CHALLENGING BEHAVIOR IN INTELLECTUAL AND DEVELOPMENTAL DISABILITIES

by

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A Dissertation
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LIST OF ABBREVIATIONS AND SYMBOLS

Aberrant Behavior Checklist ..... ABC
Alpha ..... α
Analysis of Variance ..... ANOVA
Applied Behavior Analysis ..... ABA
Autism Diagnostic Interview Revised ..... ADI-R
Autism Spectrum Disorder ..... ASD
Baby and Infant Screen for Children with aUtIsm Traits ..... BISCUIT
Bayley Scales of Infant Development-3 ..... Bayley-3
Battelle Developmental Inventory ..... BDI
Behavior Problems Inventory ..... BPI
Beta ..... β
Centro Ann Sullivan del Peru ..... CASP
Challenging Behavior ..... CB
Chi square ..... χ^2
Children's Scale of Hostility and Aggression: Reactive/Proactive ..... C-SHARE
Coefficient of determination ..... R^2
Comparative Fit Index ..... CFI
Correlation coefficient ..... r
Degrees of freedom ..... df
Developmental Disabilities ..... DD
Developmental Quotient ..... DQ
Diagnosis ..... DX
Diagnostic and Statistical Manual of Mental Disorders ..... DSM
Differential Reinforcement of Other Behavior ..... DRO
Down's Syndrome ..... DS
Food and Drug Administration ..... FDA
Functional Assessment for Multiple Causality ..... FACT
Generalized Least-Squares ..... GLS
Intellectual and Developmental Disabilities ..... IDD
Intellectual Disability ..... ID
Intelligence Quotient ..... IQ
Magnetic Resonance Imaging ..... MRI
Maximum Likelihood ..... ML
Mean ..... m

Modified Checklist for Autism in Toddlers....M-CHAT
Motivation Assessment Scale ....MAS
Normed Fit Index....NFI
Obsessive Compulsive Disorder....OCD
Parental Concerns Questionnaire....PCQ
Pervasive Developmental Disorder-Not Otherwise Specified....PDD-NOS
Probability....p
Questions about Behavioral Function....QABF
Repetitive Behavior Questionnaire 2....RBQ-2
Repetitive Behavior Scale-Revised....RBS-R
Root Mean-Square Error of Approximation....RMSEA
Sample size ....n
Selective Serotonin Reuptake Inhibitors....SSRI
Self-Injurious Behavior....SIB
Standard deviation ....SD
Structural Equation Modeling....SEM

ABSTRACT

CHALLENGING BEHAVIOR IN INTELLECTUAL AND DEVELOPMENTAL DISABILITIES

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George Mason University, 2013

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This multi-manuscript dissertation describes several aspects relevant to challenging behaviors in individuals with intellectual and developmental disabilities (IDD). In all of the studies, three challenging behaviors are investigated: self-injurious behavior (SIB), stereotyped behavior, and aggressive behavior. The manuscripts differ on several dimensions, such as the age of participants (from infants and toddlers to adults), assessment instruments, outcome measures, and level of analysis (from individual behaviors to group differences to relationships among behaviors over time). Study 1 investigates how challenging behaviors serve different functions for adults with various levels of intellectual disability (ID). Study 2 investigates how developmental skills can be risk factors for problem behaviors in infants and toddlers at risk for IDD. Study 3 investigates the relationship between the severity and frequency of problem behaviors over time for infants and toddlers at risk for IDD.

STUDY 1: FUNCTIONAL PROPERTIES OF BEHAVIOR PROBLEMS DEPENDING ONLEVEL OF INTELLECTUAL DISABILITY

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Abstract

Behavior Problems are common among individuals with intellectual disabilities especially in those with more severe forms. The determination of the functional profile of a targeted behavior has important implications for the design of customized behavioral interventions. We investigated the relationship between the level of intellectual disability and the functional profile of aggression, stereotypy, and self-injurious behavior (SIB) using the Questions about Behavioral Function (QABF). Two staff members at two time points completed the QABF for each of 115 adults with varying levels of intellectual disability participating in a day training and habilitation program. Our results suggest that there is a differential relationship between the functions of behavior problems and level of intellectual disability. While SIB is more often seen by raters to be maintained by escape of social demands and by attaining access to tangible items with the decline of the intellectual level, aggressive and stereotypic behaviors were identified more often as serving multiple functions equally across functioning level.

Keywords: intellectual disabilities, behavior problems, challenging behavior, aggressive behavior, stereotypic behavior, self-injurious behavior

Introduction

Intellectual disability (ID) is a severe and chronic condition that must manifest before the age of 18 years and that is defined by significant limitations in intellectual functioning and adaptive behavior (American Psychiatric Association, 2000). Individuals with ID have core deficits in cognitive or social-emotional self-regulation (Borkowski, Carothers, Howard, Schatz, & Farris, 2007) leading to distinct profiles of abilities and patterns of behavior problems (Brassard & Boehm, 2007). Behavior problems are generally defined as actions that significantly interfere with learning, skill performance, and social interaction, and also potentially cause physical harm to the self or others (Emerson, 2005; Emerson et al., 2001; Mudford et al., 2008). Common displays of behavior problems include aggressive behavior, self-injurious behavior (SIB), and stereotypic behavior.

SIB can be defined as self-directed behavior that causes or has the potential to cause physical damage, occurs repeatedly, or is relatively idiosyncratic, and requires intervention (Rojahn, Schroeder, & Hoch, 2008). It ranges in severity, frequency, and topography, and positively correlates with severity of intellectual disability and with sensory and communication deficits (Rojahn et al., 2008). Some of the more common topographies include head banging, self-biting, self-scratching, and self-hair pulling (Bodfish, Powell, Golden, & Lewis, 1995; Emberson & Walker, 1990; Emerson et al., 2001; Rojahn et al., 2008). Prevalence rates of SIB vary widely in the literature, with estimates reported as anywhere from 1.7% (Rojahn, 1986) to 82% (Poppes, van der Putten, & Vlaskamp, 2010).

Stereotyped behaviors are restricted and repetitive patterns of behavior, interests, and activities (American Psychiatric Association, 2000) common among individuals with ID (Rapp & Lanovaz, 2011). They are idiosyncratic repetitive behaviors that look unusual, strange, or inappropriate to the average person. Although they can interfere with everyday functioning, disturbing the individual's quality of life (Jones, Wint, & Ellis, 1990), they are not physically damaging (Rojahn, Matson, Lott, Esbensen, & Smalls, 2001).

Aggressive or destructive behaviors are offensive actions or deliberate overt attacks directed towards other individuals or objects. They occur repeatedly in the same way over and over again, and they are characteristic for that person (Rojahn et al, 2001). Aggressive behavior is more common in children with ID than in typically developing peers (Cooper, Smiley, Morrison, Williamson, & Allan, 2007; Farmer & Aman, 2011; Rojahn, Zaja, Turygin, Moore, & van Ingen, 2012; Singh et al., 2007).

Prevalence of Behavior Problems

Although these behavior problems are not only exhibited by individuals with ID, they are extremely common within this population (Matson, Wilkins, & Macken, 2009; Poppes, van der Putten, & Vlaskamp, 2010). Data on prevalence rates typically come from caretaker reports on questionnaires (with various operational definitions) of individuals without verbal abilities and self-reporting in retroactive studies from those with verbal abilities. Therefore, the wide variability in prevalence reports is due to differences in sampling and criteria for behavior problems (Roeleveld, Zielhuis, & Gabreels, 1997).

Correlates of Behavior Problems

Most studies report that behavior problems are associated with levels of ID and IQ (Allen, 2000; McClintock, Hall, & Oliver, 2003). McTiernan, Leader, Healy, and Mannion (2011) found that lower IQ was associated with an increase in the frequency of aggression, stereotypy, and SIB. Similarly, Holden and Gitlesen (2006) reported that behavior problems were more common among those with greater levels of intellectual impairment. Jacobson (1982) found that level of functioning moderated the progression of behavior problems, where individuals with severe and profound ID increased behavior problems in adulthood, and individuals with moderate and mild ID showed a stable exhibition of behavior problems across age groups. Research also suggests that individuals with mild to moderate ID exhibit more sporadic, outwardly destructive behaviors, such as aggression, while those with severe to profound ID present with more continuous, self-directed behaviors, such as SIB and stereotypy (Cooper et al., 2009; Koskentausta, Iivanainen, & Almqvist, 2007; Witwer & Lecavalier, 2008). However, some research has failed to find a relationship between behavior problems and level of ID (Murphy, Healy, & Leader, 2009).

Functions of Behavior Problems

The most common and successful treatment approach to date for behavior problems are those that involve principles of applied behavior analysis, which in turn center on the functional properties of the target behavior. Assessing functional properties to produce individualized behavioral interventions that intervene at the antecedent or consequent level can be extremely successful at reducing any behavior problems and

increasing adaptive behavior (Favazza, 1989; Lloyd, Kelly, & Hope, 1998; Matson, Bamburg, Cherry, & Paclawskyj, 1999; Nock & Prinstein, 2005; Rapp & Vollmer, 2005a; Reid, Parsons, & Lattimore, 2010). The functional properties refer to the contingencies of reinforcement that maintain a behavior. Identifying the functional properties of a given behavior allows the design of customized behavioral strategies that are rationally linked to those properties (Cooper, Heron, & Heward, 2007; O'Neill et al., 1997).

Most assessments of function report four separate behavioral reinforcement categories: external positive, external negative, internal positive (automatic), and internal negative. For example, behavior problems can serve to receive attention or a tangible item from an adult or caregiver (i.e. external positive reinforcement), escape a social demand or task (i.e. external negative reinforcement), elicit a physical sensation or self-stimulate (i.e. internal positive reinforcement), or reduce physical discomfort or pain (i.e. internal negative reinforcement).

Functional assessments include direct and indirect measures of the behavior, such as observations and rating scales (e.g. *Motivation Assessment Scale*[1] *[MAS*; Durrand & Crimmins, 1992]); whereas, functional analysis involves the systematic and repeated manipulation of antecedents and consequences in a within-subject design. Since functional analysis tends to be relatively costly and can sometimes create ethical dilemmas, functional assessment is typically the simpler, more feasible approach. Before the early 1980s, behavior interventions were often selected on the basis of the form or

topography of the behavior problems; whereas, now, they are expected to be based on the functions (Iwata et al., 1994).

Different behavior topographies tend to be associated with different functional profiles. For example, stereotypic behavior is often referred to as "stimming" (Cunningham & Schreibman, 2008; Nind & Kellett, 2002), which, in behavioral terms, means that it tends to be maintained by automatic reinforcement (Rapp & Vollmer, 2005). In addition, the majority of the literature using our current assessment options suggests that automatic reinforcement maintains most stereotypy (Rapp & Vollmer, 2005a), and researchers often refer to the neurobiological source of stereotypy, using evidence from nonhuman studies (Rapp & Vollmer, 2005b). However, behavior problems can also have multiple functions for an individual at a given time (Matson & Boisjoli, 2007) or change in function over time (Lerman, Iwata, Smith, Zarcone, & Vollmer, 1994; Vollmer & Iwata, 1991). A recent study by Rojahn, Zaja, Turygin, Moore, and van Ingen (2012) found that different functions maintain different behavior problems, with SIB and stereotypy serving nonsocial functions more often than aggression.

Research on the prevalence rates of particular functions for behavior problems varies widely (Iwata et al., 1994; Roscoe, 2002). A large study by Iwata et al. (1994) summarized 152 functional analyses in attempt to create epidemiological intervals for each of these functions of SIB. This study resulted in the following prevalence estimates for the various functional categories: social-negative/ escape = 38.1%, social-positive/ attention or tangibles = 26.3%, and automatic/ sensory = 25.7%. The remaining cases had

multiple reinforcers or had functional analyses that were either inconsistent or not interpretable.

Research on the specific prevalence of functional categories among different disability levels is scarce. Studies have attempted to determine factors that influence the tendency of an individual to endorse particular functions of behavior problems. Research has found support for the notion that some diagnoses, mainly Autism and Pervasive Developmental Disorder, are closely associated with certain functions of behavior problems (Barrera & Graver, 2009). Deficits in specific competences, such as social skills, have also been identified as related to particular functions of maladaptive behavior (Matson, Mayville, & Lott, 2002). However, research has shown the evident correlation between diagnostic categories and developmental skills with the level of disability of the individual. Therefore, the purpose of this exploratory study was to investigate the relationship between level of ID and the functions served by three behavior problems: aggression, stereotypy, and SIB.

Method

Participants

Data were collected from 115 adults with various levels of ID (n's: 21 mild, 29 moderate, 38 severe, and 27 profound) engaged in a day training and habilitation program located in Minnesota. The non-institutional program provides behavioral support for adults with intellectual and developmental disabilities, tailoring activities towards each participant's unique needs. Age of participants ranged from 17 to 60 years old (M=30.15, S= 9.95), with 80 males and 35 females. The majority of the sample was Caucasian

(81.7%), and the remainder was African American (11.3%), Asian (4.3%), and Hispanic (1.7%), with missing ethnicity data for only one individual.

Measures

Questions about Behavioral Function (*QABF*; Matson & Vollmer, 1995). The *QABF* is a 25-item questionnaire designed to assess the function of maladaptive behavior by rating the frequencies of five functional subscales on a 4-point scale (0 = never, 1 = rarely, 2 = some, 3 = often). Raters are also allowed to check "does not apply." The five subscales, each with 5 items, include: social positive/ attention, social positive/ tangibles, social negative/ escape, automatic positive or negative/ nonsocial, and pain attenuation or physical discomfort reduction/ physical)[2]. Each subscale frequency is summed, and the scale with the highest score is considered the likely cause of that target behavior (Zimbelman, 2005). The *QABF* takes about 20 minutes to administer (Paclawskyj, Matson, Rush, Smalls, & Vollmer, 2000), and the scoring and interpretation of the scale are clearly described in the manual (Matson & Vollmer, 1995). Overall, the *QABF* is a powerful substitute for functional analyses or ABA methods of assessment, which are more time consuming and costly, and require more training to administer (Zimbelman, 2005).

The *QABF* had acceptable test-retest (delay of one to three weeks) reliability, which was established with 34 staff members who were familiar with clients, producing spearman rank-order correlations from .65 to 1.0 for various subscales (Parclawskyj et al., 2000), and split half reliability (r = .91) (Dawson, Matson, & Cherry, 1998).

Zaja, Moore, van Ingen, and Rojahn (2011) found higher test-retest reliability with correlations between .81 and .82. Inter-rater reliability was established with acceptable percent agreement (Nicholson, Konstantinidi, & Furniss, 2006; Parclawskyj et al., 2000; Zaja et al., 2011), with kappa values from .63 to 1, and internal consistency is high, with an alpha range of .89 to .96 for different subscales (Nicholson et al., 2006; Zaja et al., 2011).

An exploratory factor analysis of the scale produced a five factor solution that accounted for 76% of the variance in ratings, confirming the original factor structure put forth by the authors (Paclawskyj et al., 2000). A factor analysis by Nicholson et al. (2006) yielded a 6th factor which held items related to the repetitiveness of the behaviors. A test of convergent validity of *QABF*, *MAS*, and an equivalent functional analysis in 13 individuals with behavior problems showed that the *QABF* and functional analysis agreed on 56% of the cases, whereas the MAS and functional analysis agreed on 44% of cases, and the *QABF* and *MAS* agreed 61% of the time (Paclawskyj et al., 2000). The *QABF* and *Functional Assessment for Multiple Causality (FACT;* Matson et al., 2003*)* had good convergent and discriminant validity (Zaja et al., 2011).

In the current study, inter-rater reliability varied among subscales from acceptable to good (r = .51 [Attention]; r = .54 [Social Escape]; r = .58 [Sensory stimulation]; r = .39 [Pain reduction]; r = .62 [Tangible reinforcement]), test-retest reliability was good to excellent (r = .68 [Attention]; r = .69 [Social Escape]; r = .70 [Sensory stimulation]; r = .59 [Pain reduction]; r = .76 [Tangible reinforcement]), and excellent internal consistency (α = .87).

Behavior Problems Inventory (*BPI-01*; Rojahn et al., 2001). The original *BPI* was designed to be a 'narrow band' assessment of common behavior problems seen in ID. The *BPI-01* contains 49 items on three subscales: SIB (14 items), stereotypic behavior (24 items), and aggressive or destructive behavior (11 items). The behaviors are rated for frequency (0 = never, 1 = monthly, 2 = weekly, 3 = daily, 4 = hourly) and severity (0 = no problem, 1 = a slight problem, 2 = a moderate problem, 3 = a severe problem). The *BPI-01* can be self-administered by a caregiver following online instructions (Zimbelman, 2005).

The norming sample consisted of 432 individuals with ID (54% male), ranging in age from 14 - 91 (primarily adults), who were in residential care, where 84.2% of participants had severe or profound ID. The *BPI-01* was administered by four graduate students by means of interviews with staff who knew participants well. From this sample, a confirmatory factor analysis found the three factor structure to be appropriate (Rojahn et al., 2001). Factor validity was later supported with independent confirmatory and exploratory factor analyses, and the three factor structure fit the data well (Gonzalez et al., 2009).

Frequency and severity were found to be highly correlated across subscales (r = .90), and for SIB specifically, (r = .93) (Gonzalez et al., 2009; Rojahn et al., 2001). The internal consistency of the frequency of SIB has been reported as α = .61 (Rojahn et al., 2001), α = .48 (Gonzalez et al., 2009), and α = .71 (Sturmey, Sevin, & Williams, 1995). Test-retest reliability (one week delay) of the frequency scales was high with r = .71 (Gonzalez et al., 2009) and 96% agreement (Sturmey, Fink, & Sevin, 1993).

Inter-rater agreement was acceptable, with a kappa of .65 and 95% agreement (Sturmey et al., 1993). Criterion- related validity has been established in multiple situations. The *BPI-01* was compared with the *Repetitive Behavior Scale-Revised* (*RBS-R*; Bodfish, Symons, & Lewis, 1999), and correlated at $r = .77$ (Bodfish, Symons, & Lewis, 1999). The *BPI- 01* was compared to the *Aberrant Behavior Checklist*, and the two assessments showed largely consistent results and converged and diverged appropriately (Rojahn, Aman, Matson, & Mayville, 2003). The *BPI-01was* also compared with the *Autism Spectrum Disorders-Behavior Problems for Intellectually Disabled Adults*, and the two instruments converged appropriately (Rojahn, Wilkins, Matson, & Boisjoli, 2010).

Overall, the *BPI-01* has undergone several reliability and validity examinations, and has passed. The authors highlight multiple uses for the BPI-01 including clinical assessment, intervention planning, behavior monitoring, and scientific research (Rojahn et al., 2001).

Level of ID. The ID level for each participant was previously determined through evaluations conducted by licensed psychologists using standardized measures of cognitive ability (e.g., Stanford Binet Intelligence Scales), behavioral observations, parent and family interviews, and other psychological measures (e.g., the *Vineland Adaptive Behavior Scales*). Psychological tests recorded at the day program were examined by the third author to ensure applicability with each participant and soundness of the assessment.

Procedure

Supervisory staff at the day program who were knowledgeable with the client completed both the *QABF* and the *BPI-01* on two separate occasions, with a two-month delay. Two staff members completed two sets of assessments for each client. The target behavior for the *QABF* was defined as the one with the highest *BPI-01* frequency score; therefore, each participant had data on the function of only one type of behavior problem. Average subscale scores for the *QABF* were obtained by adding the frequency scores from two raters at the two time points for each subscale (for a total of four scores per subscale) and dividing by four.

Results

Supervisory staff completed the QABF for aggressive behavior for 58 individuals (50.4%), stereotypic behavior for 25 of the individuals (21.7%), and self-injurious behavior for 32 individuals (27.8%). These subsamples did not significantly differ on age [$F\ (2, 112) = .88, p > .05$], ethnicity [$\chi^2\ (114) = 6.59, p > .05$], gender [$\chi^2\ (115) = 1.28, p > .05$], or level of ID [$\chi^2\ (115) = 2.65, p > .05$] (Table 1).

Table 1 Demographic information by behavior problem

	Behavior Problem		
	Aggression	Stereotypy	Self-Injury
N	58	25	32
Age in years (M, SD)	31.24, 10.4	29.92, 10.3	28.34, 8.9
Gender			
Male	70.7	76	62.5
Female	29.3	24	37.5
Race			
Caucasian	78.9	84	87.5
African American	10.5	16	9.4
Hispanic	0.02	0	3.1

Other	0.09	0	0

Effects codes were created to represent the four levels of intellectual functioning: mild, moderate, severe, and profound. For each behavior problem, multiple regression analyses were conducted, with the effects codes of the levels of intellectual functioning as the independent variables and the QABF subscales as the dependent variables.

Results showed that, regardless of ID level, individuals exhibited aggression equally for attention [$F(3, 46) = 1.55$, $p > .05$], sensory stimulation [$F(3, 46) = 2.74$, $p > .05$], pain reduction [$F(3, 46) = 1.55$, $p > .05$], social escape [$F(3, 46) = 2.26$, $p > .05$], and tangible items [$F(3, 46) = 2.55$, $p > .05$] (Figure 1).

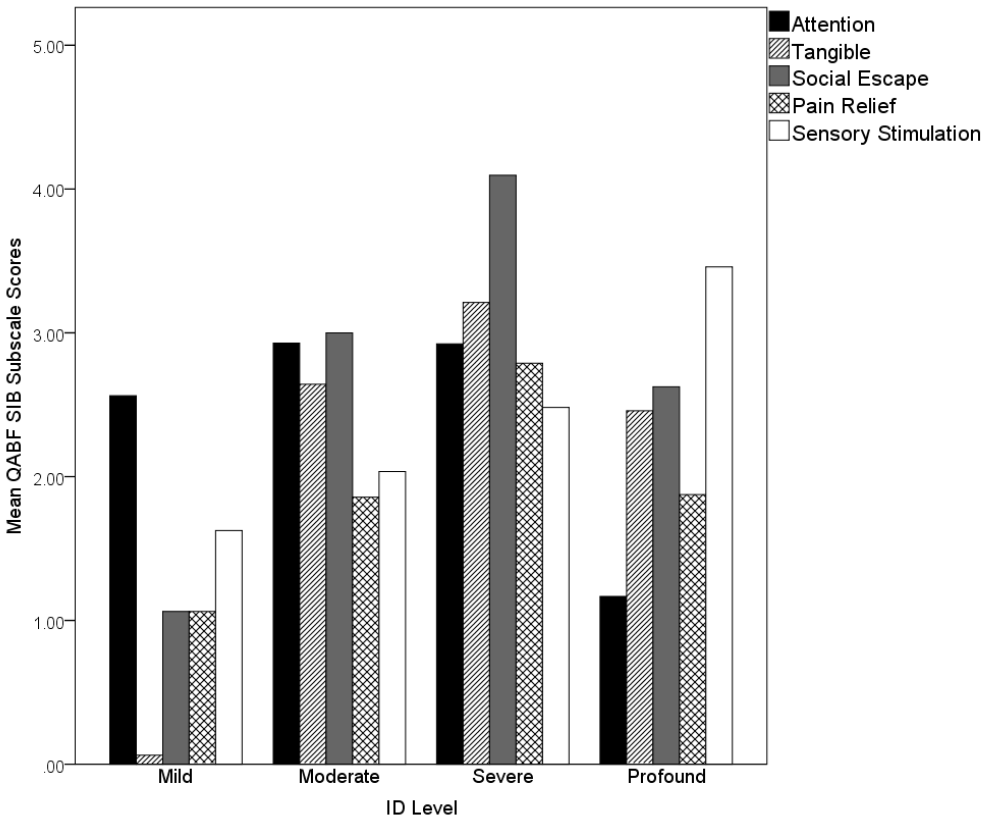

Figure 1 Mean QABF subscale scores by level of ID for SIB

Similarly, results showed that, regardless of ID level, individuals exhibited stereotypic problem behavior equally for attention [$F(3, 21) = .08$, $p > .05$], sensory stimulation [$F(3, 21) = 1.27$, $p > .05$], pain reduction [$F(3, 21) = 1.15$, $p > .05$], social escape [$F(3, 21) = 1.33$, $p > .05$], and tangible items [$F(3, 21) = 2.66$, $p > .05$] (Figure 2).

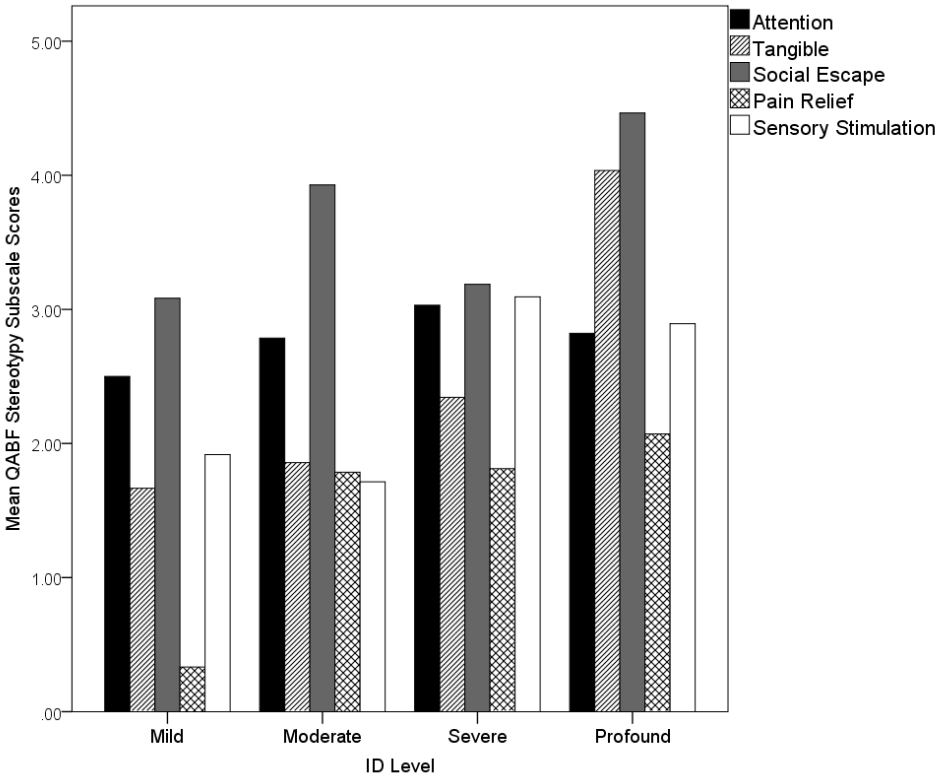

Figure 2 Mean QABF subscale scores by level of ID for stereotyped behavior

However, ID level did provide information about the functioning of SIB. Results showed that individuals with mild ID exhibited SIB to attain tangible items significantly less often than the entire group ($\beta = -.65$, $p < .01$), while individuals with severe ID exhibited SIB significantly more often to attain tangible items than the entire group ($\beta = .48$, $p < .05$). Similarly, individuals with mild ID used SIB to escape social demands significantly less often than the entire group ($\beta = -.53$, $p < .05$) and individuals with severe ID used SIB to escape social demands significantly more often than the entire group ($\beta = .60$, $p < .01$). Regardless of ID level, individuals displayed SIB equally for

attention [F(3, 26) = 1.82, p > .05], sensory stimulation [F(3, 26) = 1.15, p > .05], and pain reduction [F(3, 26) = 1.41, p > .05] (Figure 3).

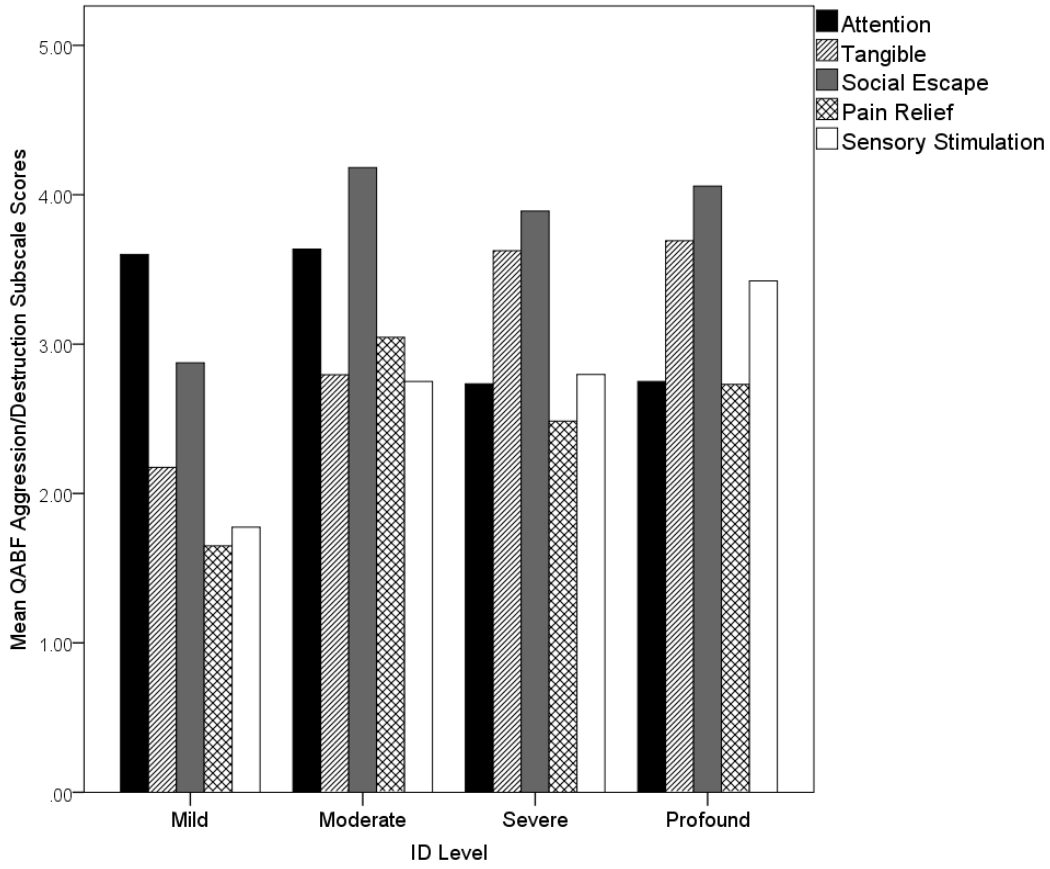

Figure 3 Mean QABF subscale scores by ID for aggressive/destructive behavior

Discussion

In this study, we examined whether the level of ID impacts the function of behavior problems. Our results showed that in general, across behavior problems, a

variety of functions are commonly endorsed by all levels of functioning. This could serve as a measure of precaution for families and professionals working with individuals with severe and profound ID, to be wary of concluding an internal or automatic reinforcement function. Concluding that a behavior problem such as aggression, stereotypy, or SIB is occurring for internally reinforcing reasons may not be justified without properly eliminating the possibility of external motivating operations such as attention, tangible items, and social demands.

In regards to SIB, two specific significant differences were found, such that individuals with mild ID tended to use SIB less often for tangible items or to escape social demands, and individuals with severe ID tended to use SIB for these same purposes significantly more often. In other words, with the decline of intellectual functioning, SIB functions more often to gain tangible items and escape social demands. This could be implemented in interventions as noting the need for support for the use of manipulatives, preferred items, or other physically stimulating objects for individuals with severe ID who exhibit SIB. Language and communication training may also alleviate SIB for the more severely impacted population, as it would provide an avenue for expressing a desire for stimulation or a desire to take a break from the social demands at hand.

This research showed that aggressive and stereotypic behavior problems can function for various reasons across all levels of functioning. In other words, regardless of the severity of ID, individuals appear to exhibit these behavior problems for the purposes of attention, sensory stimulation, pain reduction, social escape, and tangible

reinforcement. This has implications for future interventions for all levels of ID that target the elimination of behavior problems.

One limitation to this research is the measurement error in the assessment instrument, the QABF. This study may not reflect the relationship between ID and functions of behavior problems, but more accurately reflects the relationship between the label of ID that they receive and how their behavior is interpreted by an observer. By using two observers and two time points, the effect of measurement error is lessened, thus we are more confident in the appropriateness of the conclusions drawn from our assessment, albeit a questionnaire rather than a formal functional analysis. The potential interaction of rater perspective, environment, and behavior problem function is still left to be explored.

A second limitation is the measurement error in the BPI-01. Although the QABF was filled out with one target behavior in mind, previously determined by the highest frequency on the BPI-01, several participants exhibited comorbid behavior problems. At least one exhibition of aggressive behavior had been noted in 90.8% of participants, 80.8% of participants had at least one episode of stereotypic behavior, and 68.5% of participants had at least one display of SIB. Therefore, whether the comorbid behaviors were simultaneously exhibited, or whether multiple behaviors serve for the same, similar, or a variety of functions is unclear. A hierarchical usage depending on the effectiveness in different contexts is also plausible. Future studies should consider longitudinal investigations of the progression of behavior problems in quantity and quality to better describe this repertoire of functions and determine appropriate interventions.

This research was a preliminary exploration of the relationship of intellectual disability level and motivating operations of aggressive, stereotypic, and self-injurious behavior problems. These results show the potential for future research to provide an average frequency rate for population comparisons within each level of ID.

Footnotes

1. See http://www.lcisd.k12.mi.us/specialed/Behavior%20Resources/MOTIVATION%2520ASSESSMENT%2520SCALE.pdf for the full MAS, with items and scoring.

2. See http://www.robertjasongrant.com/wp-content/uploads/QABF.pdf for the full QABF, with items and scoring.

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STUDY 2: THE EFFECTS OF DEVELOPMENTAL QUOTIENT AND DIAGNOSTIC CRITERIA ON CHALLENGING BEHAVIORS IN TODDLERS WITH DEVELOPMENTAL DISABILITIES

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Abstract

Previous research has found that individuals with intellectual disability and/or autism spectrum disorder (ASD), and those with greater symptom severity within these diagnoses, show higher rates of aggressive/destructive behavior, stereotypic behavior, and self-injurious behavior. In this exploratory cross-sectional study, toddlers at-risk for a developmental disorder (n = 1,509) ranging from 17 to 36 months fell into one of three diagnostic categories: Autistic Disorder, Pervasive Developmental Disorder-Not Otherwise Specified [PDD-NOS], and atypically developing - no ASD diagnosis. Mental health professionals from EarlySteps, Louisiana's Early Intervention System, interviewed parents and guardians using the *Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT) – Part 3* (Matson, Boisjoli, & Wilkins, 2007) to obtain measures of challenging behaviors and the *Battelle Developmental Inventory, 2nd Edition (BDI-2)* (Newborg, 2005) to obtain developmental quotients (DQ). Results indicated that toddlers diagnosed with Autistic Disorder or PDD-NOS showed a positive relationship between total DQ and challenging behavior; whereas, atypically developing toddlers with no ASD diagnosis showed a more adaptive, negative relationship. The DQ domains that were most influential on challenging behaviors varied by diagnosis, with communication and motor domains playing greater roles for toddlers with Autistic Disorder or PDD-NOS, and personal-social and cognitive domains playing greater roles for atypically developing toddlers with no ASD diagnosis.

Introduction

Although a clear consensus on what constitutes a challenging behavior does not presently exist (Elgie & Hastings, 2002; Holden & Gitlesen, 2009), these behaviors are generally defined as those which significantly interfere with learning, skill performance, and social interactions, while also potentially causing physical harm to the self and/or others (Emerson, 2005; Emerson et al., 2001; Mudford et al., 2008). Examples of such behaviors include physical aggression, self-injurious behavior (SIB), stereotypy, property destruction, and verbal aggression. Despite these behaviors not being unique to individuals with developmental disabilities, they are remarkably prevalent within this population, with prevalence estimates reaching above 80% in some samples (Matson, Wilkins, & Macken, 2009; Poppes, van der Putten, & Vlaskamp, 2010). To date, the majority of research in this area has focused on individuals with intellectual disability (ID) and/or autism spectrum disorder (ASD), with school-aged children and adult participants comprising the majority of samples (e.g., Matson et al., 2009; McCarthy et al., 2010; Tarbox et al., 2009). In particular within these populations, it has been found that those individuals with comorbid diagnoses of ID and ASD engage in greater rates of challenging behaviors than individuals with ID alone (Matson & Rivet, 2008; Rojahn, Wilkins, Matson, & Boisjoli, 2010).

With respect to this comorbidity, the effect of the level of intellectual impairment on the presentation of challenging behaviors within individuals with ASD has been explored. Among children with ASD, McTiernan, Leader, Healy, and Mannion (2011) found that lower IQ was associated with an overall increase in the frequency of

aggression, stereotypy, and SIB, as well as an increase in the severity of stereotypy and SIB. Similarly, when examining a sample of children, adolescents, and adults, Holden and Gitlesen (2006) found overall rates of challenging behaviors rose with increasing levels of intellectual impairment. However, within this sample, specific topographies of challenging behavior followed different trends among the varying levels of ID; individuals with mild to moderate ID were more likely to engage in physically aggressive behaviors, while individuals with severe to profound ID were more likely to engage in SIB. Other researchers have corroborated this finding, which suggests that individuals with mild to moderate ID present with more outwardly aggressive and destructive behaviors while those with severe to profound ID evince more self-directed or sustained challenging behaviors, such as SIB and stereotypies (Cooper et al., 2009; Koskentausta, Iivanainen, & Almqvist, 2007; Murphy, Healy, & Leader, 2009; Witwer & Lecavalier, 2008). Yet, other researchers have failed to substantiate all of these findings by noting a lack of a relationship between sets of challenging behaviors and level of ID (Murphy et al., 2009). Therefore, while it is generally accepted that a decrease in intellectual functioning is associated with an overall increase in challenging behaviors, the details regarding which specific topographies of challenging behaviors are affected are somewhat less clear, though likely in the aforementioned directions.

In addition to the examination of varying levels of intellectual impairment on challenging behaviors amongst individuals with ASD, differences in the presence of challenging behaviors among individuals with and without ASD diagnoses and also between different ASD diagnoses have also been found. When comparing individuals

with ASD to those without ASD (e.g., ID, atypically developing), researchers have consistently found that those with an ASD diagnosis present with significantly more challenging behaviors overall (Baghdadli, Pascal, Grisli, & Aussilloux, 2003; Kozlowski & Matson, 2012; Matson & Rivet, 2008). Furthermore, researchers have also established that individuals with more severe ASD symptoms or more severe forms of ASD (i.e., Autistic Disorder) evince significantly more challenging behaviors than those with less severe symptomatology or less severe forms of ASD (i.e., Pervasive Developmental Disorder-Not Otherwise Specified [PDD-NOS]) (Jang, Dixon, Tarbox, & Granpeesheh, 2011; Kozlowski & Matson, 2012; Matson & Rivet, 2008). This relationship has been found to exist across many topographies of challenging behavior, including aggressive behaviors, SIB, and stereotypies.

While researchers have found that children and adults with greater symptom severity of ASD present with greater rates of challenging behavior (e.g., Jang et al., 2011), and that comorbid ID is associated with an even further increase in these rates with greater intellectual impairments correlating with higher rates of challenging behavior (e.g., Cooper et al., 2009), the precise relationship between these two disabilities has yet to be examined closely. That is, given the common co-occurrence of ASD and ID (Matson & Shoemaker, 2009) as well as the frequent presence of challenging behaviors among both populations, could one diagnosis be moderating the relationship between the other diagnosis and challenging behavior? Furthermore, since the vast majority of studies examining challenging behavior presentation within the ID and ASD populations has been focused on school-aged children and adults, the question of whether or not level of

intellectual impairment and severity of ASD symptomatology has the same effect upon toddlers has not been addressed.

Therefore, the purpose of the present study was to examine the effect of overall developmental quotient (DQ) on challenging behavior presentation in toddlers with varying levels of ASD symptomatology according to diagnosis (i.e., Autistic Disorder, PDD-NOS, and atypically developing - no ASD diagnosis). In addition to this, the specific domains of DQ were examined to determine which facets of developmental impairment were most associated with challenging behaviors for individuals with particular diagnoses.

Method

Participants

Seven hundred and five cases were removed from the dataset due to missing data on the main variables, incorrect data, or ages beyond those appropriate for the standardized, normed measures. This transformed the original sample size from 2,214 to 1,509. The participants were caregivers of toddlers with developmental disabilities. Caregivers consisted mainly of biological mothers (81.7%), but also included biological fathers (2.8%), biological grandparents (5.2%), step-parents and foster/adoptive parents (4.6%), and unidentified or other caregivers (5.7%). The toddlers ranged in age from 17 to 36 months (M = 25.7, SD = 4.7), height from 12 to 48 inches (M = 33.3, SD = 4.0), and weight from 14 to 52 pounds (M = 28.7, SD = 5.3). There were 1,070 males (70.9%), 434 females (28.8%), and 5 children who did not have gender identified. The ethnicity of the children was reported to be Caucasian (48.4%), African American (40%), Hispanic

(2.2%), or Other/Unidentified (9.4%). At the time of the assessments, all of the children were receiving services through EarlySteps, Louisiana's Early Intervention System under the Individuals with Disabilities Education Act, Part C, which provides services to infants and toddlers and their families from birth to 36 months. To qualify for services through EarlySteps, children must be diagnosed with a developmental delay or a medical condition that puts them at risk for a developmental delay.

The sample was comprised of three groups: atypically developing toddlers with no ASD diagnosis (71.8%), children diagnosed with Autistic Disorder (14.7%), and children diagnosed with PDD-NOS (13.5%). Those with no ASD diagnosis did not meet criteria for an ASD, however, were experiencing developmental delays due to various conditions (e.g., Cerebral Palsy, Down Syndrome). See Table 1 for demographic characteristics of the three groups. To diagnose toddlers with an ASD, a licensed clinical psychologist with over 30 years of clinical experience used scores from the *Battelle Developmental Inventory, 2nd Edition (BDI-2*; Newborg, 2005) and the *Modified Checklist for Autism in Toddlers (M-CHAT;* Robins, Fein, Barton, & Green, 2001), criteria from the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision* (*DSM-IV-TR*; American Psychiatric Association [APA], 2000), and clinical judgment. Inter-rater reliability was established with a subset of the entire sample. A second Ph.D. level clinical psychologist with experience assessing and treating children with developmental disabilities also provided diagnoses for 196 of the toddlers. The second psychologist was blind to the diagnoses given by the primary psychologist and assigned diagnoses based on the same criteria (i.e., *BDI-2* and *M-CHAT* scores, *DSM-IV-*

TR criteria, and clinical judgment). Inter-rater reliability was excellent with a kappa value of 0.94, $p < .001$.

Measures

***Modified Checklist for Autism in Toddlers* (*M-CHAT*).** The *M-CHAT* (Robins et al., 2001) is an informant-based measure consisting of 23 items used to screen for ASD. The items all relate to social skills, communication, or behavior. The *M-CHAT* was created as a brief tool to be used by pediatricians during regular check-ups as well as by specialists during assessments for ASD. Toddlers are referred for further evaluation if any three items are failed or if two critical items are failed. Critical items pertain to a child's tendency to point, imitate, engage in joint-attention, and respond to his or her name. Internal consistency was found to be adequate with an alpha value of .85 for all 23 items, and .83 for critical items (Robins et al., 2001). Preliminary values for sensitivity and specificity were estimated to be .87 and .99 respectively (Robins et al., 2001).

***Baby and Infant Screen for Children with aUtIsm Traits* (*BISCUIT*) – *Part 3*.** The *BISCUIT* (Matson et al., 2007) is an informant-based battery developed for infants and toddlers between the ages of 17 and 37 months. There are three main parts to the *BISCUIT*, which assess core symptoms of ASD, comorbid disorders, and challenging behavior. The *BISCUIT – Part 3* is the final section of the *BISCUIT* measure and includes 15 items related to challenging behaviors that are commonly exhibited by individuals with ASD. These challenging behaviors fall into three subscales: *Aggressive/Destructive Behavior* (10 items), *Stereotypic Behavior* (3 items), and *SIB* (2 items) (Matson, Boisjoli, Rojahn, & Hess, 2009). For each item, a score of 0, 1, 2, or X may be given. A score of 0

indicates “not a problem or impairment;” a score of 1 indicates “mild problem or impairment;” and a score of 2 indicates “severe problem or impairment.” A score of X can be given for “does not apply or don’t know.” Analysis of reliability has shown that the *BISCUIT-Part 3* has excellent internal consistency (Matson et al., 2009), and the internal consistency of the current study was excellent, with an alpha value of .89 for all 15 items.

***Battelle Developmental Inventory, 2nd Edition* (*BDI-2*).** The *BDI-2* (Newborg, 2005) is a normed and standardized measure designed to assess the developmental skills in children from birth through age 7 years 11 months. It is an informant-based and observation-based measure consisting of 450 items. The *BDI-2* is made up of five domains: adaptive, personal-social, communication, motor, and cognitive. Caregivers score each item with 0 (no ability in this skill), 1 (emerging ability), or 2 (ability at this skill). Analysis of reliability yielded acceptable test-retest reliability with all domain scores and total BDI-2 scores over .80 and excellent internal consistency scores with all domain scores and total BDI-2 scores between .98 and .99 (Newborg, 2005). Newborg (2005) also established acceptable levels of content and criterion validity through expert review and correlational comparisons. An overall DQ is obtained from the combined domains, which has a mean of 100 and a standard deviation of 15, similar to an IQ score.

Procedure

During an assessment through the EarlySteps program, a variety of diagnostic measures including the *BISCUIT* battery, *M-CHAT,* and the *BDI-2* were administered by a mental health professional to parents or caregivers in a private and quiet area. To

administer the *M-CHAT,* each item was read aloud to the parent or caregiver who then responded with "yes" or "no" regarding how the child usually functions. When administering the *BISCUIT* all items were read aloud to the parent or caregiver by the clinician. The parent or caregiver rated each item to the extent that the behavior described had been a recent problem in comparison to same age peers. The toddler was present for at least some of the measures, including the *BDI-2.* All mental health professionals held at least a bachelor's degree and were certified or licensed practitioners in areas relevant to early childhood development such as psychology, special education, social work, or speech/language pathology. Training on each measure was provided to the clinicians prior to administration. Approval for the study was obtained through the Louisiana State University Institutional Review Board and the Office for Citizens with Developmental Disabilities for Louisiana. Informed consent was obtained from all participants.

Results

Demographic characteristics of the sample can be found in Table 1. The three diagnostic categories did not significantly differ on gender, χ^2 (2, N = 1504) = 5.83, p = *.059*, or race, χ^2 (2, N = 1509) = 7.21, p = .42. In our sample of 1,509 toddlers, 44.7% exhibited aggressive/destructive behavior, 25.5% exhibited stereotypic behavior, and 16.1% exhibited SIB. Of the sample of toddlers diagnosed with Autistic Disorder, 78.5% exhibited aggression/destruction, 64.1% exhibited stereotypies, and 40% exhibited self-injury, while of the sample of toddlers diagnosed with PDD-NOS, 61.9% exhibited aggression/destruction, 32.7% exhibited stereotypies, and 20.6% exhibited self-injury, and of the atypically developing toddlers with no ASD diagnosis, 35.6% exhibited

aggression/destruction, 16.2% exhibited stereotypies, and 10.3% exhibited self-injury. Pearson chi-square tests determined these diagnostic differences in frequencies to be statistically significant for aggression/destruction, $\chi^2(2, N = 1486) = 160.11$, $p < .001$, stereotypies, $\chi^2(2, N = 1490) = 226.09$, $p < .001$, and self-injury, $\chi^2(2, N = 1492) = 122.42$, $p < .001$.

Table 1 Demographic information for toddlers with atypically developing - no ASD diagnosis, Autistic Disorder, and PDD-NOS

	Diagnosis		
	Atypical	Autistic	PDD-NOS
N	1084	221	204
Age in months (M, SD)	25.60, 4.8	26.76, 4.7	25.39, 4.4
Age range (months)	17-36	18-36	17-35
Gender			
Male	69.4	76.9	72.5
Female	30.4	22.6	27.0
Race			
Caucasian	49.2	46.6	45.6
African American	38.7	41.6	44.1
Hispanic	2.6	1.8	0.5
Other	9.3	10.0	9.3

Diagnosis Moderates the Effects of Total Developmental Quotient (DQ) on Challenging Behaviors

Our first question was how the effect of overall DQ on challenging behavior presentation varied by diagnosis (i.e., Autistic Disorder, PDD-NOS, and atypically developing with no ASD diagnosis). We computed separate multiple regression analyses for each of the three challenging behaviors (aggression/destruction, stereotypies, and self-

injury) using dummy coded variables to represent the three diagnostic categories. The first of these equaled 1 for the Autistic Disorder group and zero otherwise, while the second equaled 1 for the PDD-NOS group and zero otherwise. This resulted in regression weights that reflected comparisons of each of these groups to the uncoded atypically developing with no ASD diagnosis group. Diagnosis was a significant moderator in the effect of total DQ on aggressive/destructive behavior (adjusted R^2 change = .023, $p <$ .001), stereotypic behavior (adjusted R^2 change = .007, $p < .01$), and SIB (adjusted R^2 change = .005, $p < .01$) (See Figures 1 – 3). Specifically, higher DQ was associated with more challenging behaviors in toddlers diagnosed with Autistic Disorder whereas higher DQ was associated with fewer challenging behaviors in atypically developing toddlers with no ASD diagnosis.

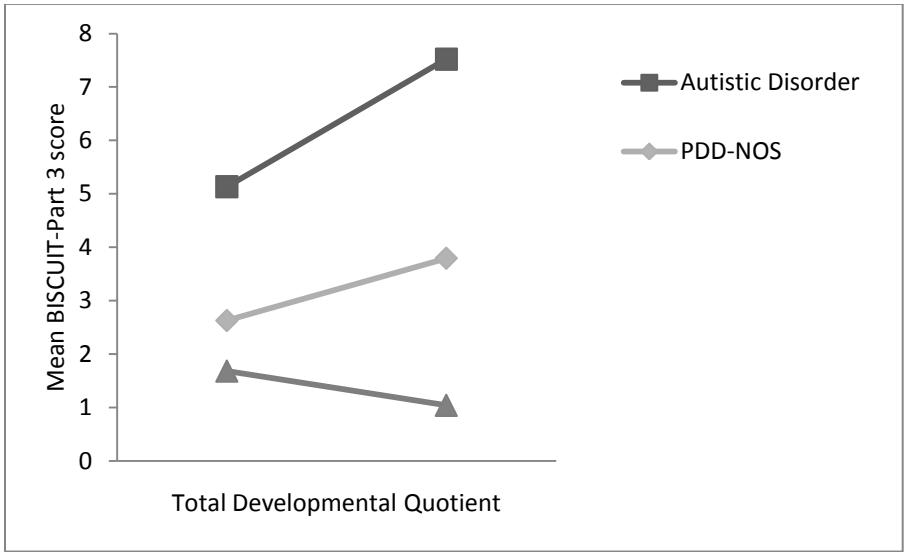

Figure 1 Effect of Total Developmental Quotient on aggressive/destructive challenging behavior by diagnostic category. This figure illustrates the simple

regression equations for each diagnostic category using 1 *SD* below and above the mean of Total Developmental Quotient (*M* = 84.85, *SD* = 14.58).

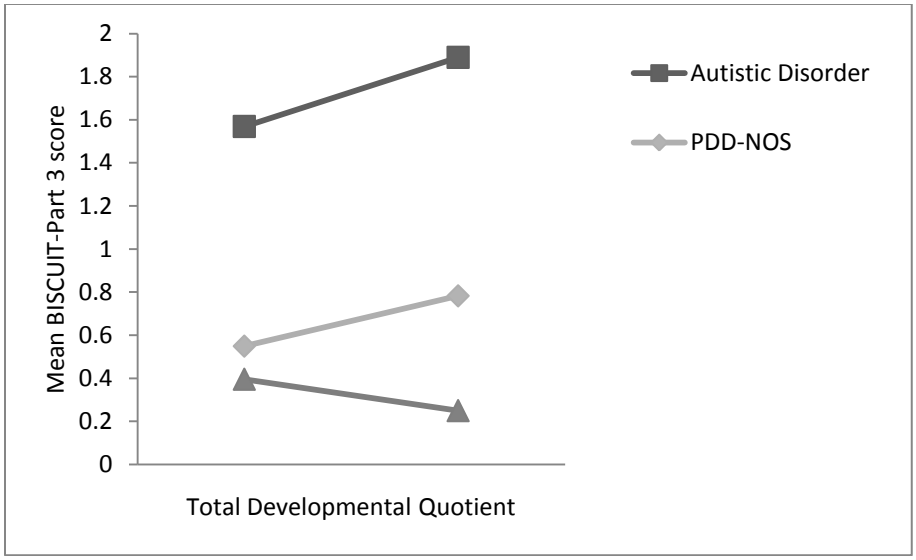

Figure 2 Effect of total Developmental Quotient on stereotypic challenging behavior by diagnostic category. This figure illustrates the simple regression equations for each diagnostic category using 1 *SD* below and above the mean of Total Developmental Quotient (*M* = 84.85, *SD* = 14.58).

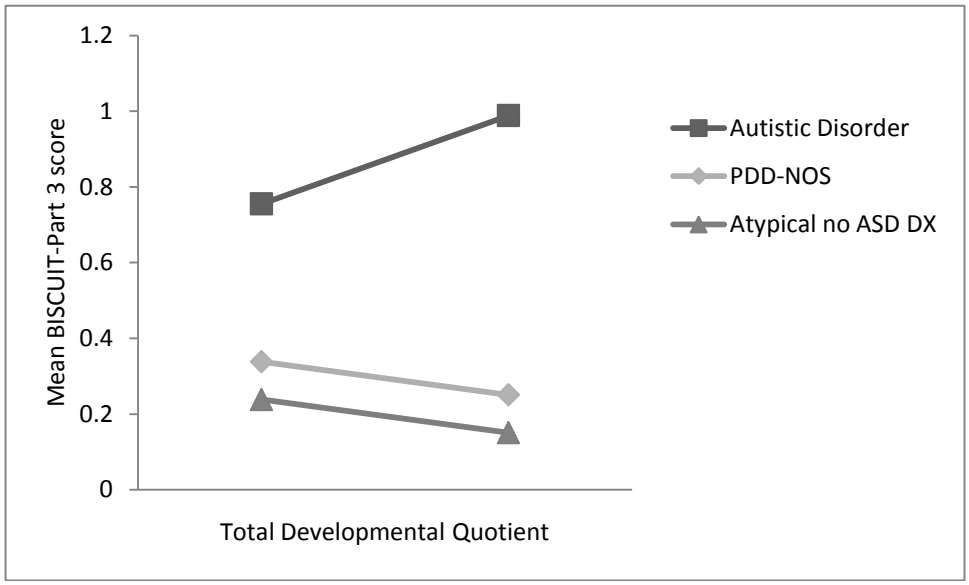

Figure 3 Effect of total Developmental Quotient on self-injurious challenging behavior by diagnostic category. This figure illustrates the simple regression equations for each diagnostic category using 1 *SD* below and above the mean of Total Developmental Quotient (*M* = 84.85, *SD* = 14.58).

The Effects of Developmental Quotient (DQ) Domains on Challenging Behaviors

Our second question was whether certain areas of developmental functioning were more highly associated with particular challenging behaviors for toddlers with distinct diagnoses. To answer this question, a series of multiple regressions was conducted for each diagnostic category using the five DQ domains as predictors and the three challenging behaviors as outcomes in separate analyses.

For toddlers diagnosed with Autistic Disorder and PDD-NOS, the communication and motor domains were significantly positively correlated with most of the three challenging behaviors. For atypically developing toddlers with no ASD diagnosis, personal-social and cognitive domains were significantly negatively correlated with all three challenging behaviors and adaptive and communication domains were significantly negatively correlated with some of the challenging behaviors.

Discussion

Challenging behaviors can cause significant restrictions to a person's quality of life, interfering with learning, skill performance, and social interactions (Emerson, 2005; Emerson et al., 2001; Mudford et al., 2008). Previous research has found that individuals with intellectual disabilities, ASDs, and those with greater symptom severity within these diagnoses show higher rates of challenging behaviors (Jang et al., 2011; Matson & Rivet,

2008; Matson et al., 2009; Poppes et al., 2010; Rojahn, et al., 2010). This research corroborated that finding, revealing more problem behaviors within the Autistic Disorder and PDD-NOS groups than the atypically developing with no ASD diagnosis group. The purpose of the present study was to 1) examine the effect of total DQ on three challenging behaviors in toddlers with varying levels of ASD symptomatology and 2) determine which specific domains of developmental functioning are most associated with particular challenging behaviors for individual diagnoses.

The results of our first exploration demonstrated that diagnosis was a significant moderator in the prediction of challenging behaviors by total DQ. Therefore, the relationship between total DQ and aggressive/destructive, stereotypic, and self-injurious challenging behaviors varied depending on diagnostic category. The general trend for toddlers diagnosed with Autistic Disorder as well as PDD-NOS was to exhibit more challenging behaviors with higher total DQ. The general trend for atypically developing toddlers with no ASD diagnosis was to exhibit less challenging behaviors with higher total DQ.

These results might have been influenced by restriction of range. In our sample, toddlers diagnosed with Autistic Disorder were underrepresented in the highest DQ quartiles, while atypically developing toddlers with no ASD diagnosis were overrepresented in the highest DQ quartiles. Although these incidence rates may be representative of the population, we might better understand the complex effects of DQ on challenging behaviors if we had a larger range of DQ within each diagnosis.

The results for our second exploration demonstrated that individual domains impacted particular challenging behaviors in different ways for toddlers with varying diagnoses. Specifically, toddlers diagnosed with Autistic Disorder showed higher rates of aggressive/destructive, stereotypic, and self-injurious challenging behaviors with greater communication skills. Toddlers diagnosed with Autistic Disorder also showed higher rates of aggressive/destructive and stereotypic challenging behavior with greater motor skills. Toddlers diagnosed with PDD-NOS showed higher rates of both aggressive/destructive and stereotypic challenging behaviors with superior communication and motor skills. Atypically developing toddlers with no ASD diagnosis showed lower rates of all three challenging behaviors with better communication skills and showed lower rates of aggressive/destructive and stereotypic challenging behaviors with better motor skills. These findings show the impact of both diagnostic criteria and particular developmental abilities on exhibited behavior, even at remarkably young ages. The differential effects of the developmental domains suggest intervention strategies for individuals of particular diagnostic categories exhibiting particular challenging behaviors.

One limitation of this study was the cyclical usage of the BDI-2. This instrument was used to diagnose participants and as the measure of a main independent variable, DQ. No statistical correction could be made for this; however, we expect that the impact was small since the BDI-2 was used as one of several diagnostic tools.

A second limitation to this study was that its cross-sectional nature did not allow for investigation of the processes involved with DQ improvement. Although all of the participants in this study were toddlers, an enormous amount of developmental growth

takes place during the first two years of life. The physical, cognitive, and emotional development contributing to these complex relationships may be better understood with a longitudinal analysis.

Moving beyond previous work, this study revealed a complex relationship between DQ, diagnosis, and challenging behavior in children as young as 17 months old. This study potentially ruled out the role of developmental delays as the core reason for challenging behaviors for those with Autistic Disorder, since populations with similar developmental delays exhibited different patterns of challenging behavior. This provides support for the current practice of early infant and toddler diagnosis.

For toddlers diagnosed with Autistic Disorder, higher levels of overall development were associated with higher levels of challenging behavior. This suggests that factors unique to the diagnosis of Autistic Disorder are interacting with developmental skills to manifest in challenging behaviors, but are perhaps less influential on a milder form of ASD (i.e., PDD-NOS).

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Table 2 Simple regressions of total DQ predicting challenging behaviors (CB) by diagnostic category

Diagnosis	CB	*N*	*b*	*Adj* r^2	*p*
Atypical	Agg/Dest	1070	-.020	.012	.001
	Stereo	1071	-.010	.009	.001
	SIB	1073	-.003	.006	.007
Autistic	Agg/Dest	219	.080	.051	.001
	Stereo	220	.010	.003	.187
	SIB	220	.010	.005	.141
PDD-NOS	Agg/Dest	197	.040	.020	.037
	Stereo	199	.008	.010	.168
	SIB	199	-.003	.000	.496

Table 3 Effect of Developmental Quotient (DQ) domains on challenging behaviors (CB) by diagnosis (DX)

DX: Atypically developing - no ASD diagnosis				
DQ Domain	CB	*r*	*adj* r^2	*p*
Adaptive	Agg	-0.09	0.01	0.00
	Stereo	-0.04	0.00	0.17
	SIB	-0.08	0.01	0.01
Personal-Social	Agg	-0.14	0.02	0.00
	Stereo	-0.14	0.02	0.00
	SIB	-0.09	0.01	0.00
Communication	Agg	-0.06	0.00	0.04
	Stereo	-0.01	0.00	0.64
	SIB	-0.05	0.00	0.09
Motor	Agg	-0.01	0.00	0.80
	Stereo	-0.03	0.00	0.41
	SIB	-0.06	0.00	0.07
Cognitive	Agg	-0.15	0.02	0.00
	Stereo	-0.15	0.02	0.00
	SIB	-0.08	0.01	0.01
DX: Autistic Disorder				
DQ Domain	CB	*r*	*adj* r^2	*p*
Adaptive	Agg	0.12	0.01	0.07
	Stereo	0.08	0.00	0.22
	SIB	0.06	0.00	0.36

Personal-Social	Agg	0.04	0.00	0.58
	Stereo	-0.05	0.00	0.44
	SIB	0.03	0.00	0.70
Communication	Agg	0.30	0.09	0.00
	Stereo	0.20	0.04	0.00
	SIB	0.19	0.03	0.01
Motor	Agg	0.35	0.12	0.00
	Stereo	0.15	0.02	0.02
	SIB	0.13	0.01	0.06
Cognitive	Agg	0.10	0.01	0.16
	Stereo	-0.04	0.00	0.52
	SIB	0.01	0.00	0.91
DX: PDD-NOS				
DQ Domain	CB	*r*	*adj* r^2	*p*
Adaptive	Agg	0.12	0.01	0.09
	Stereo	0.06	0.00	0.38
	SIB	-0.11	0.01	0.12
Personal-Social	Agg	0.04	0.00	0.58
	Stereo	-0.01	0.00	0.89
	SIB	0.01	0.00	0.85
Communication	Agg	0.26	0.06	0.00
	Stereo	0.22	0.04	0.00
	SIB	0.01	0.00	0.93
Motor	Agg	0.16	0.02	0.02
	Stereo	0.15	0.02	0.04
	SIB	-0.12	0.01	0.09
Cognitive	Agg	0.01	0.00	0.88
	Stereo	-0.01	0.00	0.87
	SIB	-0.06	0.00	0.44

STUDY 3: THE PROGRESSION OF CHALLENGING BEHAVIOR IN INTELLECTUAL AND DEVELOPMENTAL DISABILITIES: FREQUENCY AND SEVERITY OF SELF-INJURY, STEREOTYPY, AND AGGRESSION

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Abstract

Challenging behaviors, such as self-injury, stereotypy, and aggression are common among individuals with intellectual or developmental disabilities (IDD). Research has found that risk factors for these challenging behaviors are IQ, gender, and certain diagnostic groups. However, research on structural models of challenging behavior progression is limited. This study was designed to test the relationship of each challenging behavior's frequency and severity over one year for 160 infants and toddlers in a behavioral intervention program in Lima, Peru. They were diagnosed as having Down Syndrome (DS), at-risk for Autism, or experiencing other developmental delays. The frequency of SIB and stereotypy was stable over time; whereas the severity of aggression was stable over time. A uni-directional model fit the data best for individuals exhibiting SIB, with frequency being a leading indicator of future severity. A uni-directional model fit the data best for individuals exhibiting aggression, with severity being a leading indicator of future frequency. A cross-lagged autoregressive model fit the data best for individuals exhibiting stereotypy, with both frequency and severity involved. These models did not significantly vary across diagnostic groups, suggesting that toddlers exhibiting challenging behavior may be assisted with interventions, regardless of diagnostic category.

Keywords: intellectual disability, developmental disability, autism spectrum disorder, Down Syndrome, challenging behaviors, self-injury, stereotypy, aggression, structural equation modeling

Introduction

Intellectual disability (ID), formerly recognized as mental retardation (Schalock, Luckasson, & Shogren, 2007), is a severe and chronic condition that is defined by significant limitations in intellectual functioning and significant limitations in adaptive behavior that manifest themselves before the age of 18 (American Psychiatric Association, 2000). Often, developmental disabilities (DD), lifelong disabilities due to mental or physical deficits manifesting before the age of 22 (American Psychiatric Association, 2000), are comorbid and interrelated with intellectual disabilities, forming an all-encompassing class of intellectual and developmental disabilities (IDD; Schalock et al., 2010).

Two core deficits of individuals with ID are cognitive or social-emotional self-regulation and language (Borkowski, Carothers, Howard, Schatz, & Farris, 2007). Individuals with ID experience, perceive, and produce emotion in atypical ways (Lewis & Sullivan, 1996). This makes it harder for caregivers and peers to interact appropriately and confidently, decreasing the likelihood that the individual with ID will understand their reactions (Walden & Knipes, 1996). These complex interactions (Brooks-Gunn, 2003) lead to distinct profiles of abilities and patterns of challenging behavior (Brassard & Boehm, 2007), such as self-injurious behavior (SIB), stereotyped behavior (stereotypy), and aggressive behavior (Didden et al., 2012).

This study focused on identifying models of challenging behavior over time for infants and toddlers with various developmental delays. Using structural equation

modeling (SEM) we tested various models of relationships among frequency and severity within these challenging behaviors over time and across diagnostic categories.

Self-Injurious Behavior

SIB is self-directed behavior that causes or has the potential to cause physical damage, occurs repeatedly, or is relatively idiosyncratic, and requires intervention (Rojahn, Schroeder, & Hoch, 2008). SIB ranges in severity, frequency, and topography (Rojahn et al., 2008). Some of the more common topographies include banging the head or body with other body parts or objects, self-biting, self-scratching, self-pinching, gouging body cavities with fingers, and self-hair pulling (Bodfish, Powell, Golden, & Lewis, 1995; Emberson & Walker, 1990; Emerson et al., 2001; Rojahn et al., 2008).

Prevalence. Most epidemiological research of SIB reports point prevalence rates, which are the proportion of identified cases within a population at a given point in time (Kiley & Lubin, 1983). Individuals with ID who engage in SIB usually show no symbolic meaning, thought, content, or affect during the exhibitions and seem to do so without shame or attempt to conceal their maladaptive behaviors (Favazza, 1996). Data on prevalence comes from questionnaires (with various operational definitions) for caretakers of those without verbal abilities and self-reporting in retroactive studies from those with verbal abilities. The number of individuals with ID that present SIB has been reported as anywhere from 1.7% (Rojahn, 1986) to 82% (Poppes, van der Putten, & Vlaskamp, 2010). The wide variability in prevalence reports is due to differences in sampling, criteria for SIB, and reporter perspectives (Roeleveld, Zielhuis, & Gabreels, 1997).

SIB is positively correlated with chronological age, severity of intellectual disability, and sensory and communication deficits (Rojahn et al., 2008). Prevalence rates of SIB among ID are not associated with gender (e.g., Collacott, Cooper, Branford, & McGrother, 1998; Emerson et al., 2001), but are strongly associated with level of functioning, where higher rates of SIB are seen with more severe intellectual impairment (Rojahn et al., 2008). Prevalence rates also differ according to the living environment of the individual, with higher rates of SIB associated with higher levels of restriction (Rojahn et al., 2008). Of course, it should be noted that this relation is not causal, and individuals with more frequent self-injury are sometimes understandably provided with more restrictive environments.

Etiology. Early onset of SIB appears to be consistent, with parental concern starting when the child is two years old (Borthwick-Duffy, 1994; Rojahn, 1994); however, the particular developmental trajectory of SIB appears to be less consistent. Some research has found a quadratic pattern, with an increase in the behaviors during early and middle childhood, a stabilization during adolescence, and a decrease during adulthood (Borthwick, Meyers, & Eyman, 1981; Saloviita, 2000). Other research has found that the trajectory was moderated by factors such as level of functioning, with severe and profound ID cases increasing self-injury in adulthood and moderate and mild ID cases showing a stable amount of self-injury across age groups (Jacobson, 1982). Despite these differences in progress and patterns, SIB can be extremely dangerous at any point in life, due to its diminishing effects on physical, cognitive, and social development, and to its general detriment to an individual's quality of life (Rojahn &

Esbensen, 2002). The extensive nature and lack of congruent developmental research of SIB supports the need for a greater understanding of its causes, maintenances, and complex interactional development.

One hypothesis of etiology is the gene-brain-behavior interactional model of SIB, which accounts for the continuous and ongoing process of SIB development and maintenance by evaluating the interactions of biology and environment. Couperus and Nelson (2006) described the contributions of early brain development to an individual's prognosis, from prenatal experiences to synaptic pruning in infancy and throughout youth. This plasticity of the brain provides social scientists with the potential to affect the growth of those with ID or atypical development, although the full mechanisms by which this gene-environment interaction is possible still remains to be revealed (Nelson & Bloom, 1997).

This research has also found genetic risk factors, as evidenced by the behavioral phenotypes of several genetic disorders, such as Lesch-Nyhan syndrome (Nyhan & Wong, 1996), Smith-Magenis Syndrome (Dykens & Smith, 1998), Cornelia de Lange Syndrome (Jackson, Kline, Barr, & Koch, 1993), Rett's Syndrome (Oliver et al., 1993; Deb, 1998), Prader-Willi Syndrome (Dykens & Kasari, 1997; Symons et al., 1999), Tourette's Syndrome (Bloch & Leckman , 2009), Fragile X Syndrome (Symons et al., 2003), and Autism Spectrum Disorders (ASD) (Duerden, Szatmari, & Roberts, 2012; Furniss & Biswas, 2012). Genetic and epigenetic antecedents to SIB are currently under study, and potentially monumental progress has been made with rat models, showing that a knockout of particular genes at specific periods of development can almost entirely

eliminate SIB (Schroeder, Loupe, & Tessel, 2008). This illustrates the importance of timing during brain development on the origin or exhibition of SIB.

There are two bio-behavioral models of SIB. The physiological states hypothesis (Guess & Carr, 1991) is that rhythmic stereotyped behaviors develop in response to under- or over- stimulating environments, and that these stereotypies then progress into SIB. The compulsive behavior hypothesis (King, 1993) is that a susceptibility to react compulsively to stress, anxiety, or task demands in combination with cerebral damage leads to SIB.

Although pharmacotherapy is widely used to help decrease symptoms of SIB, and some non-researchers use this as an argument for a simple underlying chemical cause, research shows very inconsistent results in regards to the effectiveness of neurochemicals. Some studies have found deficiencies in serotonin to be associated with SIB (Jawed, Krishnan, & Cassidy, 1994; Kolevzon et al., 2010; New et al., 1997; Weld et al., 1998), while other studies have not (Stanley et al., 2010). Research has found SIB to be associated with increases in dopamine (Sandman, 1990; Sandman & Hetrick, 1995), decreases in dopamine (Stanley et al., 2010), and not associated with dopamine (Verhoeven et al., 1999). Similarly, there are also highly inconclusive findings about the contributions of opioids to SIB as a source of internal reinforcement (Thompson, Symons, Delaney, & England, 1995).

Some consistent neurological risk factors for the development and maintenance of SIB are seizures (Coulter, 1990), degenerative neurological conditions (Breese et al., 2005), and abnormal pain perception (Symons & Thompson, 1997). Mental health risk

factors include mood disorders (Rojahn, Matson, Naglieri, & Mayville, 2004) and compulsions (King, 1993; Thompson et al., 1995). General medical risk factors include monthly menses for women, which involve body pains and fluctuations in hormones and emotions (Taylor, Rush, Hetrick, & Sandman, 1993), and inner ear infections (Luiselli, Cochran, & Huber, 2005). Developmental risk factors include age, level of intellectual disability, and sensory and communication deficits (Rojahn et al., 2008).

Measurement. There is limited research on the validity of measurement techniques for SIB in children with IDD. SIB may be measured through individualized functional analyses (Foxx, 2007) or comprehensive interviews or questionnaires (Horner, Carr, Strain, Todd, & Reed, 2002). It is worth mentioning that Horner et al. (2002) described that, at times, a child may outgrow a particular challenging behavior relatively quickly, and in these instances, the behavior may go unmeasured and undocumented.

Zaja, Moore, van Ingen, and Rojahn (2011) describe a hierarchical approach in assessing SIB directly. Interviews of individuals who are most familiar to the child should be performed first, followed by direct observations of the child's targeted behavior in a natural setting, and concluded with the use of an individualized functional assessment and rating scales to give the broadest and most detailed measurement of the targeted behavior (Zaja et al., 2011). The *Aberrant Behavior Checklist (ABC;* Aman & Singh, 1986*), Reiss Screen for Maladaptive Behavior* (Reiss, 1987), and *Diagnostic Assessment for the Severely Handicapped-Revised* (*DASH-II;* Matson, 1995), as well as the *Autism Diagnostic Interview-Revised (ADI-R*; Lord, Rutter, & Le Couteur, 1994), *Questions about Behavioral Function (QABF;* Matson & Vollmer, 1995*),* and *Functional*

Assessment for Multiple Causality (FACT; Matson et al., 2003) are some of the most widely used psychometric rating scales. With the exception of the *QABF* and *FACT*, the majority of these broad assessments fail to focus heavily on directly measuring problem behaviors.

Rojahn and colleagues contend that when measuring problem behaviors such as SIB, it is crucial to determine both the frequency and severity of the behavior because of the independent nature of each (Rojahn, Matson, Lott, Esbensen, & Smalls, 2001). To date, one of the only assessments to successfully measure these two components of challenging behavior is the *Behavioral Problem Inventory (BPI-01*; Rojahn et al., 2001).

Treatment. Much of the research on treating SIB in IDD has centered on individualized methods for those with ASD. Treatment methods are focused on two different techniques: behavioral and pharmacological. There is no single best way to treat SIB; rather, because SIB can vary in severity, frequency, topography, and function, both behavioral and pharmacological interventions should be tailored to the individual (Ernst, 2000; Foxx, 2007; Horner et al., 2002; Mahatmya, Zobel, & Valdovinos, 2008).

Researchers agree that the leading method in treating SIB is behavioral (Ernst, 2000; Foxx, 2007; Horner et al., 2002; Mahatmya et al., 2008). Functional assessments of the target behavior determine the specific applied behavior analysis (ABA) intervention that is used (Ernst, 2000; Fox, 2007; Horner et al., 2002; Mahatmya et al., 2008). Once the targeted antecedent is identified, behavior analysts intervene with methods such as a token economies and fading procedures (Fox, 2007), or functional communication training (Mahatmya et al., 2008), to reduce the challenging behavior. In some cases,

pharmaceuticals are used in conjunction with behavioral methods to manage extremely severe behaviors (Mahatmya et al., 2008).

Prevalence ratings have estimated that over 45% of individuals with a clinical diagnosis of autism receive psychotropic medicine to reduce SIB and other problem behaviors (Handen & Lubetsky, 2005). Because of abnormal serotonin levels, selective serotonin reuptake inhibitors (SSRI), such as fluoxetine (Prozac) or sertraline (Zoloft) can sometimes be successful. Antidepressants are prescribed in certain cases, although there is much conflicting evidence as to their effectiveness (Handen & Lubetsky, 2005; Mahatmya et al., 2008). Opioid antagonists are also suggested due to the diminished beta-endorphin levels that cause abnormal pain tolerance. The most popular pharmaceutical treatment method is the prescription of the Food and Drug Administration (FDA)-approved, risperidone (Risperdal), and other antipsychotics (Handen & Lubetsky, 2005; Mahatmya et al., 2008; Read & Rendall, 2007). Risperdal in particular is a successful dopamine and serotonin post-synaptic blocker with positive long-term and discontinuation results (Mahatmya et al., 2008).

Stereotyped Behavior

Stereotyped behavior (or stereotypy) is defined as restricted and repetitive patterns of behavior, interests, and activities, manifested by 1) preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus, 2) apparently inflexible adherence to specific, nonfunctional routines or rituals, 3) stereotyped and repetitive motor mannerisms, or 4) persistent preoccupation with parts of objects (American Psychiatric Association, 2000). Stereotypy is relatively common

among individuals with ID (Rapp & Lanovaz, 2011). The exhibition of stereotypy is highly heterogeneous, and the form it takes usually depends on the level of disability of the individual. These behaviors look bizarre, grotesque, and inappropriate to others, and they can interfere with everyday functions, disturbing the individual's quality of life (Gal, 2009; Jones, Wint, & Ellis, 1990).

Stereotypic behavior has been seen in both typically and atypically developing children as young as 22-months old (MacLean & Dornbush, 2012). Typically developing children usually stop these behaviors by age five (Kurtz, Chin, Huete, & Cataldo, 2012), whereas further manifestation of these proto-injurious stereotyped behaviors is commonly seen in children possessing associated risk factors (MacLean, Tervo, Hoch, Tervo, & Symons, 2010; Richards, Oliver, Nelson, & Moss, 2012). The stereotypic behaviors exhibited are often overlooked in hopes that the child will grow out of the behavior (Kurtz et al., 2012); however, it has been suggested that early diagnosis and intervention of stereotypy can prevent later development of SIB (Gal, Dyck, & Passmore, 2009; Richman, 2008). However, the "proto-injurious" theory has little support, and a recent literature review suggests that SIB typically appears earlier than stereotypy (Furniss & Biswas, 2012).

Prevalence. Little research has focused on the prevalence rates of stereotypic behavior in IDD, especially in comparison to typically developing individuals. This may be due to the different topographies and duration of target behaviors between these two populations (MacDonald et al., 2008). MacDonald et al. (2008) and Totsika, Toogood, Hastings, and Lewis (2008) do agree that while stereotypic behavior subsides in typically

developing individuals, the same behavior will most likely increase with age for atypically developing individuals. Totsika et al. (2008) also found that the more severe the behavior is, the longer it may persist. Honey, Rodgers, & McConachie (2012) found that stereotypic behavior occurs more in ASD than in ID or DD alone.

Etiology. Little research has focused on the etiology of stereotypic behavior in children with IDD (Honey et al., 2012). Tanimura, Yang, and Lewis (2008) did find an association between stereotypy and cortico-basal ganglia functioning in deer mice.

Measurement. Stereotypic behavior is measured using questionnaires and rating scales (MacDonald et al., 2007), live observations (Honey et al., 2012), and interviews (Duerden et al., 2012b). Three of the most cited, reliable, and valid assessment tools are the *Repetitive Behavior Questionnaire-2 (RBQ-2;* Leekam et al., 2007*)*, the *ADI-R*, and the *Repetitive Behavior Scale Revised (RBS-R*; Bodfish, Symons, & Lewis, 1999). Honey and colleagues (2012) have suggested that researchers should not disregard the severity and frequency of stereotyped behaviors. As with SIB, the *BPI-01* seems to be the only psychometric measure of severity and frequency in problem behavior in IDD (Gonzalez et al., 2009; Rojahn et al., 2001). It is worth noting, however, that the majority of this research has been conducted with individuals diagnosed with ASD.

Treatment. Stereotypy can be treated behaviorally or medicinally. ABA interventions for stereotyped behaviors typically begin with individualized functional analyses to determine motivational antecedents (Ahearn, Clark, MacDonald, & Chung, 2007; Athens et al., 2008). Once function has been determined, a more successful behavior program can be implemented. Taylor, Hoch, and Weissman (2005) found that

differential reinforcement of other behavior (DRO) lowered vocal stereotypy. Athens and colleagues (2008) implemented non-contingent reinforcement followed by a fading procedure to significantly diminish vocal repetition. Differential reinforcement, punishment, and response blocking are also popular behavioral interventions used in treating socially-mediated stereotypy (Hagopian & Toole, 2009). Researchers also contend that one of the most successful means of treatment is to enhance the child's environment (Ahearn et al., 2007; Hagopian & Toole, 2009).

Similar pharmaceuticals are used for stereotypy as for SIB. Clomipramine (Handen & Lubetsky, 2005) and valaxafine (Effexor) are highly regarded antidepressants (Handen & Lubetsky, 2005; Mahatmya et al., 2008). Handen and Lubetsky (2005) note that the SSRI, Zoloft, may successfully reduce repetitive and restricted behaviors in ID.

Aggressive Behavior

Research has found that children diagnosed with IDD are more likely to develop aggression than their typically developing peers (Cooper, Smiley, Morrison, Williamson, & Allan, 2007; Farmer & Aman, 2011; Rojahn, Zaja, Turygin, Moore, & van Ingen, 2012; Singh et al., 2007). Aggression can either be proactive (cold), where one acts with intentions to obtain a desired outcome, or reactive (hot), where one impulsively acts with anger without a deliberate purpose (Farmer & Aman, 2010; Farmer & Aman, 2011).

Although each case is considered idiosyncratic in nature and context, heightened aggression has been attributed to two overriding factors: 1) lack of adaptive and socially acceptable communication abilities (Koegal, Stiebel, & Koegel, 1998) and 2) social reinforcement (Marcus, Vollmer, Swanson, Roane, & Ringdahl, 2001; Rojahn et al.,

2012). There seems to be a bidirectional relationship between aggression and the child's social environment. For example, children with IDD tend to have fewer friends due to their aggressiveness (Marcus et al., 2001), and aggression directed towards parents and siblings can cause strained family relationships (Singh et al., 2007). Studies of this interactional development of aggression are limited, and much more work and improved measurement techniques are needed to confirm these findings (Farmer & Aman, 2009).

Prevalence. Although researchers have consistently found that aggression is more prevalent in those with IDD, especially in individuals diagnosed with ASD, there are almost no recent prevalence data available (Farmer & Aman, 2011). The lack of research could be due to the disagreement between numerous definitions and subdivisions of aggression (Farmer & Aman, 2011) or to the notion that frequent, less severe aggression is reported more often than severe, infrequent aggression (Cohen, Helen Yoo, Godwin, & Moskowitz, 2011). Benson and Brooks (2008) provided the only insight into possible prevalence rates; stating that over 50% of the IDD population engages in aggression, but only a fraction commit the behavior at severe or frequent levels.

Etiology. Research on the etiology of aggressive behavior in IDD is sparce (Matson, 2009). Matson (2009) suggested that aggression occurs more often in children who have lower social skills and fewer expressive language abilities, most specifically in individuals with a comorbid diagnosis of ASD. Research has shown that aggressiveness can originate and strengthen from reinforced behavior (Matson, 2009) as well as abnormal brain chemistry (Aylward et al., 1999). Aggressive behavior has been linked to irregular serotonin and cerebral activity (Matson, 2009). Aylward and colleagues (1999)

used MRI images to further relate this problem behavior to possible abnormalities of the brain's amygdala, hippocampus, medial temporal lobe, and striatum.

Measurement. Although questionnaires are widely used, the majority of these measurements are biased toward typically developing children and do not account for the inflated levels of aggression in individuals with IDD (Farmer & Aman, 2009). Farmer and Aman created and later validated (Farmer & Aman, 2010) a measure of aggression called the *Children's Scale of Hostility and Aggression: Reactive/Proactive (C-SHARE).* The C-SHARE has robust psychometric properties and is more representative of aggressive tendencies in children with IDD. However, research tends to favor ABA approaches to the recognition, measurement, and treatment of aggression in IDD over questionnaires (Koegel et al., 1998; Marcus et al., 2001; Rojahn et al., 2012).

Treatment. Aggression in IDD is often treated with individualized ABA interventions. In some cases, environmental changes and medication may be used as well. One therapy that targets parents involves meditation practices to encourage a clear and calm demeanor and a tolerant mindfulness when approaching their child's aggression. Research on this technique has shown enhanced levels of happiness in both the parent and child, improved parent-child relationships, and lower aggressive behavior (Singh et al., 2007).

In individuals who exhibit severe aggressive behavior, psychopharmacological intervention may be considered. Risperdal, one of the few drugs currently approved by the FDA, is prescribed for the management of significant aggression and behavioral problems. Risperdal is approved for children as young as 5 years old, and is often

administered to children with IDD (Scahill, Koenig, Carroll, & Pachler, 2007). Rigorous, placebo-controlled studies have concluded that, despite some rare but serious side effects involving weight gain, the drug is effective at managing aggressive and destructive behavior problems in children with IDD (Reyes, Croonenberghs, Augustyns, & Eerdekens, 2006), including ASD (Gencer, et al., 2008; Sharma & Shaw, 2012), Smith-Magenis Syndrome (Niederhofer, 2007), and Tourette Syndrome (Kim, Lee, Hwang, Shin, & Cho, 2005).

Functions of Challenging Behavior

Functional assessments and analyses are used to examine the causes of SIB, stereotypy, and aggression. These tools assess four distinct behavioral functions that maintain the target behavior: external positive reinforcement, external negative reinforcement, internal positive (automatic) reinforcement, and internal negative reinforcement. For example, challenging behavior can serve to receive attention or a tangible item from an adult or caregiver (i.e., external positive reinforcement), evade a social demand or a task (i.e., external negative reinforcement), produce a physical sensation (i.e., internal positive reinforcement), or reduce physical discomfort or pain (i.e., internal negative reinforcement).

Assessment of functional properties of the target behavior serves to customize individualized behavioral interventions that manipulate the antecedent or consequent or substitute the target behavior with a "replacement behavior." Functional assessment and analysis have been shown to greatly enhance the effectiveness of behavioral interventions in reducing any challenging behavior and increasing adaptive behavior (Rapp & Vollmer,

2005a; Reid, Parsons, & Lattimore, 2010). However, it is common for observers to assume that stereotypic behaviors are maintained by automatic reinforcement (Wilks et al., 2012). Stereotypy is even referred to as "stimming" in the literature to signify how the behavior is self-stimulatory in nature (Cunningham & Schreibman, 2008; Nind & Kellett, 2002). The majority of the literature using our current assessment options suggests that automatic reinforcement maintains most stereotypy (Rapp & Vollmer, 2005a), and researchers frequently refer to the neurobiological source of stereotypy, using evidence from nonhuman studies (Rapp & Vollmer, 2005b). In addition, sometimes a challenging behavior serves multiple functions for an individual at a given time (Matson & Boisjoli, 2007) or changes in function over time (Lerman, Iwata, Smith, Zarcone, & Vollmer, 1994; Vollmer & Iwata, 1991). A recent study by Rojahn et al. (2012) found that unique functions maintain various challenging behaviors. For example, SIB and stereotypy served nonsocial functions (internal reinforcement) more often than aggression.

Functional assessments are often used to identify the contingencies maintaining aggression since there is a large social operant conditioning component to the behavior (Koegel et al., 1998; Marcus et al., 2001; Rojahn et al., 2012). Social attention tends to be the dominant positive reinforcer of aggression in children with IDD, but gaining socially mediated material items (positive reinforcement) and escaping demands or events (negative reinforcement) are also common (Marcus et al., 2001; Rojahn et al., 2012).

Risk Factors for Challenging Behaviors

The most common risk factors for the occurrence of stereotypy and SIB in children are IDD, a diagnosis of autism, and genetic syndromes (i.e. Fragile X, Down

syndrome, Lesch-Nyhan) (Kurtz et al., 2012; Muehlmann & Lewis, 2012; Richards et al., 2012; Richman, 2008; Schroeder & Courtemanche, 2012). Often, these primary risk factors are comorbid with one another (MacLean & Dornbush, 2012; MacLean et al., 2010; Richards et al., 2012). Individuals with ASD tend to have more severe challenging behaviors than atypically developing individuals without ASD (MacLean et al., 2010), and more severe autistic symptoms are positively related to the frequency of challenging behaviors (Matson & Rivet, 2008).

Muehlmann and Lewis (2012) suggested that tic disorders, such as Tourette Syndrome and Obsessive Compulsion Disorder (OCD) might be one root of stereotypy. Some research has shown higher frequency of stereotypy during low stimulating conditions, alluding to a more environmental origin (Hall, Thorns, & Oliver, 2003). Sensory and physical disabilities, communication deficits, underdeveloped motor skills, low mood, and age are some factors that account for SIB prognoses (Hayes, McGuire, O'Neill, Oliver, & Morrison, 2011; Kurtz et al., 2012; MacLean & Dornbush, 2012; MacLean et al., 2010; Oliver, Hall, & Murphy, 2005; Poppes et al., 2010; Richards et al., 2012; Richman, 2008). However, a recent study of stereotypic behaviors in 140 adults with severe and profound ID and ASD found that gender, but not age, was associated with frequency of stereotypy, with males displaying greater stereotypy than females (Hattier, Matson, Tureck, & Horovitz, 2011).

Interrupted sleep, impulsivity, and disruptiveness have also been identified as contributing to challenging behaviors (Furniss & Biswas, 2012; MacLean & Dornbush, 2012; MacLean et al., 2010), with low behavioral inhibition proposed as leading to

impulsivity and hyperactivity and later stereotypy and destructive behavior and unusual habits as leading to SIB (Burbridge et al., 2010).

A meta-analysis by McClintock, Hall, and Oliver (2003) found that only SIB and stereotypy were associated with more severe and profound disability levels. They also concluded that males tend to exhibit more aggression than females, and receptive and expressive communication deficits are associated with more SIB. The role of IQ and disability level may be different for frequency and severity of challenging behaviors, where lower IQ predicts increased frequency of all three challenging behaviors but only the severity of SIB and stereotypy (McTiernan, Leader, Healy, & Mannion, 2011). In other words, the severity of aggression was not related to the level of intellectual disability.

Structural equation modeling of SIB in 617 individuals with ASD found that impulsivity and stereotypy were strong predictors of the frequency of SIB, controlling for disability level and IQ (Richman et al., 2012). The majority of this sample was male and Caucasian, and the average age was 11 years old.

Prevalence, Frequency, and Severity of Challenging Behaviors

Poppes et al. (2010) found that out of 180 individuals with profound ID, 82% displayed SIB and stereotypy, while 45% displayed aggressive behaviors. However, frequency rates were comparable across topographies; SIB was displayed hourly, daily, or weekly, stereotypy was displayed hourly or daily, and aggressive behavior was displayed hourly or weekly.

The predictive power of risk factors for challenging behavior varies in regards to which stability factors are investigated: frequency or severity (Totsika et al., 2008). A recent study of 644 toddlers between 17-37 months old at risk for DD showed that severe challenging behaviors were less common than mild challenging behaviors; however, those children who had severe challenging behaviors were more likely to exhibit aggression.

Structure and Patterns of Challenging Behaviors

The long-term course of challenging behaviors has only just recently been investigated. Overall, research has shown that challenging behaviors typically develop early, are pervasive and chronic (Fodstad, Rojahn, & Matson, 2012), and are highly correlated (Totsika et al., 2008). A longitudinal study of 58 adults with ID in a residential setting found that individuals with severe aggression and SIB paired with highly frequent stereotypy were more likely to present these challenging behaviors 11 years later; whereas the severity of challenging behaviors did not predict the severity of later challenging behaviors (Totsika et al., 2008). Age and level of adaptive behavior were also predictors of the persistence of challenging behaviors.

In a cohort study of 49 individuals with ID and SIB, researchers found that 84% exhibited SIB 20 years later, with no significant changes in the topography or severity (Taylor, Oliver, & Murphy, 2011). A review by Furniss and Biswas (2012) found that the presence of SIB (measured by frequency of symptoms) seems to be often chronic, regardless of behavioral interventions.

The Current Study

Few studies have looked at the interactional structure of challenging behavior over time. One recent study of 943 children between 4-18 years old with severe ID and showed that high frequency repetitive behavior (stereotypy) was a risk factor for later severity of SIB and the presence of other challenging behaviors (Oliver, Petty, Ruddick, & Bacarese-Hamilton, 2012).

There is a need to look at the structure of challenging behaviors, adopting a more dimensional approach rather than categorical approach (Achenbach, 2000). Furthermore, there is theoretical work to be done such that behavior problems can be understood in relation to sequences, processes, and developmental tasks (Achenbach, 2000). The developmental processes producing externalizing challenging behavior must be identified; therefore, children should be classified based on patterns of behavior rather than topography of behavior (Tackett, 2010).

In summary, research has shown that disability level or IQ, certain diagnoses, and gender are risk factors for these challenging behaviors. Some behavior assessments include a measure of both the frequency and severity of challenging behavior, which provide qualitatively different information. However, frequency and severity are often highly correlated, and for simplicity, most research focuses on frequency alone. Longitudinal research of challenging behaviors is often limited to severe or profound institutionalized populations, to only one of the three challenging behaviors, and to a homogeneous diagnostic group (e.g. ASD). There are very few studies utilizing structural

equation modeling that can better account for error in measurement and better estimate parameters than commonly used analysis of variance (ANOVA) techniques.

Research Questions. Our three research questions were: 1) What is the stability in frequency and severity of the three challenging behaviors (SIB, stereotypy, and aggression)? Consistent with the literature, we hypothesized that these behaviors would be stable over time. 2) Does earlier frequency set the stage for worse severity later on, does earlier severity set the stage for higher frequency later on, or are both influences involved? Little research has investigated these questions; however, we hypothesized that both influences would be involved given their high correlation in past research. 3) Do these relations change as a function of diagnostic group? Little research has investigated this question as well; however, we hypothesized that the relations would be most apparent for children at-risk for Autism since challenging behaviors have been most clearly associated with this diagnostic group.

Method

Participants

Data for this study came from a longitudinal, on-going research project at the Centro Ann Sullivan del Peru (CASP) in Lima, Peru. Participants were recruited with media advertisements targeted towards parents. Roughly 1,000 parents called CASP expressing concerns for their child's development, 341 of these parents were interviewed over the phone using the *Parental Concerns Questionnaire (PCQ),* and 262 of these interviews met the criteria for enrollment in the on-going study based on IDD risk factors such as genetic factors, family history of disabilities or disorders, neuropsychological

factors, and communications deficits (see Mayo et al., 2012 for full study description). Twenty individuals were removed from the dataset due to missing data on the Bayley cognitive scale, which we used as a covariate in subsequent analyses.

One hundred and sixty children with developmental delays participated in this longitudinal study. There were 103 boys and 57 girls ranging in age from 4 to 44 months at the first observation point (m = 27.4, SD = 9.78). The majority of the sample were considered "at-risk for autism" (n = 70), and the rest were either diagnosed with Down's Syndrome (DS; n = 41), or experiencing other developmental delays ("Other"; n = 49). In multi-group analyses, children with DS or with other developmental delays were collapsed into one "Developmental Delays" group and compared to children who were "At-risk for Autism".

Instruments

Behavior Problems Inventory (BPI-01). The *BPI-01* (Rojahn, Matson, Lott, Esbensen, & Smalls, 2001) contains 49 items measuring challenging behaviors that have occurred once during the past two months on frequency (0 = *never*, 1 = *monthly*, 2 = *weekly*, 3 = *daily*, 4 = *hourly*) and severity (0 = *no problem*, 1 = *a slight problem*, 2 = *a moderate problem*, 3 = *a severe problem*). These challenging behaviors are divided into three subscales: SIB (14 items), stereotypic behavior (24 items), and aggressive or destructive behavior (11 items).

The norming sample consisted of 432 individuals with ID (54% male), ranging in age from 14 - 91 (primarily adults), who were in residential care, where 84.2% of participants had severe or profound ID. The *BPI-01* was administered by four graduate

students by means of interviews with staff who knew participants well. From this sample, a confirmatory factor analysis found the three factor structure described above to be appropriate (Rojahn et al., 2001). Factor validity was later supported with independent confirmatory and exploratory factor analyses, and the three factor structure fit the data well (Gonzalez et al., 2009).

Frequency and severity were found to be highly correlated across subscales (r = .90), and for SIB specifically, (r = .93) (Gonzalez et al., 2009; Rojahn et al., 2001). The internal consistency of the frequency of SIB has been reported as α = .61 (Rojahn et al., 2001), α = .48 (Gonzalez et al., 2009), and α = .71 (Sturmey, Sevin, & Williams, 1995). Test-retest reliability (one week delay) of the frequency scales was high with r = .71 (Gonzalez et al., 2009) and 96% agreement (Sturmey, Fink, & Sevin, 1993).

Inter-rater agreement was acceptable, with a kappa of .65 and 95% agreement (Sturmey et al., 1993). Criterion- related validity has been established in multiple situations. The *BPI-01* was compared with the *RBS-R*, and correlated at r = .77 (Bodfish, Symons, & Lewis, 1999). The *BPI-01* was compared to the *ABC*, and the two assessments showed largely consistent results and converged and diverged appropriately (Rojahn, Aman, Matson, & Mayville, 2003). The *BPI-01* was also compared with the *Autism Spectrum Disorders-Behavior Problems for Intellectually Disabled Adults (ASD-BPA*; Matson & Rivet, 2008*),* and the two instruments converged appropriately (Rojahn, Wilkins, Matson, & Boisjoli, 2010).

Overall, the *BPI-01* has undergone several reliability and validity examinations, and has shown itself to be a reliable, helpful, and useful tool. The authors highlight

multiple uses for the *BPI-01* including clinical assessment, intervention planning, behavior monitoring, and scientific research (Rojahn et al., 2001). The few criticisms include (1) the little explanation of administration and scoring and (2) that most of the psychometric research of the *BPI-01* has used groups of adults with severe to profound ID. However, a few studies have found it was useful to assess symptomatic drug-related behavior change in children and adolescents with mild ID (Aman et al., 2002; Snyder et al., 2002).

Bayley Scales of Infant Development, 3rd Edition. The *Bayley Scales of Infant Development-3* (*Bayley-3*; Bayley, 2006) is an assessment for children between 1 to 42 months old with scales to assess development in five domains: Cognitive, Language, Motor, Social-Emotional, and Adaptive. The psychometric properties of the *Bayley-3* are impressive, with an abundance of separate studies supporting the instrument's reliability, validity, and factor structure (Albers & Grieve, 2007; Scattone, Raggio, & May, 2011; Steenis, Verhoeven, & van Baar, 2012). Only the cognitive scale was administered at the time of entrance into this study, and these scaled scores served as an indication of IQ or intellectual disability level for the participants in this study.

Procedures

Demographic information was acquired from the parent during the initial observation (i.e., child's gender, child's age, family income, parents' marital status, and parents' education). Cognitive scores on the *Bayley-3* were recorded at the first observation, and the *BPI-01* was recorded at all three observations, approximately six months apart for each participant, creating one year of data on this cohort with three

equally-spaced time points. At the time of this data extraction, only 23 families had dropped out of the study for various reasons (e.g., loss of cell phone contact, moving, hospitalization, or illness).

The data for this study only include participants who completed all three rounds of *BPI-01* data and had Bayley cognitive scale scores at time 1 (N = 160). Participants who did not have data for the Bayley cognitive scale and were subsequently removed from the dataset did not differ significantly from those who had Bayley cognitive scale scores on age, t (178) = -.05, p = .961, parent income, t (175) = .53, p = .597, or gender, χ^2 (1) = 3.56, p = .079. However, participants were more likely to have other developmental delays besides DS or at-risk for autism, χ^2 (2) = 15.73, p < .001 (See Table 1 for demographic information). Children at-risk for autism were more likely to be male, χ^2 (1) = 6.98, p = .008, more likely to be older, t (157.99) = -3.12, p = .002, and more likely to score higher on the Bayley Cognitive scale, t (157.52) = -3.51, p = .001. These differences supported including gender and IQ as covariates in subsequent analyses.

Parents of participants were provided with six workshops on strategies and support for raising a child with IDD. CASP also contacted families every month by phone to monitor the child's behavior and provide suggestions for assisting with common concerns (e.g., daily living skills, eating, sleeping, and discipline). This intervention seemed to reduce family stress and prevent drop-out throughout the study (paper being prepared for another publication).

Analytic Approach

Our main analyses took place within a Structural Equation Modeling (SEM) framework which assumes data be normal, continuous, or dummy coded (Willett, Singer, & Martin, 1998). We examined skewness and kurtosis values to determine normality for the *BPI-01* challenging behavior observations. The range of normal skewness values was plus or minus two standard errors: -.36 to .36. All observations failed this test of normality. The range of normal kurtosis values was plus or minus two standard errors: -.72 to .72. Most of the observations failed this test of normality, and a bonferroni adjustment was unsuccessful. To handle this non-normal data, we used Generalized Least-Squares (GLS) estimation instead of the default Maximum Likelihood (ML) estimation. One risk to this method is that GLS may accept incorrect models and return inaccurate parameter estimates more often than ML (Olsson, Foss, Troye, & Howell, 1999). However, when the hypothetical model fits the data well and is, in reality, not false, Bollen (1989) found that GLS and ML produce identical results (e.g., fit statistics, parameter estimates).

Table 1. Demographic information by diagnostic category

	Diagnosis		
	At risk Autism	Down Syndrome	Other
N	72	44	49
Females	24.3%	56.1%	34.7%
Males	75.7%	43.9%	65.3%
Age in months at time 1 (*M*, *SD*)	30.01, 8.11	21.93, 10.02	28.35, 10.12
Bayley Cognitive (*M*, *SD*)	6.23, 2.72	3.76, 3.04	5.22, 3.42
Self-injury present at time 1	94.3%	82.9%	75.5%
Stereotypy present at time 1	98.6%	68.3%	83.7%
Aggression present at time 1	87.1%	78.0%	81.6%

Statistical Analyses

To answer our research questions, we built cross lagged autoregressive models of challenging behavior. We entered the respective challenging behavior *BPI-01* frequency and severity score for times 1, 2, and 3 as manifest variables with error terms. We constrained the regression weights to be the same over time separately for frequency and severity. We added gender and IQ (cognitive scaled score from *Bayley-3*) as exogenous, correlated, predictors of the six time points. We also constrained the correlations among the error terms across frequency and severity to be the same for time 2 and time 3. This was our unconditional model for all three challenging behaviors. To answer our first research question about the stability of frequency and severity in challenging behaviors, we had to identify the best fitting models of each challenging behavior, and then we examined the path coefficients for frequency and severity over time. Using

recommendations made by Choudhury (2009), we determined the strengths of these coefficients, and therefore the strength of stability.

To answer our second research question, does earlier frequency set the stage for worse severity later on, does earlier severity set the stage for higher frequency later on, or are both sets of association involved, we compared the model of frequency as a leading indicator of severity and severity as a leading indicator of frequency to the unconditional model, and the cross-lagged model to the best fitting uni-directional model. Chi-square statistics were used from each model in chi-square change tests to determine the best fitting model of challenging behavior.

To answer our third research question of whether the best fitting models varied across diagnostic groups, we performed a multi-group analysis for each challenging behavior, comparing the sample of toddlers at-risk for autism and toddlers with other developmental delays. We used a similar strategy of examining relative fit across models which allowed the best fitting model to vary across groups, a model which constrained the stability between time points to be the same across groups, and models which constrained the frequency and severity lags to be the same across groups.

Results

Stability in Frequency and Severity

The best fitting models, which constrained the unstandardized frequency and severity regression paths respectively, showed different levels of stability for the challenging behaviors (See Figures 1-3 for the standardized path coefficients). The frequency of both SIB and stereotypy appeared to be very stable over time, with betas

ranging from .51 to .92; whereas the frequency of aggressive behavior was very weak and unstable, with betas ranging from .09 to .10. However, severity of both SIB and stereotypic behavior was unstable, with betas ranging from .14 to -.23, while the severity of aggression was very stable over time, with betas ranging from .62 to .67. Interestingly, these paths were weak and negative for the severity of stereotypy over time, meaning that greater earlier severity was related to lower severity at future time points.

Does Earlier Frequency Set the Stage for Worse Severity, Does Earlier Severity Set the Stage for Higher Frequency, or are Both Influences Involved?

Each behavior provided its own answer to this question based on its final model. The best fitting model for SIB was a unidirectional model which accounted for frequency as a leading indicator of severity (Table 2; Figure 1), with betas ranging from .33 to .39. The bidirectional model was trending towards significance, but the unidirectional, frequency leading to severity model was the best, most parsimonious representation of the data. This means that frequency is an influential variable in the development of SIB frequency and severity over time, holding gender and IQ constant. Children who exhibited highly frequent self-injury tended to have more frequent and more severe SIB at later time points, controlling for child's gender and IQ.

Table 2. Chi-square change test statistics for SIB

	χ^2	df	$\Delta\chi^2$	Δdf	*p*
Unconditional	43.0	11			
F -> S*	33.8	10	9.2	1	.002
S -> F	34.0	10	9.0	1	.003
F <-> S	30.9	9	2.9	1	.089

Note: F = Frequency; S = Severity; * = best fitting model

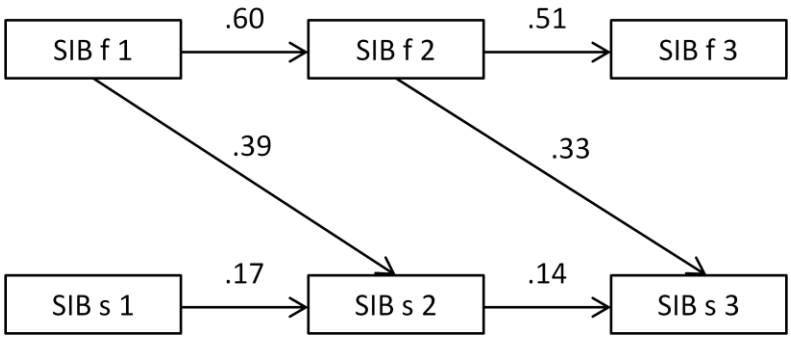

Figure 1. Best fitting model for SIB with standardized path coefficients.
Notes: For simplicity, covariates (gender and IQ) and error terms have been removed from the figure. f = frequency; s = severity.

The best fitting model for stereotypy was a fully cross-lagged auto regressive model, with both frequency and severity implicated as leading indicators of future stereotypy (Table 3; Figure 2). The path coefficients show that the frequency of stereotypy was strongly related to the frequency (with betas ranging from.90 to .92) and severity (with betas ranging from .79 to .80) of later stereotypy, meaning that children who exhibited highly frequent stereotyped behavior also exhibited highly frequent and highly severe stereotyped behavior in the future. The severity of stereotypy was negatively related to the future frequency (with betas ranging from -.29 to -.41) and severity (with betas ranging from -.19 to -.23) of stereotypy, meaning that the severely stereotypic behaviors were associated with less frequent and less severe stereotypy in the future. These relationships were found while controlling for child gender and IQ.

Table 3. Chi-square change test statistics for Stereotypy

	χ^2	df	$\Delta\chi^2$	Δdf	*p*
Unconditional	59.0	11			
F -> S	38.2	10	20.8	1	.000005
S -> F	58.3	10	.7	1	.403
F <-> S*	32.3	9	5.9	1	.015

Note: F = Frequency; S = Severity; * = best fitting model

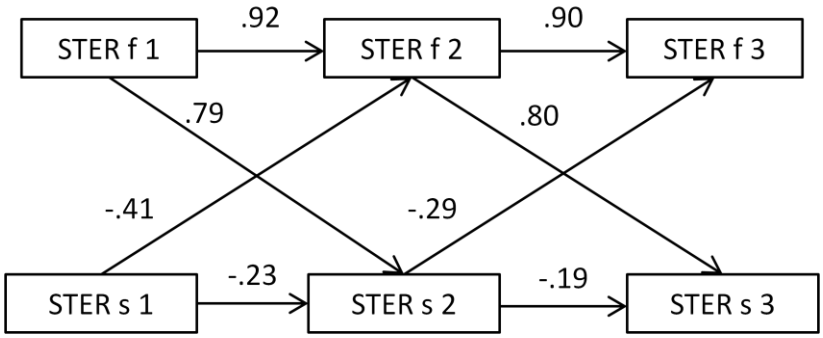

Figure 2. Best fitting model for stereotypy with standardized path coefficients.
Notes: For simplicity, covariates (gender and IQ) and error terms have been removed from the figure. f = frequency; s = severity.

The best fitting model for aggression included paths from earlier severity to later frequency (Table 4; Figure 3). The high standardized path coefficients show that the severity of aggressive behavior is associated with later frequency (with betas ranging from .49 to .53) and severity (with betas ranging from .62 to .67). This means that severity is an influential element in the development of aggressive behavior's frequency and severity over time, holding gender and IQ constant. In other words, children who exhibited severely aggressive behavior were likely to show more severe and highly frequent aggression in the future, controlling for gender and IQ.

Table 4. Chi-square change test statistics for Aggression

	χ^2	df	$\Delta\chi^2$	Δdf	*p*
Unconditional	55.7	11			
F -> S	43.8	10	11.9	1	.0006
S -> F*	27.8	10	27.9	1	.0000001
F <-> S	27.7	9	.1	1	.752

Note: F = Frequency; S = Severity; * = best fitting model

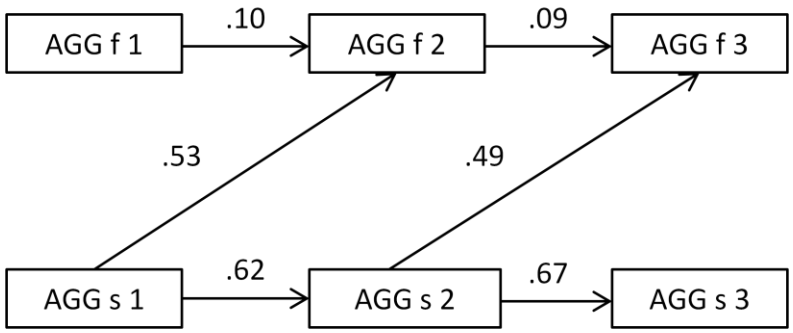

Figure 3. Best fitting model for aggression with standardized path coefficients. Notes: For simplicity, covariates (gender and IQ) and error terms have been removed from the figure. f = frequency; s = severity.

Do These Relations Change as a Function of Diagnostic Group?

The multi-group analyses showed that the models generalized to both groups (at-risk for autism and other developmental delays) for SIB (Table 5), stereotypy (Table 6), and aggression (Table 7). In other words, the models did not fit worse when constrained to fit across both groups.

Table 5. Chi-square change test statistics for SIB multi-group

	χ^2	df	$\Delta\chi^2$	Δdf	*p*

Free to vary	51.3	22			
Stability constrained	51.4	24	.1	2	.951
F->S constrained	53.8	25	2.5	3	.475

Note: F = Frequency; S = Severity

Table 6. Chi-square change test statistics for Stereotypy multi-group

	χ^2	df	$\Delta\chi^2$	Δdf	*p*
Free to vary	51.2	20			
Stability constrained	52.1	22	.9	2	.638
F->S constrained	52.1	23	.9	3	.825
S->F constrained	52.1	23	.9	3	.825
Cross-lag constrained	52.1	24	.9	4	.925

Note: F = Frequency; S = Severity

Table 7. Chi-square change test statistics for Aggression multi-group

	χ^2	df	$\Delta\chi^2$	Δdf	*p*
Free to vary	40.55	20			
Stability constrained	45.51	22	4.96	2	.084
S->F constrained	45.92	23	5.37	3	.147

Note: F = Frequency; S = Severity

General Discussion

This research investigated the relationships among frequency and severity for three challenging behaviors (SIB, stereotypy, and aggression) in children who were diagnosed or at risk for various IDDs (i.e. DS, at-risk for Autism, or other delays). Three findings emerged: there was variability in the stability of frequency and severity over time, there was variability in the models of these factors across different challenging behaviors, and these models of challenging behavior did not vary across diagnostic categories.

Variable Stability of Frequency and Severity

We found that the frequency if SIB and stereotypy were relatively stable over time, which supports several previous studies (i.e., Fodstad et al., 2012; Furniss & Biswas, 2012; Taylor et al., 2011). Whereas those studies compared average rates of challenging behavior over large periods of time, this study examined the behaviors within a much tighter timeframe of one year. However, we found that the severity of SIB and stereotypy were relatively unstable over time. Finally, we found that the severity of aggressive behavior was very stable, while the frequency of aggressive behavior was very unstable. These findings highlight the importance of treating various challenging behaviors as distinct behavioral profiles, with two potential targets for intervention: the frequency and severity of the behaviors. For example, a child exhibiting severe SIB may not be as concerning as severe aggressive behavior, and a child exhibiting highly frequent SIB may be more concerning than highly frequent aggressive behavior.

Variable Models of Challenging Behavior

We found each domain of challenging behavior had a different way that frequency and severity played out over time. The frequency of SIB was a strong leading indicator of later SIB frequency and later severity. This could be of importance to caregivers and practitioners creating or implementing behavior modification plans. A main target for SIB intervention should be the frequency of the behavior to potentially lower the development of more severe and frequent SIB in the future.

The frequency of stereotyped behavior was a strong leading indicator of the future frequency and severity of stereotyped behavior. Concurrently, the severity of stereotypy

was a negative leading indicator of future severity and frequency. This negative relationship may be due to concerned parents receiving more specific or helpful suggestions during the intervention. When their child displayed highly severe stereotypy earlier in the study, the research staff's support and guidance may have modified parent behaviors to produce decreases in frequency and severity at later points in the study. Parents may have been more concerned, expressed more concern, and received more information in response to highly severe stereotypy relative to highly frequent stereotypy.

The severity of aggression was a leading indicator of the frequency of later aggression. This provides an argument to those who currently remove severity data from their studies for simplicity reasons, due to the common correlation between these topographies. Stereotypy was best described using a cross-lagged auto regressive model, where both frequency and aggression were both involved as leading indicators. This information could be useful for practitioners, caregivers, and families in terms of assessment and target variables for behavioral interventions. This may also serve as a starting point for assessment and intervention for particular challenging behaviors in toddlers.

Similar Models across Diagnostic Categories

Finally, we found that these distinct challenging behavior models did not differ significantly between the toddlers at-risk for autism and the toddlers with other developmental delays. This may support the practice of assessing and intervening similarly to combat distinct challenging behaviors, regardless of diagnostic categories. The lack of distinction that we found could be due to the diagnostic categories not having

differentiated yet behaviorally at this young age. Thus, this conclusion should only be applied to cases of individuals in early intervention programs or prior to receiving any formal IDD diagnosis. Some research has shown similar findings in infants and toddlers with challenging behaviors (Sipes, Rojahn, Turygin, Matson, & Tureck, 2011); whereas, others have found distinct patterns of challenging behaviors for toddlers at risk for autism (Matson, Mahan, Sipes, & Kozlowski, 2010).

Limitations

One limitation to the current study is the period of observation. As discussed by Mitchell and James (2001) and Singer and Willet (2003), the time of measurement is crucial for identifying relationships between variables. Although equally spaced and during the early years of rapid developmental growth, three observations over a year may not have been the specific observations required to accurately represent the larger picture of how these behaviors progress over time. Future research would benefit from a longer study and more points of observation around periods of intense development that take place in the early years.

A second limitation to this study is that the parents of participants had access to a mild behavioral intervention throughout the year that they were observed. This clearly changed the type of data obtained and could be considered a very particular sample within this population, limiting generalizations. However, the percentage of individuals with IDD who seek as well as receive assessments and services for challenging behavior is high, given our improvements in this area over the past years. Since families of children with IDD are most likely provided similar behavior intervention experiences, we

argue that the results of these models can be generalized to a typical individual with IDD. Future research should collect data to examine the potential confounding effects of an intervention program for challenging behavior development and progression, since parents of different challenging behaviors could have received slightly different information and support.

A third limitation to this study is the small number of diagnostic categories represented. As these challenging behaviors are commonly exhibited by several genetic disorders (e.g., Smith Magenis Syndrome and Cornelia de Lange Syndrome), future research should examine how well these models hold up across other diagnoses and in populations of children without any diagnosis or risk for diagnosis. The development of these behaviors in an otherwise typically developing population could provide a good basis of comparison for just how atypical these challenging behaviors are in a group of young children.

Finally, as with all SEM analyses, causal conclusions cannot be made, and the relationships among the variables are simply correlations. The advantage of examining models of patterns of behavior is not without its disadvantages. However, we believe this research adds a new perspective on this field, and is worth pursuing to assist in the development of interventions for children with highly frequent and severe challenging behaviors. Another limitation of SEM is that the models are data specific, as we are examining the how well the specific data fits these theoretical models. As this dataset was not large enough to split and conduct validating replication studies, future research should pursue replication of these models with various datasets of challenging behaviors.

Conclusions

This research brings a relatively new type of statistical research in the IDD population. We examined the theoretical models of the relationship between frequency and severity among challenging behaviors across different diagnostic groups. More studies are needed that attempt to establish a theoretical model for the development and progression for various challenging behaviors for various diagnostic categories. While previous researchers have tended to eliminate severity data in favor of a simpler frequency study, our findings support the inclusion of severity as providing important additional information. Finally, this study supports generally treating toddlers with developmental delays and toddlers at-risk for autism as similar in their progression of particular challenging behaviors, but treating different challenging behaviors as unique in their progression and influences.

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