology and CBs across childhood highlight the

importance of early intervention to treat both autism symptomatology and CBs in individuals

with ASDs. With the addition of such treatments, it may be possible to avoid the inflation in

autism symptomatology and CBs that occurs during childhood. Furthermore, knowledge of the

progression of both autism symptomatology and CBs may be beneficial to parents of individuals

with ASDs, especially since an eventual decline is expected for both sets of behaviors. This

knowledge may alleviate parental concerns during periods in which autism symptomatology and

CBs reach their peak, which would undoubtedly be advantageous for the families of individuals

with ASDs. Additionally, the stability of aggressive/disruptive and self-injurious behaviors may

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facilitate caregivers in seeking treatment to alleviate these problem behaviors, as a reduction in these behaviors is unlikely in the absence of treatment based on the present findings.

Study 2 Method

As a follow-up to Study 1, a second study was conducted to examine the ability of

changes in overall autism symptomatology and specific autism symptomatology domains to

predict changes in overall CBs and specific classes of CBs in toddlers. This was completed as a

follow-up to Study 1 because, since it was determined that autism symptomatology and some

CBs follow similar trends, it stands to reason that a change in autism symptomatology may

predict a change in CBs, regardless of what brought about the change in the first variable. In line

with this, it would also be beneficial to service providers to know which specific domains of

ASDs best predict specific classes of challenging behaviors.

Participants

The participants for Study 2 were similarly selected from a pre-existing database.

Participants selected for inclusion were toddlers ages 17 through 37 months, and their respective

parents/caregivers, who had received services through Early Steps and met criteria for an ASD

diagnosis. ASD diagnoses were assigned to toddlers by a licensed clinical psychologist with

over 30 years of experience in assessment and treatment of individuals with intellectual and

developmental disabilities. Diagnoses were based on each child's scores on the *Modified*

Checklist for Autism in Toddlers (Robins, Fein, Barton, & Green, 2001), criteria from the

Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (APA,

2000), scores from the *Battelle Developmental Inventory, Second Edition* (Newborg, 2005), and

clinical judgment. Inter-rater reliability of diagnoses was established by a second Ph.D. level

clinical psychologist, who was blind to the first psychologist's diagnoses.   A subset of 196

individuals were provided diagnoses by the second psychologist. Inter-rater reliability was

excellent with a kappa value of 0.94, $p < .001$. All participants received follow-up assessments

of their functioning related to autism symptomatology and CB presentation by Early Steps. All

follow-ups were conducted between 4 and 16 months following the initial evaluation, with the

mean follow-up period being 8.50 months after the initial assessment. Sixty eight participants

met inclusion criteria to participate in Study 2. Of these, 80.9% were male and 19.1% were

female. The breakdown in race of the participants was: 48.5% African American, 42.6%

Caucasian, 1.5% Hispanic, and 7.4% Other/Unidentified. The average age of participants at the

time of the first assessment was 22.9 months with a range of 17 to 30 months.

Measures

In order to participate in Study 2, participants were required to meet set criteria for a

diagnosis of autistic disorder or PDD-NOS according to the *DSM-IV-TR*. Diagnoses were based

on each child's scores on the *Modified Checklist for Autism in Toddlers* (Robins et al., 2001),

criteria from the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text

Revision* (APA, 2000), scores from the *Battelle Developmental Inventory, Second Edition*

(Newborg, 2005), and clinical judgment. Similar methods have been used elsewhere in the

research literature (e.g., Fombonne et al., 2004).

Modified Checklist for Autism in Toddlers (M-CHAT; Robins et al., 2001). The *M-

CHAT* is a 23-item parent-report measure used to screen children ages 16 through 30 months for

an ASD. Each item is answered "yes" or "no" to indicate whether the symptom is exhibited by

the child. Of the 23 items, six are considered critical items. If two or more of the six critical

items, or three or more of the total 23 items, are endorsed, the child is then identified as being at

risk for an ASD and requiring further evaluation. The *M-CHAT* has good internal consistency,

with .85 for the entire scale and .83 for the critical items (Robins et al., 2001). Its sensitivity and

specificity have been found to vary depending on the sample examined and the cutoff scores

used. The sensitivity of the *M-CHAT* ranges from .70 to .97 and the specificity ranges from .38

to .99 (Matson, Wilkins, Sharp, et al., 2009; Robins et al., 2001; Snow & Lecavalier, 2008).

   Battelle Developmental Inventory, Second Edition (BDI-2; Newborg, 2005). The *BDI-*

2 is a standardized test designed to assess the developmental functioning of children from birth

through 7 years, 11 months of age. It is an informant- and observation-based tool consisting of

450 items addressing five domains: adaptive, personal-social, communication, motor, and

cognitive. Caregivers score each item as 0 (no ability in this skill), 1 (emerging ability in this

skill), or 2 (ability in this skill). The total score is then used to determine the child's overall

developmental quotient, similar to an IQ score, with a mean of 100 and a standard deviation of

15. The *BDI-2* has acceptable test-retest reliability and excellent internal consistency (Newborg,

2005). Furthermore, content and criterion validity have been established through expert review

and correlational comparisons.

   The *BISCUIT-Part 1* and *BISCUIT-Part 3* in their entirety were also used for Study 2.

Please see the Measures section for Study 1 for further information regarding both of these

assessment instruments.

Procedure

   All participants received a comprehensive assessment battery typically offered by the

Early Steps program, with the addition of the *BISCUIT*. Assessments were conducted in the

child's home or day care setting with the parent/caregiver and child both present. Assessors

were mental health professionals ($N = 175$) possessing bachelor to doctoral level degrees, and

they were trained on the administration of the *BISCUIT* battery and symptoms of ASD in

general. The assessors were certified or licensed in their respective disciplines (e.g., psychology,

early childhood development, social work, special education, and speech/language pathology).

Interviews were conducted with the same parent/caregiver across two assessments, which were at least three months apart but no more than one year apart. This study was approved by the Louisiana State University and Louisiana's Office for Citizens with Developmental Disabilities IRBs. Informed consent was obtained from parents/caregivers of all toddler participants.

Statistical Analyses

Prior to conducting statistical analyses, missing datum points for the *BISCUIT-Part 1* and *BISCUIT-Part 3* were replaced with the sample's mean value for that item. Next, total difference scores for the *BISCUIT-Part 1* and *BISCUIT-Part 3* were calculated by first summing the *BISCUIT-Part 1* and *BISCUIT-Part 3* scores for each individual's two assessments, and then subtracting the second administration's total score from the first administration's total score for each measure. Therefore, one *BISCUIT-Part 1* difference score and one *BISCUIT-Part 3* difference score existed for each participant. Identical methodology was adopted to calculate difference scores for each of the three factors of the *BISCUIT-Part 1* (i.e., socialization/nonverbal communication, repetitive behavior/restricted interests, and communication) and the *BISCUIT-Part 3* (i.e., aggressive/disruptive behavior, stereotypic behavior, and self-injurious behavior). Because this resulted in some individuals having negative values for their difference scores, a constant value was added to all difference scores in order to ensure that all values were positive.

Next, a series of correlations and regression analyses were conducted. First, a one-tailed bivariate correlation was conducted with differences in *BISCUIT-Part 1* and *BISCUIT-Part 3* total scores as the independent variables. A simple linear regression was also conducted with difference in *BISCUIT-Part 1* total scores as the predictor variable and difference in *BISCUIT-Part 3* total scores as the outcome variable.

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Second, a set of three one-tailed bivariate correlations was conducted with the difference in *BISCUIT-Part 1* total scores as one independent variable and the differences in each of the three *BISCUIT-Part* 3 CBs factors (i.e., aggressive/disruptive behavior, stereotypic behavior, and self-injurious behavior) as the other independent variable. Additionally, a set of three simple linear regressions was conducted with difference in *BISCUIT-Part 1* total scores as the predictor variable and each of the three *BISCUPT-Part 3* CB factors as the outcome variables.

Third, another set of three one-tailed bivariate correlations was conducted with the difference in each of the *BISCUIT-Part 1* factor scores (i.e., socialization/nonverbal communication, repetitive behavior/restricted interests, and communication) as one independent variable and the difference in *BISCUIT-Part 3* total scores as the other independent variable. Additionally, a multiple linear regression was computed with each of the *BISCUIT-Part 1* factor difference scores as predictor variables and the total *BISCUIT-Part 3* difference score as the outcome variable.

Lastly, three sets of one-tailed bivariate correlations were conducted with differences in each factor of the *BISCUIT-Part 1* and *BISCUIT-Part 3* as independent variables. In addition, a set of three multiple linear regressions was computed with each of the *BISCUIT-Part 1* factor difference scores as the predictor variables and each of the *BISCUIT-Part 3* CB factors as the outcome variables.

Study 2 Results

Changes in autism symptomatology, as reflected in changes in *BISCUIT-Part 1* total scores, were significantly correlated with changes in CBs, as reflected in changes in *BISCUIT-Part 3* total scores, in individuals with ASD, $r(66) = .47, p < .001$. Furthermore, changes in autism symptomatology significantly predicted changes in CBs, $\beta = .47, t(66) = 4.36, p < .001$, and explained a significant proportion of variance in changes in CBs, $R^2 = .22, F(1, 66) = 19.04, p < .001$.

Changes in autism symptomatology scores were also significantly correlated with changes in scores of each of the classes of CBs: aggressive/disruptive behavior $[r(68) = .33, p = .003]$, stereotypic behavior $[r(68) = .50, p < .001]$, and self-injurious behavior $[r(68) = .44, p = < .001]$. Furthermore, changes in autism symptomatology scores significantly predicted changes in aggressive/disruptive behavior scores $[\beta = .33, t(66) = 2.86, p = .006]$, stereotypic behavior scores $[\beta = .50, t(66) = 4.64, p < .001]$, and self-injurious behavior scores $[\beta = .44, t(66) = 3.98, p < .001]$. Additionally, changes in *BISCUIT-Part 1* scores explained a significant proportion of variance in changes in aggressive/disruptive behavior scores $[R^2 = .11, F(1, 66) = 8.18, p = .006]$, stereotypic behavior scores $[R^2 = .25, F(1, 66) = 21.53, p < .001]$, and self-injurious behavior scores $[R^2 = .19, F(1, 66) = 15.81, p < .001]$.

Changes in overall CB scores were significantly correlated with changes in socialization/nonverbal communication scores $[r(66) = .37, p = .001]$, repetitive behavior/restricted interests scores $[r(66) = .44, p < .001]$, and communication scores $[r(66) = .28, p = .012]$. Furthermore, the overall model of changes in socialization/nonverbal communication scores, repetitive behavior/restricted interests scores, and communication scores significantly predicted changes in and explained a significant proportion of variance in changes

in overall CB scores, $R^2 = .22$, $F(3, 64) = 6.00$, $p = .001$. However, only changes in repetitive behavior/restricted interests scores were significantly predictive of changes in overall CB scores, $\beta = .31$, $t(66) = 2.05$, $p = .045$. Changes in socialization/nonverbal communication scores, $\beta = .13$, $t(66) = 0.88$, $p = .385$, and communication scores, $\beta = .13$, $t(66) = 1.12$, $p = .265$, were not significantly predictive of changes in overall CBs.

Next, correlations of differences in each of the *BISCUIT-Part 1* factors (i.e., socialization/nonverbal communication, restricted interests/repetitive behaviors, and communication) and each of the *BISCUIT-Part 3* factors (i.e., aggressive/disruptive behaviors, stereotypic behaviors, and self-injurious behaviors) were examined. Please refer to Table 5 for the results of these correlations.

Table 5. Correlations of changes in *BISCUIT-Part 1* factor scores and changes in *BISCUIT-Part 3* factor scores

	CB Factor		
	Aggressive/Disruptive Behaviors	Stereotypic Behaviors	Self-Injurious Behaviors
Socialization/Nonverbal Communication	.278*	.322*	.364*
Restricted Interests/Repetitive Behaviors	.253	.605*	.434*
Communication	.210	.239	.254

An asterisk (*) indicates that the one-tailed correlation was significant at the 0.05 level after controlling for conducting multiple correlations simultaneously.

The overall model of changes in socialization/nonverbal communication scores, repetitive behavior/restricted interests scores, and communication scores did not significantly predict or explain a significant proportion of variance in changes in aggressive/disruptive behaviors, $R^2 = .10$, $F(3, 64) = 2.37$, $p = .079$.

The overall model of changes in socialization/nonverbal communication scores, repetitive behavior/restricted interests scores, and communication scores significantly predicted and

explained a significant proportion of variance in changes in stereotypic behaviors, $R^2 = .38$, $F(3, 64) = 12.98$, $p < .001$. However, change in the repetitive behavior/restricted interests score was the only variable within that model that significantly predicted the changes in stereotypic behaviors. The standardized regression equations are reported in Table 6.

Table 6. Standardized regression equations for predicting changes in stereotypic behaviors from changes in *BISCUIT-Part 1* factor scores

	β	t	p
Socialization/Nonverbal Communication	-.142	-1.079	.285
Restricted Interests/Repetitive Behaviors	.683	5.086	.000
Communication	.046	0.440	.662

The overall model of changes in socialization/nonverbal communication scores, repetitive behavior/restricted interests scores, and communication scores significantly predicted changes in self-injurious behaviors, $R^2 = .21$, $F(3, 64) = 5.67$, $p = .002$. However, change in the repetitive behavior/restricted interests score was the only variable within that model that significantly predicted the changes in self-injurious behaviors. The standardized regression equations are reported in Table 7.

Table 7. Standardized regression equations for predicting changes in self-injurious behaviors from changes in *BISCUIT-Part 1* factor scores

	β	t	p
Socialization/Nonverbal Communication	.124	0.834	.408
Restricted Interests/Repetitive Behaviors	.315	2.078	.042
Communication	.111	0.934	.354

Study 2 Discussion

The first hypothesis, that changes in autism symptomatology scores would significantly predict changes in total CB scores, was supported. Changes in autism symptomatology were significantly correlated with and significantly predicted changes in CBs. Increases in autism symptomatology predicted increases in CBs and vice versa. Although numerous researchers have previously noted a positive correlation between autism symptomatology and CBs (e.g., Jang et al., 2011; Kozlowski & Matson, 2012; Matson, Wilkins, & Macken, 2009), researchers have seldom explored the possibility of changes in autism symptomatology predicting increases and/or decreases in CBs. Knowledge of the ability of changes in autism symptomatology to predict changes in CB presentation is critical, especially in regard to guiding assessment and treatment for both symptoms associated with ASDs and CBs themselves. It is widely known that the vast majority of individuals with ASDs present with at least one, if not multiple, topographies of CB (Baghdadli et al., 2003; Holden & Gitlesen, 2006; McTiernan et al., 2011). Therefore, in many cases in which treatment is sought for individuals with ASDs, treatment is needed to target both the deficits associated with ASDs as well as the behavioral excesses manifesting as CBs. The finding that changes in autism symptomatology, such as an amelioration of symptoms due to effective intervention, predicts changes in CBs, such as decreases in CBs secondary to interventions targeting impairments associated with ASDs, suggests that the effective treatment of these target problems can be accomplished simultaneously.

The second hypothesis, that changes in autism symptomatology scores would significantly predict changes in each of the three classes of CBs (i.e., aggressive/disruptive behaviors, stereotypic behaviors, and self-injurious behaviors), was also fully supported. Similar to the research behind the formulation of the first hypothesis, researchers have previously

provided evidence of a relationship between autism symptomatology and each class of CBs (e.g., Fodstad, 2011; Kozlowski & Matson, 2012; Matson, Wilkins, & Macken, 2009). Evidence that changes in autism symptomatology not only predict changes in overall CBs, but also each major class of CBs, is enlightening. This finding further extends the findings by providing evidence of the widespread secondary gains of the treatment of autism symptomatology. Although some CBs exhibited by children with ASDs, such as stereotypic behaviors, are more commonly associated with a diagnosis of an ASD as opposed to another diagnosis, the treatment of autism symptomatology may impact the presence of seemingly unrelated CBs (e.g., aggressive/disruptive behaviors). Many such strategies are commonly employed today, such as teaching functional communication and appropriate leisure skills, to replace CBs (Kurtz et al., 2011; Lang et al., 2010).

The third set of hypotheses, that differences in the communication, socialization/nonverbal communication, and repetitive behavior/restricted interests factor scores would each significantly predict differences in overall CBs, was only partially supported. Although changes in communication, socialization/nonverbal communication, and repetitive behavior/restricted interests factor scores were each significantly positively correlated with changes in overall challenges behaviors, only changes in repetitive behavior/restricted interests scores were significantly predictive of changes in overall CBs. This finding is quite interesting, especially because teaching functional communication is one of the most highly utilized treatments to replace CBs (Durand & Merges, 2001). However, given the heterogeneity of symptoms of autism symptomatology in those with ASDs and the variability in the type and severity of CBs, the lack of the ability of changes in communication and socialization/nonverbal communication to predict changes in CBs is understandable. Despite this lack of a specific

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predictive relationship, due to the significant correlational relationships found, we know that changes in communication and socialization/nonverbal communication do coincide with changes in CBs. Therefore, treatment for autism symptomatology and CBs may also affect changes in the opposite problem area. The reason for changes in repetitive behavior/restricted interests being both positively correlated with and significantly predictive of changes in overall challenges behaviors is potentially at least in part due to the two possessing some overlapping behaviors.

Lastly, only a few of the hypotheses related to the ability of changes in specific autism feature domains to predict changes in specific classes of CBs were supported. As predicted, changes in repetitive behavior/restricted interests were significantly correlated with and significantly predicted changes in stereotypic behaviors and self-injurious behaviors. Because repetitive behavior/restricted interests and stereotypic behaviors share many similar behaviors, their relationship is reasonable. The same relationship existing between repetitive behavior/restricted interests and self-injurious behavior is possibly attributable to some self-injurious behaviors also presenting as stereotypic behaviors and the two behaviors being related to one another (Muehlmann & Lewis, 2012). Therefore, a decrease in repetitive behavior/restricted interests may result in a subsequent decrease in stereotypic self-injurious behaviors. In line with this finding, Richman and colleagues (2013) recently found that severity of stereotypy significantly predicted self-injurious behaviors. As such, it stands to reason that targeting repetitive behavior/restricted interests for treatment may also result in improvements in self-injurious behaviors, at least to the extent that those behaviors are repetitive.

Changes in repetitive behavior/restricted interests were not significantly correlated with and did not significantly predict aggressive/disruptive behaviors, despite it having been hypothesized based on research by Oliver and colleagues (2012) that this relationship would

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exist. Although this result had not been hypothesized, it was not completely unexpected. The relationship between repetitive behavior/restricted interests and aggressive/disruptive behaviors has seldom been explored, and the relationship between the two areas may vary considerably on a case by case basis. For example, some individuals with ASDs may strictly adhere to non-functional routines and insist upon things being a certain way or that they be able to engage in repetitive behaviors to the point of becoming aggressive or disruptive if they are prevented or interrupted from doing so (Peters-Scheffer, Didden, Sigafoos, Green, & Korzilius, 2013). Then, a decrease in repetitive behavior/restricted interests would understandably also result in a decrease in aggressive/disruptive behavior because the antecedent event has decreased. Therefore, the possibility of such a relationship should be further explored while examining the function of the aggressive/disruptive behaviors.

Changes in communication scores were not significantly correlated with, nor did they significantly predict, changes in any class of CBs. Although it had not been expected that changes in communication scores would predict changes in stereotypic behaviors (e.g., Matson & Rivet, 2008), it was hypothesized that changes in communication scores would predict changes in both aggressive/disruptive and self-injurious behaviors (e.g., Baghdadli et al., 2003; Hartley et al., 2008; Matson, Neal, et al., 2010; Matson & Rivet, 2008). Due to the heterogeneity of symptoms of autism symptomatology in those with ASDs and the variability in the type and severity of CBs, the lack of the ability of changes in communication to predict changes in aggressive/disruptive and self-injurious behaviors is understandable, but the complete lack of a relationship between changes in communication and changes in these CB classes is astounding. This is especially true due to the strong support for a correlation between communication and these CB classes by previous researchers as well as the support for functional communication

training to increase communication and decrease these types of CBs most specifically. The most notable difference between the current study and others having found a relationship between communication and aggressive/disruptive and self-injurious behaviors is the young ages of those included in the current study. The children included in the current study were still in the age range where speech and other modes of communication are still just developing; therefore, this may have complicated the relationship between communication and aggressive/disruptive and self-injurious behaviors. Interestingly, during this time period, changes in communication are not predictive of changes in these types of CBs; however, this finding may have been the result of the limited scoring range of communication. It is possible that clinically significant changes in communication could have occurred to which the measure was not sensitive. Therefore, it is recommended that this study is replicated with a more detailed communication measure. Also, the lack of a relationship found between communication changes and challenging behavior changes in early childhood does not say that this lack of a relationship continues as children age. Whether this lack of a relationship continues or not as children age needs to be investigated. Because functional communication training has been used so successfully with children with ASDs, it is hypothesized that either the communication measure was not sensitive to communication changes or that the relationship between communication and challenging behaviors had not yet emerged. If so, it would also be important to find out at what time communication begins to have a relationship with aggressive/disruptive and self-injurious behaviors.

Changes in socialization/nonverbal communication scores were significantly correlated with all three classes of CBs; however, changes in socialization/nonverbal communication scores did not significantly predict changes in any class of CBs. Based on prior research, it was

anticipated that changes in socialization/nonverbal communication would significantly predict changes in aggressive/disruptive and self-injurious behaviors (Baghdadli et al., 2003; Hartley et al., 2008; Matson, Neal, et al., 2010; Matson & Rivet, 2008). Once again, a notable difference between the current study and others investigating the relationship between socialization/nonverbal communication and CBs is the young age of those included in the current study. All of the children in the current study were under the age of 3 years, which means that many of the children may have not had ample opportunities to socialize with other children. Social skills, in conjunction with communication skills, are still just developing during this time period.

The current study, of course, is not without its limitations. As was already mentioned, the children included in the current study were toddlers, which may have impacted some of the results found. Granted, this is not a limitation in and of itself, but it is imperative that similar studies are conducted with children and adults of different ages to determine whether these results are limited to toddlerhood. Another limitation is that participants were only assessed for a diagnosis of an ASD at the time of the first assessment. Because researchers have found variability in autism symptomatology during the toddler years (Matson, Worley, et al., 2011; Moore & Goodson, 2003; van Daalen et al., 2009), it is possible that some of the children included in Study 2 may no longer have qualified for a diagnosis of an ASD by the conclusion of the study. In future studies, this can be addressed by re-assessing the participants for a diagnosis of an ASD at the second time of assessment. Although this may be most beneficial for studies including children of young ages, it may also be helpful to identify changes in diagnoses in older individuals as well.

General Discussion

Challenging behaviors are remarkably prevalent within the ASD population (Baghdadli et al., 2003; Holden & Gitlesen, 2006; Jang et al., 2011; McTiernan et al., 2011) and often result in referrals for treatment. Although a great deal is known about factors associated with challenging behaviors in the ASD population, much of this information simply indicates which individuals may be more or less likely to engage in specific challenging behaviors (e.g., ID) without information related to treatment. Therefore, additional information is needed to further enhance the services provided to individuals engaging in challenging behaviors based on factors associated with challenging behaviors. The purposes of the two studies contained within were to investigate the effect of age in conjunction with autism symptomatology on CBs in children with ASDs, and also to further examine the effect of autism symptomatology on CBs in young children with ASDs by examining the ability of changes in autism symptomatology to predict changes in CBs over time.

Collectively, the results of the studies herein contribute to the importance of early intervention to treat not only autism symptomatology, but also to treat challenging behaviors evinced by those children with ASDs. Both autism symptomatology and challenging behaviors follow quadratic trends across childhood; symptoms of both increase during childhood before gradually decreasing in adolescence. Treating autism symptomatology and challenging behaviors early in childhood may prevent increases in these symptom areas. Furthermore, in line with the importance of early intervention for autism symptomatology and challenging behaviors, changes in autism symptomatology in young children with ASDs correlate with and predict changes in overall challenging behaviors. Although these correlations and predictions may not

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occur for each subset of autism symptomatology or type of challenging behaviors, they do exist when symptoms of both are assessed broadly.

While these studies have highlighted the importance of early intervention with respect to the treatment of autism symptomatology and challenging behaviors, additional studies are needed. Future studies should take treatment into consideration when determining the trend of autism symptomatology and challenging behaviors across childhood. They should focus on whether age differences with respect to autism symptomatology and challenging behaviors differ when treatment is provided to target such symptoms. Additionally, with respect to the impact of changes in autism symptomatology domains on changes in challenging behaviors, more research is needed using more fine-tuned measures of communication and socialization abilities to determine if changes in these areas impact changes in challenging behaviors, and also to determine specific communication and socialization domains with the most impact on challenging behaviors. This type of information would prove beneficial to service providers and caregivers when determining the services to be delivered and problem areas to be targeted in individuals with ASDs who also engage in challenging behaviors.

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Appendices

Appendix A: Challenging Behavior Items

Aggressive/Disruptive Behaviors

Kicking objects (e.g., doors, walls)

Removal of clothing at inappropriate times

Playing with own saliva

Throwing objects at others

Banging on objects (e.g., doors, walls, windows) with hand

Leaving the supervision of caregiver without permission (i.e., elopement)

Aggression towards others

Pulling others' hair

Yelling or shouting at others

Property destruction (e.g., ripping, breaking, tearing, crushing, etc.)

Stereotypic Behaviors

Unusual play with objects (e.g., twirling string, staring at a toy, etc.)

Repeated and unusual vocalizations (e.g., yelling, humming, etc.)

Repeated and unusual body movements (e.g., handflapping, waving arms, etc.)

Self-Injurious Behaviors

Poking him/herself in the eye

Harming self by hitting, pinching, scratching, etc.

Appendix B: IRBs and Exemptions

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

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This application must accompany all research proposals submitted for review by the DHH IRB. All items must be either completed or indicated as not applicable.

1. Title of Research Proposal: An Early Autism Screening Initiative within a State Early Intervention Program: Description of Results and Comparison of Two Screening Instruments

2. Principal Investigator: Cheryl L. Knight, Ph.D
    Address: Office for Citizens with Developmental Disabilities
                                     628 North 4th St
                                     PO Box 3117 – Bin#21
                                     Baton Rouge, LA 70821
    Phone: (225)342-3106
    Affiliations: Office for Citizens with Developmental Disabilities
    Education/Qualifications (attach vita): Ph.D., Clinical Psychologist; CV attached.

3. Co-Investigator: Johnny L. Matson, Ph.D.
    Address: 324 Audubon Hall
                                     Department of Psychology
                                     Louisiana State University
                                     Baton Rouge, LA 70803
    Phone: (225)578-4104
    Affiliations and Education/Qualifications (attach vita if applicable): Ph.D.; Professor; Psychologist; CV attached.

    Co-Investigator: Brenda Barron Sharp, M.A.
    Address: Office for Citizens with Developmental Disabilities
                                     628 North 4th St.
                                     PO Box 3117 – Bin#21
                                     Baton Rouge, LA 70821
    Phone: (225)342-8853
    Affiliations and Education/Qualifications (attach vita if applicable): M.A.; CCC-SLP; CV attached

    Co-Investigator: Brandi Smiroldo, Ph.D.
    Address: Office for Citizens with Developmental Disabilities
                                     628 North 4th St.
                                     PO Box 3117 – Bin#21
                                     Baton Rouge, LA 70821
    Phone: (225)342-0095
    Affiliations and Education/Qualifications (attach vita if applicable): Ph.D., Clinical Psychologist; CV attached

4. University Faculty Sponsor (complete if researcher is a student): Not Applicable
5. Approximate dates research is to be conducted: (ex. xx/xx/xxx)

    *Begin date: 07/28/2008
    End date: 06/30/2012

    •   NOTE: This is a request to extend an IRB with the original Begin Date of 7/28/2008 and End Date of 06/30/2010. The current request is to extend the project until 06/30/2012, and includes some changes in Investigators, an instruments, and data management procedures.

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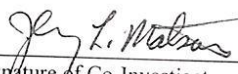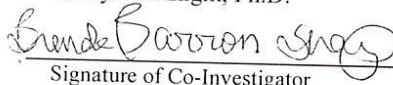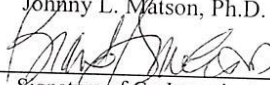
   Total amount of program support from administrative assistant personnel is estimated as requiring only occasional time with printing-copying, training material assembly, some assistance with monitoring and tracking; and data de-identification and monitoring, which will not exceed current resources.

   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.

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.

_____   05.26.10
Signature of Principal Investigator   Date
Cheryl L. Knight, Ph.D.

_____   May 12, 2010
Signature of Co-Investigator   Date
Johnny L. Matson, Ph.D.

_____   5/26/10
Signature of Co-Investigator   Date
Brenda Barron Sharp, M.A.

_____   5/26/10
Signature of Co-Investigator   Date
Brandi Smiroldo, Ph.D.

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Application for Exemption from Institutional Oversight

LSU

Institutional Review Board
Dr. Robert Mathews, Chair
131 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
F: 225.578.5983
irb@lsu.edu
lsu.edu/irb

Unless qualified as meeting the specific criteria for exemption from Institutional Review Board (IRB) oversight, ALL LSU research/ projects using living humans as subjects, or samples, or data obtained from humans, directly or indirectly, with or without their consent, must be approved or exempted in advance by the LSU IRB. This Form helps the PI determine if a project may be exempted, and is used to request an exemption.

- Applicant, Please fill out the application in its entirety and include the completed application as well as parts A-F, listed below, when submitting to the IRB. Once the application is completed, please submit two copies of the completed application to the IRB Office or to a member of the Human Subjects Screening Committee. Members of this committee can be found at http://research.lsu.edu/CompliancePoliciesProcedures/InstitutionalReviewBoard%28IRB%29/item24737.html

- A Complete Application Includes All of the Following:
  (A) Two copies of this completed form and two copies of parts B thru F.
  (B) A brief project description (adequate to evaluate risks to subjects and to explain your responses to Parts 1&2)
  (C) Copies of all instruments to be used.
      *If this proposal is part of a grant proposal, include a copy of the proposal and all recruitment material.
  (D) The consent form that you will use in the study (see part 3 for more information.)
  (E) Certificate of Completion of Human Subjects Protection Training for all personnel involved in the project, including students who are involved with testing or handling data, unless already on file with the IRB. Training link: (http://phrp.nihtraining.com/users/login.php)
  (F) IRB Security of Data Agreement: (http://research.lsu.edu/files/item26774.pdf)

1) Principal Investigator: Dr. Johnny L. Matson   **Rank:** Clinical Director

Dept: Clinical Psychology   **Ph:** (225) 578-8745   **E-mail:** johnmatson@aol.com

2) Co Investigator(s): please include department, rank, phone and e-mail for each
   *If student, please identify and name supervising professor in this space

IRB# E 8292 LSU Proposal #

☑ Complete Application

☑ Human Subjects Training

3) Project Title: Autism in Early Childhood

Study Exempted 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
Exemption Expires: 4/30/2016

4) Proposal? (yes or no) no   **If Yes, LSU Proposal Number** [   ]

Also, if YES, either   ○ This application **completely** matches the scope of work in the grant

OR   ○ More IRB Applications will be filed later

5) Subject pool (e.g. Psychology students) | Young children assessed for developmental delay via EarlySteps
   *Circle any **"vulnerable populations" to be used:** (children <18; the mentally impaired, pregnant women, the ages, other). Projects with incarcerated persons cannot be exempted.

6) PI Signature [signature]   **Date** 4-19-13   (no per signatures)

** I certify my responses are accurate and complete. If the project scope or design is later changes, I will resubmit for review. I will obtain written approval from the Authorized Representative of all non-LSU institutions in which the study is conducted. I also understand that it is my responsibility to maintain copies of all consent forms at LSU for three years after completion of the study. If I leave LSU before that time the consent forms should be preserved in the Departmental Office.

Screening Committee Action: Exempted ✓ Not Exempted ___ Category/Paragraph 4

Signed Consent Waived?: Yes / No

Reviewer Mathews   **Signature** [signature]   **Date** 5/11/13

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Project Report and Continuation Application

(Complete and return to IRB, 131 David Boyd Hall, Direct questions go to IRB Chairman Robert Mathews 578-8692.)

LSU

Institutional Review Board
Dr. Robert Mathews, Chair
131 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
F: 225.578.5983
irb@lsu.edu
lsu.edu/irb

IRB#: 2609   **Current Approval Expires On:** 09/14/2012

Review Type: Expedited   **Risk Factor:** small

PI: Johnny Matson   **Dept:** Psychology   **Phone:** 225-578-8745

Student/Co-Investigator:

Project Title: Developing the Autism Spectrum Disorder

Number of Subjects Authorized: 2000

Please read the entire application. Missing information will delay approval!
IRB Security of Data Agreement: http://research.lsu.edu/files/item26774.pdf

I. PROJECT FUNDED BY: N/A   **LSU Proposal #:**

II. PROJECT STATUS: Check the appropriate blank(s) and complete the following:

- ● 1. **Active, subject enrollment continuing;** # subjects enrolled: 676
- ○ 2. **Active, subject enrollment complete;** # subjects enrolled:
- ○ 3. **Active, subject enrollment complete;** work with subjects continues.
- ○ 4. **Active, work with subjects complete;** data analysis in progress.
- ○ 5. **Project start postponed;** date:
- ○ 7. **Project cancelled:** no human subjects used.
- ○ 6. **Project complete;** end date:

III. PROTOCOL: (Check one).

- ● Protocol continues as previously approved
- ○ Changes are requested*
    - *--List (on separate sheet) any changes to approved protocol.*

IV. UNEXPECTED PROBLEMS: (did anything occur that increased risks to participants):
- --State number of events since study inception: 0   since last report: 0
- --If such events occured, describe them and how they affect risks in your study, in an attached report
- --Have there been any **previously unreported** events? Yes/No: n

V. CONSENT FORM AND RISK/BENEFIT RATIO:
Do new knowledge or adverse events change the risk/benefit ratio? Yes/No: n
Is a corresponding change in the consent form needed? Yes/No: n

VI. ATTACH A BRIEF, FACTUAL SUMMARY of project progress/results to show continued participation of subjects is justified; or to provide a final report on project findings.

VII. ATTACH CURRENT CONSENT FORM (only if subject enrollment is continuing); and check the appropriate blank;
- ● 1. Form is unchanged since last approved
- ○ 2. Approval of revision requested herewith: (identify changes)

Signature of Principle Investigator: _P. Matson_   **Date:** Sept. 4, 2012

IRB Action:	✓ Continuation approved;	Approval Expires: 9,9,13
	___ Disapproved	
	___ File Closed	
Signed _____		Date 9/10/12

Print Form

Vita

Alison Marie Kozlowski received her bachelor's degree at Boston University in 2006. Thereafter, she worked at the May Institute in Randolph, Massachusetts, where she developed a passion for working with children with intellectual and developmental disabilities. As her interest grew, she made the decision to enroll in graduate school at Louisiana State University to pursue a career in clinical psychology. She received her master's degree in August 2010 and will be completing her doctoral degree in December 2013.