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Co-Occurring Behavior Problems in Youth with Intellectual and Developmental Disabilities: A Developmental Perspective

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ABSTRACT OF THE DISSERTATION

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by

Yasamin R. Bolourian

Doctor of Philosophy, Graduate Program in Education
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Dr. Jan Blacher, Chairperson

The objective of this dissertation is to explore the nature of behavior problems at crucial stages of development. Following a brief overview of autism spectrum disorder (ASD) and intellectual disability (ID), including the expression of co-occurring behaviors in these populations, two related studies are presented. Both studies utilized the instruments of the *Achenbach System of Empirically Based Assessments* (ASEBA; Achenbach & Rescorla, 2000; 2001) to describe behavior problems, as observed during early childhood to adolescence. Study 1 utilized a sample of young children, ages 5 years and under, deemed at risk of a developmental disorder who were referred to a university-based screening clinic to be assessed for possible ASD. The objective of Study 1 was to empirically identify homogenous classes of emotional and behavioral syndromes during early childhood. Using latent class analysis, results revealed that behaviors clustered into two classes: a highly behavioral class characterized by emotion dysregulation difficulties (56%) and a normative class (44%). Predictors of autism classification and severity were included in the analysis but yielded no significant effects. These findings highlight the need to assess emotional regulation issues prior to formal schooling and to provide emotion-focused interventions that may foster the use of effective coping strategies. Study 2 utilizes a sample of children and adolescents with and without ID from a NICHD-funded longitudinal study (PIs: Bruce L. Baker, Jan Blacher, & Keith Crnic). The aim of Study 2 was (a) to examine the trajectory of behavior problems from ages g to 15 and (b) to explore whether a transactional relationship exists between behavior problems and social skills over these time points. Controlling for disability status, results of a fitted path analysis model revealed that ratings of behavior problems (internalizing and externalizing) and social skills were highly stable over time. A behavior-driven model fit the data best and revealed that behaviors in early adolescence significantly contributed to later social difficulties. Findings illustrate how challenging behaviors may impact emerging social competence during adolescent years. Implications for practice and future research directions are discussed.

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CHAPTER I

Introduction

Elevated behavior problems in individuals with autism spectrum disorder (ASD) and intellectual disability (ID) are frequently reported across clinic and research settings and have been associated with negative child and family outcomes. These co-occurring conditions have been linked to detrimental life outcomes for the individual, such as social isolation, failed attempts at community living, and poor academic and vocational functioning (Pearson et al., 2000). Significant behavioral issues undoubtedly interfere with an individual's functioning (learning, community integration, socialization), while also creating substantial challenges to caregivers and support agencies (Emerson et al., 2010). Family studies have shown that behavior problems of children with ASD or ID significantly predict negative familial well-being, such as poor parental mental health, marital maladjustment, negative sibling impact, and overall poor quality of life (Baker, Blacher, & Olsson, 2005; Baker et al., 2003; Davis & Gavidia-Payne, 2009; Gardiner & Iarocci, 2012; Hauser-Cram, Warfield, Shonkoff, & Krauss, 2001; Maskey, Warnell, Parr, Le Couteur, & Conachie, 2013; Neece, Blacher, & Baker, 2010; Tonge & Einfeld, 2003). Due to the evidence of substantial impact, increased research attention has focused on the behavior problems of youth with ASD or ID, which has led to a greater awareness of the importance of recognizing coexisting conditions in the assessment, diagnosis, and treatment of these disorders.

Despite the high risk of behavior problem and associated negative outcomes in ASD and ID populations, there is much to learn about the presentation and trajectory of these issues across childhood and adolescence. Thus, this dissertation focuses on the behavior problems of youth with ASD or ID during crucial developmental periods.

Autism Spectrum Disorder and Intellectual Disability

Autism spectrum disorder (ASD) is a pervasive neurodevelopmental disorder characterized by substantial deficits in two domains: (1) social interaction and communication, and (2) restricted, repetitive patterns of behavior (American Psychiatric Association [APA], 2013). Standardized diagnostic assessments with sound psychometric properties should be used to assess autistic-like behaviors. Such instruments include caregiver- and self-ratings on interviews and questionnaires (e.g., *Social Communication Questionnaire* [SCQ]; Rutter, Bailey, & Lord, 2003), as well as clinician behavioral observation measures (e.g., *Autism Diagnostic Observation Schedule, Second Edition* [ADOS-2]; Lord, Rutter, DiLavore, & Risi, 2012).

Between 2002 and 2014, prevalence estimates of ASD demonstrated a steep upward trend. In 2014, the Centers for Disease Control and Prevention (CDC) estimated that 1 in 68 children has a diagnosis of ASD, up from a rate of 1 in 88 in 2008, 1 in 110 in 2006, and 1 in 150 in 2002. While reasons for this increase are greatly debated, posited explanations include methodological differences in epidemiology studies (i.e., instrument use, sample size, geographic location), broadening of diagnostic criteria, and an increased awareness of autism across public and professional realms (Fombonne, 2005; Fombonne, 2009). Phenotypic heterogeneity has also been linked to the complexity of diagnosis and clinical presentation of ASD (Masi, DeMayo, Glozier, & Guastella, 2017), a verdict that has been supported by genetic (Jeste & Geshwind, 2014; Geschwind & Levitt, 2007) and neuroimaging studies (Lenroot & Yeung, 2013). As frequently quoted from Stephen Shore, "If you've met one person with autism, you've met one person with autism." Concomitant symptoms and diagnoses are also common among ASD populations (e.g., Simonoff et al., 2008), and greatly influence the clinical variation.

Comorbid issues are also often observed in individuals with intellectual disability (ID), another neurodevelopmental disorder of interest to the current study. ID is defined by the DSM-5 as including deficits in intellectual and adaptive functioning. Deficits in intellectual functioning are typically measured by using a psychometrically valid, individualized, and standardized intelligence instrument (APA, 2013). Persons who meet criteria for ID have an intelligence quotient (IQ) score two standard deviations or more below the population mean of 100, including a margin of measurement error of ± 5 (APA, 2013). The second diagnostic criteria, deficits in adaptive functioning, represents a failure to meet developmental standards for personal independence and social responsibility. Adaptive functioning limitations must impact one or more areas of daily living, such as communication, social participation, and independent living in the home, school, work, and/or recreation environment. In fact, the DSM-5 designates the level of ID (i.e., mild, moderate, severe, profound) based on the severity of adaptive impairments (e.g., how deficits in adaptive behavior impact conceptual, social, and practical domains). While conceptual domains are represented by IQ scores, adaptive skills should be assessed by using clinical evaluations and/or psychometrically sound, individualized, and standardized measures with a caregiver, teacher, and/or service provider, as well as the individual to the extent possible.

Over time, many terms have been used to refer to intellectual disabilities, such as mental retardation, mental handicap, and learning disabilities. In 2009, a U.S. federal statute (Public Law 111-256, Rosa's Law) prohibited the use of the term *mental retardation* and mandated that all references be replaced with *intellectual disability.* The change in terminology is applauded as being more sensitive to people with disabilities and promoting inclusion (Moeschler & Nisbet, 2011). Yet, one of the reasons why study results vary across the literature is because of the evolution of diagnostic labels. Other influencing factors include age ranges of the study population and study designs employed. For example, Maulik and colleagues (2011) conducted a systematic review, evaluating the prevalence rates of ID in studies published between 1980 and 2009. The literature search was conducted using numerous key terms related to sample characteristics (e.g., intellectual disability, mental subnormality, mental insufficiency) and study design (e.g., cross-sectional, longitudinal, panel, cohort). Among 52 studies included in the meta-analysis, results revealed that estimates varied widely by subgroups: prevalence was higher among studies of children and adolescents versus adults, in low and middle-income group countries, and in studies using psychological assessments versus standard diagnostic instruments. However, through deliberate consideration of relevant terminology and by collating data from various studies, the authors concluded that the best estimate of true prevalence is about 1% (Maulik, Mascarenhas, Mathers, Dua, & Saxena, 2011). This finding was later supported by a national survey study (National Survey of Children's Health [NSCH], 2012), and is comparable to the worldwide percent prevalence of ASD (Baird et al., 2006; CDC, 2014).

Prevalence of comorbidity in ASD and ID. Comorbidity has been defined as the co-occurrence of one or more conditions (more often disorders, rather than symptoms) in the presence of a primary diagnosis (Feinstein, 1970; Maser & Cloninger, 1990; Matson & Nebel-Schwalm, 2007; Munir, 2016). The literature has shown high rates of psychiatric comorbidities in ASD and ID populations, with reports of overall prevalence reaching up to 97% in ASD samples (Mukaddes & Fateh, 2010) and 80% in ID samples (Borthwick-Duffy, 1994). de Bruin and colleagues (2007) examined 94 children (ages 6-12 years) with Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS). PDD-NOS is terminology from the DSM-IV, now collapsed under ASD in the DSM-5 (APA, 2013). Beyond the overall prevalence of 81%, these researchers found that 54% of the sample had two or more diagnoses. In a population-based study, Simonoff and colleagues (2008) investigated psychiatric disorders in a sample of 112 school-aged children with ASD (ages 10-14 years). Results revealed that 70% of children met criteria for at least one disorder, and 41% had two or more disorders. In 2003, Emerson surveyed 10,438 children with and without ID (ages 5-15 years) and found that there was a 39% overall prevalence of psychiatric disorders in children with ID, compared to 8% of those without ID. Of those with a comorbid psychiatric disorder, 19% of children with ID had at least one disorder, compared to 6% of the non-ID group; 16% had two comorbid disorders, compared to 2% of the non-ID group. A small percent of the sample (3%) had three or more comorbid disorders. Some studies have indicated that children with ASD or ID may have as many as five different psychiatric comorbidities (Bradley, Summers, Wood, & Bryson, 2004; de Bruin, Ferdinand, Meester, de Nijs, & Verheij, 2007;

Dominick, Davis, Lainhart, Tager-Flusberg, & Folstein, 2007; Joshi et al., 2010; Leyfer et al., 2006; Mattila et al., 2010).

The most common specific disorders include anxiety (Simonoff et al., 2008; White, Oswald, Ollendick, & Scahill, 2009), depression (Magnuson & Constantino, 2011), attention-deficit/hyperactivity disorder (ADHD; de Bruin et al., 2007; Ghanizadeh, 2012; Siminoff et al., 2008), and obsessive-compulsive disorders (Leyfer et al., 2006). With regards to the prevalence of specific comorbid disorders, de Bruin et al.'s study (2007) revealed that 62% of children with PDD-NOS exhibited disruptive behavior disorders (e.g., ADHD, oppositional defiant disorder, conduct disorder). About 55% of children met criteria for at least one anxiety disorder (e.g., phobias, social anxiety, separation anxiety, generalized anxiety disorder), and 14% had a mood disorder (e.g., major depression). Almost half of children in the study (41%) had a disruptive and anxiety/mood disorder, concurrently.

Risk factors. Risk factors of comorbid disorders include gender (Emerson & Hatton, 2007; Strømme & Diseth, 2000), socioeconomic status (Emerson & Hatton, 2007), and severity of ID/ASD (de Bruin et al., 2007; Molteno, Molteno, Finchilescu, & Dawes, 2001; Rao & Landa, 2014), although findings are mixed.

Gender. Research on the effects of gender in ID have indicated a higher prevalence of comorbidities among males than females (Emerson & Hatton, 2007; Strømme & Diseth, 2000). In a study of 641 youth with ID (ages 5-16 years), Emerson and Hatton (2007) found that males were more likely to be identified as having a conduct disorder than females. Strømme and Diseth (2000) also examined gender effects in a sample of 213 children (ages 8-13 years) with ID. While the sample had a greater proportion of males than females, the authors found a relative risk of overall psychiatric comorbidity in males. These studies indicate that among youth with ID, males are at greater risk of being diagnosed with an additional psychiatric disorder. Other studies have found no significant gender effects (Dekker & Koot, 2003; Molteno et al., 2001).

Within ASD, males are more commonly diagnosed than females. The male-to-female ratio is estimated to range from 4:1 to 3:1 (Fombonne, 2009; Loomes, Hull, & Mandy, 2017). The marked sex discrepancy has been said to have created a gender bias in research (Loomes et al., 2017). As such, recent research attention has been given to gender differences in ASD symptomology between males and females. However, few studies have extended this line of study to examine the degree to which the prevalence and occurrence of comorbid disorders may vary by gender in ASD groups. In the two studies that examined gender by rates of comorbid disorders in ASD (Gjevik, Eldevik, Fjæran-Granum, & Sponheim, 2011; Simonoff et al., 2008), no significant differences were found.

What has been studied in the context of gender are co-occurring *symptoms* or behavior problems endorsed by parents of youth with ASD (e.g., Brereton, Tonge, & Einfeld, 2006; Frazier, Georgiades, Bishop, & Hardan, 2014; Hartley & Sikora, 2009; Holtmann, Bölte, & Poustka, 2007; Mayes, Calhoun, Murray, & Zahid, 2011; Sukhodolsky, Scahill, Gadow, Arnold, & Aman, 2008). The *Child Behavior Checklist* (CBCL) is a widely used parent rating scale of child internalizing and externalizing behavior problems (Achenbach & Rescorla, 2000; 2001). Utilizing the CBCL, Holtmann and colleagues (2007) measured parent-reported behavior problems in a sample of 46 individuals with ASD (ages 5-20 years), matched on IQ and age. Results revealed that parents reported more behavior problems in females than males, particularly on subscales of Social Problems, Attention Problems, and Thought Problems. The authors note that while the CBCL is not a valid diagnostic instrument, its subscales are closely related to mental health disorders. For instance, the CBCL Attention Problems subscale has been shown to highly correlate with a diagnosis of ADHD (Biederman et al., 1993). Other studies of ASD using the CBCL have also shown that females demonstrate greater comorbid behavior problems than males (e.g., Frazier et al., 2014).

SES. In a systematic review, Einfeld, Ellis, and Emerson (2011) identified two studies that examined the association of socioeconomic status (SES) and comorbid mental health disorders in ID. In the first study, Emerson and Hatton (2007) identified the following SES variables as significant risk factors: living in income poverty, a household with no paid employment, and "no mother educational qualifications." When statistically controlling for exposure to SES disadvantage, results yielded a significantly reduced risk of comorbidity in children with ID. The other study (Dekker & Koot, 2003) found no significant difference between children of "low SES" and those of "medium/high SES." This discrepancy may be a result of how SES was measured, a topic of continued debate (e.g., Gottfried, 1985; National Center for Education Statistics [NCES], 2016).

Within the literature on ASD, the impact of SES (i.e., lower levels of employment status, maternal/paternal education, or household income) has also been suggested (Delobel-Ayoub et al., 2015; Rosa, Puig, Lázaro, & Calvo, 2016). Rosa and colleagues

(2016) utilized a sample of 50 youth with ASD (ages 7-17 years), matched on IQ and SES, and revealed a significant relationship between SES and a comorbid diagnosis. Moreover, this study found that variables of higher SES and low cognitive functioning (IQ scores below 88.5) were the strongest predictor of comorbidities.

Severity of cognitive functioning and autistic-like symptoms. Among individuals with ASD without ID (IQ>70), persons with more autism severity may exhibit more comorbidities. In de Bruin et al.'s study (2007), a double comorbid disorder group emerged, in which children with PDD-NOS were also identified with a disruptive disorder and an anxiety/mood disorder. Children in this group also had greater parent-reported social deficits associated with a PDD-NOS diagnosis, thus suggesting that children with severe autistic-like symptoms without cognitive impairments are at greater risk of an additional disorder.

Certainly, individuals on both the high and low ends of the cognitive spectrum evince behavior problems. Mazzone and colleagues (2012) conducted a review of the literature and reported which psychiatric disorders have been more frequently associated with Asperger's syndrome or high-functioning ASD (average to above average IQ). Results revealed significant associations with depression, bipolar disorders, and anxiety, in particular (Mazzone, Ruta, & Reale, 2012). Yet few of these studies also included low-functioning ASD groups (below average IQ) or included samples with a wide range of IQ, making direct comparisons of behavior problems on the basis of cognitive functioning difficult.

Mazurek and Kanne (2010) utilized a large study of children and adolescents with a wide range of IQ. Results revealed that youth with high IQ and low autism severity scores displayed more symptoms of anxiety and depression. A study of 46 older adolescents and adults (ages 18-44 years) produced similar results (Sterling, Dawson, Estes, & Greenson, 2008), indicating that high-functioning individuals with ASD may exhibit greater internalizing behaviors. These authors also reflected that persons with higher IQ and fewer autism symptoms might experience greater self-awareness on social and emotional functioning. While this relationship is commonly found in the literature, some studies did not find the same relationship (Cederlund, Hagberg, & Gillberg, 2010; Strang et al., 2012).

ASD and ID are also known to co-occur. In a recent CDC study of 3,390 children (Christensen et al., 2016), 32% of children with ASD were identified as having ID (IQ ≤ 70) and 25% as having borderline ID (IQ = 71-85), leaving almost half (44%) of the sample as having average/above average cognitive ability (IQ > 85). While a diagnosis of autism has shown to distinctly contribute to behavior problems (O'Brien & Pearson, 2004), of children who have comorbid ASD and ID, the presence of an additional disorder is often observed at even higher rates (Hill & Furniss, 2006). In a study of 2,201 adults with ID (i.e., learning disabilities), those with more autistic-like behaviors demonstrated significantly more behavior problems (Bhaumik, Branford, McGrother, & Thorp, 1997). These findings are still unclear, as some studies show no significant relationship between comorbid ASD/ID and the presence of an additional disorder (Gjevik et al., 2011; Goldin, Matson, & Cervantes, 2014; Simonoff et al., 2008; Totsika, Hastings, Emerson, Lancaster, & Berridge, 2011; van Steensel, Bögels, & de Bruin et al., 2013).

Within the most severe subgroups of ID, behavioral profiles are expected to differ. However, it is likely difficult to distinguish core symptoms of severe to profound ID from symptoms of concomitant behavioral problems, which makes comorbid diagnoses in this population problematic (Molteno et al., 2001). According to the DSM-5 (APA, 2013), impairments at the severe or profound level are partially defined by very limited communication skills and co-occurring physical and sensory impairments. Additional explorations are needed to determine how to reasonably parse co-occurring mental health and behavioral issues associated with the most severe levels of functioning in order to estimate prevalence rates of comorbidities in these populations. This may also be related to individuals with ASD who exhibit more severe autistic-symptoms, as ASD severity may mask behavioral profiles (Matson & Nebel-Schwalm, 2007).

While an exhaustive list may not be presented here, the aforementioned studies provide an understanding of the nature and risk of comorbidities in ASD and/or ID. Although the influence of these factors remains uncertain (Einfeld, Ellis, & Emerson, 2011), they have emerged as possible confounds that need to be considered in future investigations. Further, many of these studies focused on the additional presence of a clinical disorder. Yet, clinically significant behavior problems, in the absence of a diagnosis, are also crucial to examine. This is made evident by the compounding negative impact that behavior problems have on families and caregivers (Baker et al., 2003; Davis

& Gavidia-Payne, 2009) and the predictive nature of atypical levels of problem behaviors on later diagnoses of DSM disorders (Dekker & Koot, 2003; Poulton et al., 2000).

Developmental Course of Behavior Problems

In the literature of childhood and adolescent development, several labels for emotional and behavioral symptoms are used: psychopathology, maladaptive behaviors, challenging behaviors, and problem behaviors (Mudford et al., 2008). Consequently, such terms like "psychopathology" and "behavior problems" are often used interchangeably (e.g., Osório, Rossi, Gonçalves, Sampaio, & Giacheti, 2016), arguably creating confusion over the types of problems being discussed. It is, thus, essential to clearly define primary study variables, as definitional differences partially account for variations observed across studies (e.g., Hill et al., 2014). For the sake of clarity, the current study is an examination of *behavior problems*, which encompasses internalizing and externalizing behaviors. *Internalizing behaviors* reference symptoms of psychopathology or substantial emotional problems that are focused inward (e.g., depression, anxiety, withdrawn), whereas *externalizing behaviors* are significant behavioral issues that are directed towards the external environment (e.g., aggression, noncompliance). Having stated this distinction, it is also important to note that some studies have shown an association or overlap between symptoms of internalizing and externalizing behaviors (e.g., Holden & Gitlesen, 2009; Rojahn, Matson, Naglieri, & Mayville, 2004). For instance, children with ASD who experience anxiety may also exhibit aggressive behaviors.

One of the challenges in determining clinically significant internalizing and externalizing problems in children is that many behaviors are considered normative during early developmental periods. For instance, from a developmental perspective, children during the preschool years, children often attempt greater independence and may feel frustrated when confronted with boundaries, thereby reacting by having a temper tantrum. While such behavioral responses can impact the child's immediate functioning, it would be a mistake to pathologize them or classify them as clinically significant since they reflect normative developmental behaviors (Campbell, 1995; Keenan & Wakschlag, 1998). In fact, certain behavior problems, such as tantrums, low frustration tolerance, anger, and irritability, have been shown to begin in toddler or preschool years and generally end or decrease once children reach school-age (Copeland, Angold, Costello, & Egger, 2013; Osterman & Bjokqvist, 2010), thus suggesting an important effect of development on child behavior problems.

In ASD or ID populations, emotional and behavioral problems are consistently reported and may be attributed to underlying biological processes. Some young children with ASD may tantrum because of a loud noise or because a normal daily routine was broken. Such children may have difficulty identifying and expressing thoughts or emotions (e.g., Baron-Cohen, 1995). As a result, children with ASD may experience heightened emotions, such as anxiety and anger, as overwhelming and may react to them in inappropriate ways. When these emotional and behavioral responses begin to substantially interfere with functioning, above and beyond the core diagnosis, they should be regarded as concomitant clinical symptoms.

Early childhood. Behavior problems can occur at a young age and continue through development. Though some researchers encourage the mental health field to recognize significant psychiatric symptoms in early infancy (e.g., Egger, 2009), clinically significant behavior problems are commonly recognized in children as young as two years (Egger & Angold, 2006) and are frequently measured by well-validated behavioral instruments for children as young as a year and a half (e.g., CBCL Preschool Form; Achenbach & Rescorla, 2000). Indeed, behavior problems are reported to be the most common reasons for referral to mental health clinics in young children (Keenan & Wakschlag, 2000; Luby & Morgan, 1997).

Although there have been immense efforts towards earlier identification and treatment of neurodevelopmental disabilities (Guralnick, 2016; Matson, Wilkins, & González, 2008), it should be noted that an ASD or ID diagnosis is not yet reliable at very early ages. Research has shown that a diagnosis of autism at 2 years of age can be reliable (Johnson & Myers, 2007; Lord, Risi, DiLavore, Shulman, Thurm, & Pickles, 2006), and in the case of ID, unless there is a presence of a genetic disorder (e.g., Down syndrome, Fragile X syndrome), the DSM-5 recommends a classification of developmental delay or global delay for children under 5 years of age (APA, 2013). Classification indices (e.g., reliability, stability) of early diagnosis have continued to be of high interest to researchers (Ozonoff et al., 2015), and thus the current lack of support should not discourage others from pursuing more research on the behavior problems of very young children with ASD or ID. Importantly, researchers utilizing samples of infants and toddlers with ASD or ID before these age points should be transparent in descriptions of methodology (e.g., inclusion criteria, diagnostic instruments), and results should be interpreted with caution.

Within these very early ages, concerns about behavior problems have been frequently reported (Davis et al., 2010; Fodstad, Rojahn, & Matson, 2010; Matson, Boiskoli, Hess, & Wilkins, 2011; Matson, Hess, & Boisjoli, 2010; Matson, Mahan, Sipes, & Kozlowski, 2010). In one of the first investigations of behavior problems in toddlers with ASD, Fodstad and colleagues (2010) studied 269 children (ages 12-39 months) recruited from EarlySteps, a state-level early intervention system that provides services to eligible infants and toddlers with significant delays. Compared to children with non-ASD delays (e.g., Down's syndrome, cerebral palsy, fetal alcohol syndrome), those in the ASD group showed more severe behavior problems. To examine the effects of age on behavior problems, the sample was then divided by age groups: 12-18 months, 19-24 months, 25-31 months, and 32-39 months. Results revealed an increasing trend for tantrums and anxious behaviors as age increased in toddlers with ASD. These findings suggest that children with ASD as young as 12-months are highly vulnerable to significant co-occurring behavior problems, that may continue to worsen, at least until about 3 years of age. Utilizing a sample of toddlers (ages 17-36 months) with ASD or cognitive delay, Matson and colleagues (2011) examined the interrelationship between internalizing and externalizing behaviors in young children at the time of diagnosis. Consistent with the literature of children with ASD, results revealed parent-reported elevations in the ASD group compared to non-ASD group. The researchers also found significantly higher scores on related problems. For instance, toddlers who demonstrated greater levels of avoidant behaviors and tantrums also showed greater levels of aggression, destructive behavior, stereotyped behaviors, and self-injurious behaviors. This finding corroborates previous research suggesting that some children with ASD experience a cluster of internalizing and externalizing behavior problems (Hill et al., 2014; Kozlowski, Matson, Sipes, Hattier, & Bamburg, 2011; Weissman & Bates, 2010), which may increase the risk of long-term adverse outcomes (Taylor, Chadwick, Heptinstall, & Danckaerts, 1996). Much can be learned about these complex patterns of behavior problems that emerge in the early years and how they develop over time.

Compared to the infant and toddler literature, there is far more research on behavior problems in the preschool-age years and beyond. Indeed, among preschool-aged children (3-5 years) with and without developmental delays, several studies have reported high rates of behavior problems (Baker, Blacher, Crnic, & Edelbrock, 2002; Baker et al., 2003; Eisenhower, Baker, & Blacher, 2005). For instance, Baker and colleagues (2002) studied parent (both mother and father) perspectives of early behavior problems in 225 three-year-old children with and without delays. Parents of children with delays (IQ < 85) were three to four times more likely to endorse more clinically significant behavior problems than parents of children without delays. Results also showed stability of reported behavior problems over one year and, unexpectedly, moderate agreement between mothers and fathers of children with delays, as evident by significantly correlated scores on a the CBCL preschool-age form (Achenbach & Rescorla, 2000). The authors posit that parental agreement within the delay group suggests that mothers and fathers may be highly communicative and likely aligned regarding their child's behavioral functioning. This finding of moderate parental agreement on behavior problems of children with ASD or ID has been corroborated in some of the few studies that have examined both mother and father reports within early childhood (e.g., Baker et al., 2003; Hastings et al., 2005).

Childhood and adolescence. When children reach school age (6-12 years), teachers are often asked to participate in the assessment of child emotional and behavioral functioning, either as relevant raters for research purposes or as part of their school-related responsibilities to students in their classrooms (e.g., Individualized Education Plans, under the federal law; Individuals with Disabilities Education Act [IDEA], 2004). Research studies using parent and teacher data have shown that both parties frequently endorse significantly high rates of behavior problems in children with ASD or ID (e.g., Dekker, Koot, van der Ende, & Verhulst, 2002; Lecavalier, Leone, & Wiltz, 2006; Molteno et al., 2001). However, they do not always show perfect agreement on the nature and severity of problems (Lecavalier et al., 2006). This can be linked to the different contexts (home versus school) in which child behavior problems are observed. For example, teacher reports tend to be more reliable on measures of externalizing behaviors than internalizing behaviors, due to the covert and overt presentation of symptoms (Silverman & Ollendick, 2005). For instance, symptoms of anxiety can be more easily concealed in the context of a classroom, while noncompliance or disruptive behaviors can be more distracting and make classroom management more difficult for teachers. Indeed, previous research on children with ASD or ID has shown that externalizing behavior problems substantially impact the quality of student-teacher relationships (Blacher, Baker, & Eisenhower, 2009; Blacher, Howell, Lauderdale-Littin, Reed, & Laugeson, 2014; Eisenhower, Baker, & Blacher, 2007; Eisenhower, Bush, &

Blacher, 2015), and poor student-teacher relationships have negative effects on externalizing behaviors at later ages (Doumen et al., 2008), thus indicating a bidirectional influence between the student-teacher relationships and child behavior problems.

Among school-aged children and adolescents (13-19 years), behavior problems often become more noticeable with increasing physical and cognitive changes (Picci & Schef, 2015), as well as in the face of increased social and educational demands (White et al., 2009). In order to examine changes across development in samples with wide-ranging age groups, researchers have employed cross-sectional and longitudinal studies, among other designs, in order to better understand the pathways of behavior problems during these crucial years of development. In cross-sectional studies of children and adolescents, the effects of age on behavior problems indicate a relatively consistent overall pattern, in which externalizing behaviors decrease and internalizing behaviors increase as youth with ID age (Dykens, Shah, Sagun, Beck, & King, 2002; Molteno et al., 2001). In an examination of age effects on specific behavior problems, Emerson and Hatton (2007) examined protocols from 641 children with ID (ages 6-18 years) and found that younger children were more likely to be identified with hyperactivity, while older children were more likely identified as having anxiety. Similarly, among youth (ages 4-18 years) with ASD, Brereton and colleagues (2006) found fewer symptoms of attention/hyperactivity and increased symptoms of depression as children aged. It is important to note here that one of the studies defined the diagnostic group by attendance at a special school (Molteno et al., 2001), and another by parent and/or teacher reports of child learning difficulties (Emerson & Hatton, 2007), rather than by standardized instruments. Nonetheless, considering the combined results from the above cross-sectional studies suggest that youth with ASD or ID are likely to experience fewer externalizing problems as they age, while being at risk of more internalizing problems.

Although cross-sectional research is helpful in understanding changes in behavior problems across development, longitudinal research is considered a more powerful design option. Yet, longitudinal studies examining the developmental course of behavior problems in children and adolescents with ASD or ID are limited. Utilizing two longitudinal multiple-birth-cohort samples, de Ruiter and colleagues (2007) examined the course of behavior problems, measured by the CBCL, in 978 youth with ID and 2,047 without ID (ages 6-18 years). As expected, results revealed higher levels of overall behavior problems in ID groups than non-ID groups across three time points. In terms of the developmental course of behavior problems, the internalizing problems did not differ between diagnostic groups across time. However, children with ID showed a larger decrease on externalizing problems, particularly in areas of aggression and attention problems, than children without ID (de Ruiter, Dekker, Verhulst, & Koot, 2007). This finding supports previous studies showing that as youth age, externalizing behaviors often diminish while internalizing behaviors become more salient. A possible explanation is that specialized education and therapies received in childhood often target externalizing behavior problems, whereas internalizing behaviors (i.e., mental health), as targets of intervention or as outcomes, are largely ignored (Wong et al., 2015).

Summary and Transition

This review of the literature has provided an overview of ASD and ID, mainly as neurodevelopmental disabilities that are highly impacted by co-occurring behavior problems from early childhood through adolescence (e.g., Baker et al., 2003; Blacher & Baker, 2017; Dekker et al., 2002; Mazefsky, Borue, Day, & Minshew, 2014). Certain risk factors (i.e., gender, SES, severity) of behavioral issues have been highlighted. With regard to the influence of age, researchers employing cross-sectional and longitudinal designs have begun to provide an understanding of the developmental pathways of behavior problems in the context of these disorders. These researchers have provided suggestions for future investigations of behavior problems throughout the course of development in samples of youth with ASD or ID. These include: (a) understanding the latent classes of child behavior problems to uncover group membership; (b) testing the stability and change processes of behavior problems within longitudinal data; and (c) exploring correlates that might influence the development of behavior problems (e.g., Baltes, 1987; de Ruiter et al., 2007; Ghisletta, Renaud, Jacot, & Courvoisier, 2015).

Building on these methodological suggestions, two studies will be presented in this dissertation to examine significant behavior problems across the span of early childhood through early adolescence. With a focus on early childhood, Study 1 will employ a mixture model to identify homogenous classes of internalizing and externalizing behaviors in a community sample of children (< 5 years of age) at risk of autism, and to determine the risk of class membership based on ASD classification. In Study 2, using longitudinal data, a cross-lagged model will be utilized to examine the stability of behavior problems (total, internalizing, externalizing) in youth with and without ID from childhood to adolescence (ages 6-15 years), across 6 time points. Further, while social skills limitations are not part of the diagnostic criteria of ID, poor social functioning is an important characteristic within this population and a key indicator of adolescent development (APA, 2013; De Bildt et al., 2005). As such, social skills will be examined as a possible predictor of behavior problems in youth with ID across these crucial years of development. Additionally, in both studies, significantly different demographic variables between diagnostic groups (Study 1: ASD vs. non-ASD; Study 2: ID vs. TD) will be covaried in analyses when related to primary outcomes.

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CHAPTER II. Early Childhood

Study 1. Behavioral Profiles of Preschool-Aged Children with ASD

Rationale for the Study

It has been well documented that young children with developmental delays often have high rates of behavior problems (e.g., Baker et al., 2003; de Bruin, Ferdinand, Meester, de Nijs, & Verheij, 2007). Among children with delays, those with autism spectrum disorder (ASD) surface as having the highest level of behavioral issues (de Bruin et al., 2007). Children with ASD often have significant externalizing behavior problems, such as disruptive behaviors and aggression (de Bruin et al., 2007; Ghanizadeh, 2012; Siminoff et al., 2008), as well as significant internalizing problems, specifically anxiety and depression (Magnuson & Constantino, 2011; Simonoff et al., 2008; White, Oswald, Ollendick, & Scahill, 2009).

As a result of associated behaviors, families of children with ASD experience very low levels of familial well-being (Baker et al., 2003; Baker-Ericzn, Brookman-Frazee, & Stahmer, 2005; Blacher & McIntyre, 2006; Davis & Carter, 2008; Gardiner & Iarocci, 2012; Lecavalier, Leone, & Wiltz, 2006; Maskey, Warnell, Parr, Le Couteur, & Conachie, 2013; Neece, Blacher, & Baker, 2010; Schieve, Blumberg, Rice, Visser, & Boyle, 2007). In fact, behavior problems are often perceived as more problematic than core autism features, and have been shown to supersede symptoms of delay as a significant predictor of negative family outcomes (Baker, Blacher, & Olsson, 2005; Baker et al., 2002; Hastings, 2003; Lecavalier et al., 2006; Neece, Green, & Baker, 2012).

In a study of youth (ages 3-18) with ASD, Lecavalier and colleagues (2006) conducted hierarchical multiple regressions to examine the impact of behavior problems on parent stress. Results revealed that behavior problems were more associated with stress than any other child characteristic, including social and communication skills, adaptive functioning, and motor skills. This suggests that substantial behavior problems in children with ASD can be extremely stressful for their families and better account for family wellbeing rather than developmental functioning. Given the gravity of possible deleterious outcomes, the objective of this study is to better understand significant behavior problems in very young children. One method for doing this is to develop taxonomies to classify behavior profiles early on, in order to identify children who may be at risk of a negative trajectory of behavior problems.

Classifying Behaviors using Taxonomic Analysis

As a type of taxonomic analysis, latent mixture modeling has been used in previous studies to identify patterns of behaviors in different populations, for example in persons with conduct disorder. In the National Comorbidity Survey Replication study (Nock, Kazdin, Hiripi, & Kessler, 2006), retrospective reports of 9, 282 adults were utilized to identify subtypes of conduct disorder from 15 DSM-IV symptoms via latent class analysis. Five subtypes were identified: rule violations, deceit/theft, aggression, severe covert behaviors, and pervasive CD symptoms. In this study, latent class analysis was a useful data reduction method to identify empirically derived subtypes.

De Los Reyes and colleagues (2009) utilized a sample of 327 referred and non-referred children (ages 3-5 years) with symptoms of disruptive behavior (i.e., Oppositional Defiant Disorder [ODD], Conduct Disorder [CD], or Disruptive Behavior – Not Otherwise Specified [DB-NOS]). Disruptive behaviors were considered clinically significant if three or more symptoms were present. Using parent and examiner reports, latent class analysis was conducted to examine variations of behavior problems. Results revealed four distinct patterns: (1) low behavior problems across parent and examiner reports (47%); (2) high behavior problems with parent report only (30%); (3) high behavior problems with examiner report only (16%); and (4) high behavior problems with parent and examiner reports (8%). A few conclusions can be made from this analysis. First, about half of preschoolers were not detected as being disruptive, and a small percent were identified as pervasively disruptive. Second, between parents and examiners, parents endorsed more child behavior problems. This may suggest a true informant discrepancy on measures of behavior problems, as behaviors of young children may vary across contexts (at home versus in the laboratory or office). Nevertheless, this study demonstrated the usefulness of latent mixture modeling techniques in identifying intricate variations within research.

The Present Study

In the context of ASD, studies have employed latent mixture modeling to investigate the phenotypic heterogeneity of core symptoms (Georgiades et al., 2014; Georgiades et al., 2013). For example, Georgiades and colleagues (2014) utilized a mixture model approach to examine symptom severity subtypes in a sample of 280 children with ASD at the time of diagnosis. The model of autism symptoms revealed that a three-class solution fit the data best, using the *Autism Diagnostic Interview – Revised*

(ADI-R; Rutter, LeCouteur, & Lord, 2003) as a measure of autism symptoms. This study indicated that at child age 3, autism symptoms were described in this sampled using three distinct classes of children with different levels of severity. They then examined CBCL behavior problem scores as a correlate of these classes and found that Class 2, in which 9% of the sample fell into, was associated with less severe autism symptoms, higher adaptive functioning, and fewer emotional and behavioral problems. From this type of analysis, qualitative and quantitative differences can be drawn from complex profiles. However, few studies have performed these models to examine patterns of associated behavior problems as the outcome. Thus, the objective of the current study is to utilize advanced statistical techniques to characterize latent patterns of behavior problems in a sample of young children who were assessed as part of an autism screening clinic. Specifically, using an existing dataset provided by the screening clinic, Study 1 will address the following main research questions:

1. Is there a latent class structure that adequately represents the heterogeneity in clinically significant behavior problems among preschool-aged children with and without ASD? If so, what are the types of behavioral classes and their corresponding prevalence?
2. Is diagnostic status (ASD versus non-ASD) predictive of membership in identified behavioral classes? Is the degree or severity of autistic-like symptoms predictive of class membership?

I expect to find at least one class that represents children who demonstrate purely externalizing problems (e.g., hyperactivity, conduct problems) and another with internalizing problems (e.g., anxiety, withdrawn). In analyses of the CBCL/1½-5 scales using a normative sample (Achenbach & Rescorla, 2000), younger children scored significantly higher on externalizing scales (i.e., Attention Problems and Aggressive Problems). Thus, it is expected that there will be a higher prevalence in classes of externalizing behaviors. The most noteworthy and telling of classes will be an amalgam of behaviors that may show a complex profile seen in young children at the time of screening. For instance, a subgroup of individuals in the sample may show a prevalent pattern of inattention, withdrawal, anxiety, and aggression, which are symptoms from both the externalizing and internalizing domains. These classes move beyond a single classification category to describe a combination of manifested behavior problems, a reality experienced by many parents of children in their early years. Related to the second research question, as individuals with ASD demonstrate higher levels of behavior problems compared to those with other atypical and typical development (Baker & Blacher, 2017), it is expected that an ASD classification will be predictive of more severe behavioral classes. Lastly, not all children who at risk of ASD will exhibit significant co-occurring behavior problems to the same degree. As such, severity of autistic-like symptoms will be examined as a possible predictor of classes.

Methods

Procedures

Approval for the gathering of data for research purposes was granted from the university Institutional Review Board (HS 10-080). Children were referred from local schools, community mental health centers, regional centers that provided services to individuals with disabilities, and other families whose children had been screened at the center. When parents contacted the clinic, they spoke to staff via telephone, and completed a brief intake form that determined initial risk for ASD. Thus, all children who were assessed at the clinic demonstrated a need for developmental screening.

Data collection took place when families visited the autism center. During the visit, parents received written and verbal information about assessment procedures and were provided informed consent prior to screening. The *Autism Diagnostic Observation Schedule* (Lord, Rutter, DiLavore, & Risi, 1999; Lord, Rutter, DiLavore, & Risi, 2012) was administered to determine whether the child met diagnostic criteria for autism or autism spectrum, while parents completed a demographic form and behavioral questionnaires. Assessments were conducted by doctoral students and postdoctoral fellows from school psychology, special education, or clinical psychology programs. All assessors were extensively trained in the use of the ADOS. Clinic supervision was provided by the autism center director and licensed assistant director, as well as an affiliated licensed and bilingual psychologist. No mental health diagnoses were given based on the completed behavioral questionnaires. Before families received feedback, clinic co-directors reviewed scored measures and written reports.

Participants

Study participants were 170 children (1 year 7 months to 5 years 8 months; *M* = 4.00, *SD* = .99) who were referred to an autism-specific screening clinic located at a research center on a university campus in Southern California. Data were collected from children and families over seven years. Sample characteristics can be found in Table 1a.

In total, about 5% of the sample self-identified as African American, 1% as Asian, 23% as Caucasian, 50% as Latino, and 19% as Other. Two participants chose not to disclose their ethnic backgrounds. The greater proportion of Latino families in this sample reflects the composition of the community; the location of the clinic is in an urban area, of which Latino families constitute about 48% of the region (U.S. Consensus Bureau, 2016). Child participants were mostly male (80.0%). About half (46.7%) of the children in the study were enrolled in preprimary programs (i.e., preschool, kindergarten, or nursery school programs).

Measures

Child Behavior Checklist for Ages 1.5-5 (CBCL; Achenbach & Rescorla, 2000). The *Child Behavior Checklist* (CBCL) is one of the most widely used measures of behavior problems in research and clinic settings (e.g., Baker, Blacher, Crnic, & Edelbrock, 2002; Baker et al., 2003; Bolte, Dickhut, & Poustka, 1999; Eisenhower, Baker, & Blacher, 2005; Hartley, Sikora, & McCory, 2008). Parents completed the 99-item measure at the screening clinic to assess child behavioral functioning. Based on the preceding 2 months, each item is rated on a 3-point scale: 0 (not true), 1 (somewhat or sometimes true), or 2 (very true or often true). Example items include: Disturbed by any change in routine; Clings to adults or is too dependent; Headaches (without medical cause); Acts too young for age; Has trouble getting to sleep; Can't concentrate; Can't pay attention for long; and Destroys things belonging to his/her family or other children. The CBCL yields a total problem score, broadband externalizing and internalizing scores, seven narrow-band syndrome scores, and five DSM-oriented syndrome scores.

The present study utilizes the narrow-band syndrome scales, which comprise problem items that tend to occur together. The CBCL narrow-band scales are: (1) Emotionally Reactive, (2) Anxious/Depressed, (3) Somatic Complaints, (4) Withdrawn, (5) Sleep Problems, (6) Attention Problems, and (7) Aggressive Behavior. The first four scales are grouped together as *Internalizing* problems, while the last two are grouped under *Externalizing* problems. The Sleep Problems scale is not included in either Internalizing or Externalizing grouping. The CBCL syndrome scores have alpha coefficients from .66 to .92. Reliability of the CBCL ranged from .78 to .92 (Achenbach & Rescorla, 2000). In a study by Ivanova and colleagues (2010), the generalizability of the seven-syndrome model was tested across 23 different societies (e.g., from Asia, Australia, Europe, the Middle East, and South America). Results revealed that the seven syndromes adequately captured patterns of emotional, behavioral, and social problems as rated by over 19,000 parents of preschool-age children. The authors, thus, recommended the use of the seven syndromes to assess and characterize parent-rated early childhood problems. In addition, Pandolfi and colleagues (2009) were the first evaluate the factor structure of the CBCL preschool-age form in a sample of children with autism. Results provided strong psychometric evidence in support of its use in the assessment of emotional and behavioral issues in ASD groups, further maintaining the CBCL's longstanding history of clinical and research use.

While the manual generally recommends raw scores for statistical analyses, *T*-scores are prescribed and understood as useful for analyses in which scores on each scale are compared to the scores from a sample of typically developing peers (Achenback &

Rescorla, 2000); this study will utilize group comparisons in the prediction model. Further, for the purposes of determining the presence or absence of clinically significant behaviors between ASD and non-ASD groups, interpretations of narrow-band syndrome scales based on T-scores were used. Specifically, behavior problems on the CBCL were categorized as *Normative* if T-scores fell below 65 and *Atypical* if T-scores fell at or above 65 (i.e., borderline to clinically significant levels). These cutoffs are suggested by the authors in the manual (Achenbach & Rescorla, 2000). Each indicator will be coded 1 (Normative) or 2 (Atypical). Dichotomized coding will account for individuals who present with clinically significant problems on the observed variables. Descriptive statistics on the CBCL Narrow-Band Scales can be found in Table 1.2.

Autism Diagnostic Observation Schedule, Second Edition (ADOS-2; Lord, Rutter, DiLavore, & Risi, 2012). The ADOS-2 is a gold standard assessment for autism. It is a semi-structured, standardized clinical observation tool composed of two domains: (1) Social Affect and (2) Restricted, Repetitive Behaviors. The ADOS modules are dependent on the child's level of development and language, and each consist of standard activities that allow the examiner to observe communication skills, social interaction skills, and stereotyped behaviors or restricted interests. Specific items identified as relevant to autism form the algorithm for each module. These items are summed and compared to thresholds, which results in a classification of "autism", "autism spectrum", or "non-spectrum." For the purposes of this study, children were put into the ASD group if they received an ADOS classification of autism or autism spectrum. Child participants were in the non-ASD group if they received an ADOS classification of non-spectrum.

ASD status will be used as a covariate and is coded as a dummy variable, non-ASD = 1 and ASD = 2.

Autism Severity. The ADOS also yields a calibrated comparison score, a metric for gauging autism severity (Gotham, Pickles, & Lord, 2012). Comparison scores are determined based on the child's age and language level, and range from 1 (lowest severity) to 10 (highest severity). Given that autism severity has been shown to be a possible correlate of child behavior problems (e.g., Hill et al., 2014; Cooper & Lanza, 2014), the ADOS comparison score will be used in analyses as a second covariate. Correlational analyses revealed that ADOS classification and ADOS comparison scores are significantly highly correlated ($r(156)=.84$, $p<.001$).

Data Analytic Plan

A mixture modeling approach will be used to assess the class structures of child behavior problems that may be influenced by a classification of ASD and the severity of autistic-like symptoms in a community sample of young children at risk of a developmental disorder. Latent class analysis (LCA), a type of mixture modeling, is anticipated to be the most optimal model for the study's objectives for several reasons.

LCA is beneficial for analyses that utilize categorical latent variables. Categorical variables can be expressed through the LCA in order to find homogenous groups of individuals in the sample based on observed behaviors (Lubke & Muthén, 2007). These groups are referred to as classes. LCA is often used in psychological and educational research to identify meaningful classes within a heterogonous population (James, Dubey, Smith, Ropar, & Tunney, 2016), as it then yields homogeneous classes of individuals with similar profiles on a set of categorical variables. In the extension of LCA, categorical covariates are applied to predict latent class membership. Within the current study, these covariates are ASD classification (ASD vs. non-ASD. As latent mixture models are largely exploratory (e.g., with respect to the number classes), upon completion of data collection, the conditions and assumptions of these models were thoroughly examined. The following sections outline the parameters and step-by-step approach for LCA.

LCA model parameters. Two parameters are estimated in the traditional latent class model: (1) γ (gamma), which represents the class membership probability, and (2) ρ (rho), which represents the item probability on latent class membership (Collins & Lanza, 2010; Lanza, Collins, Lemmon, & Schafer, 2007). The class probability parameters provide the prevalence, or relative frequency, of class membership. Item probability parameters reflect the association between the observed items or indicators and the latent classes. In other words, the item probability parameters contain information on the probability that an individual in a given latent class has of endorsing the item (Collins & Lanza, 2010; Lanza et al., 2007). In Figure 1a, a path diagram of the LCA is represented on the left, and the class distribution on the right. As LCA is a fully categorical model, no continuous latent variables are involved. Variables in boxes represent measured categorical items or outcomes, u_i. The circled variables represent the categorical latent class variable, C_i. As mentioned in the section above, the conditional independence assumption for LCA implies that the correlation among *u*'s are fully explained by the latent class variable, *C.* Thus, there is no residual covariance among the *u*'s. The distribution, shown on the right, would be described by providing the relative frequencies of the classes.

Grouping variable versus covariate. Using LCA, ADOS classification can be incorporated either in a multiple-group LCA or in LCA with a covariate. Using the former, cases would be grouped by ASD status in order to investigate the equivalence of latent class proportions for children with and without ASD. Thus, autism classification would play the role of a blocking variable and standard methods of estimation for latent classes may be used (Collins & Lanza, 2010). However, the multiple-group method would significantly reduce the sample size by splitting the sample into two groups (ASD and non-ASD) prior to running the model. In other words, two LCA models would be run on smaller samples (versus running one LCA with a covariate on the larger sample). This would significantly reduce the power of the analysis and likely yield inadequate degrees of freedom for fitting the basic model (Collins & Lanza, 2010). Thus, ASD status was used as a covariate, extending the basic LCA model to include classification as a predictor of class membership through a logistic link and providing possible differences in latent class prevalence.

When a categorical covariate is included in the model, an additional set of parameters is estimated: β (beta) parameters are logistic regression coefficients for covariates, predicting class membership. The β parameter corresponding to the covariate is an odds ratio, reflecting the increase in odds of class membership relative to reference class *C* corresponding to a one-unit increase in the covariate (Collins & Lanza, 2010). Because class membership probabilities are modeled as functions of the covariate and individuals vary with respect to their covariate, there is a vector of estimated class membership probabilities corresponding to each individual. The prevalence of each latent class is calculated as the average across participant-specific class membership probabilities (Collins & Lanza, 2010)

Model building. The LCA approach involves three model building steps: (1) data screening/descriptives; (2) class enumeration process and selection of the final unconditional model; and (3) adding potential predictors (e.g., Nylund-Gibson & Masyn, 2016).

Step 1: Data screening/descriptives. The first step of LCA, as in any data analysis, is the use of descriptive techniques to explore the dataset. Variables used in analyses were explored for missing data patterns, data entry errors, and outliers. LCA does not need to meet assumptions related to linearity, normal distribution, or homogeneity (Collins & Lanza, 2010); however, the data were examined for outliers. Data points that were more than three standard deviations above or below the mean were considered outliers. Z-scores on the CBCL Syndrome Scales were examined: no outliers were present on the Emotionally Reactive, Withdrawn, Sleep Problems, Attention Problems, and Aggressive Problems scales. One outlier was present in the Anxious/Depressed scale, and one on the Somatic Complaints scale. As suggested by Cohen and colleagues (2003), the outliers were constrained to three standard deviations from the mean in order to reduce the influence of extreme data points. The positive outliers were set to three standard deviations above the mean.

An additional assumption for LCA models is the conditional independence assumption, in which the correlations among the indicators are assumed to be explained by the latent class variable and, thus, there are no residual covariances among the indicators (Nylund, Asparouhov, & Muthén, 2007). The assumption of local independence was tested by examining the standardized residual (z-scores > 1.96) during model selection. In addition, Geiser (2013) outlined several recommendations to avoid local independence, including using a sufficient number of random start values and initial stage iterations in models with more than two classes.

Step 2: Class enumeration process and selection of the final unconditional model. Several models were applied in order to select the proper number of classes. It is recommended that all new analyses begin by fitting a baseline, one-class model with no covariates, with each additional class added to the model in a stepwise fashion (Lanza et al., 2007). The relative fit of each model were compared in order to identify the optimal number of classes. Comparative fit was assessed using information criteria (IC) designed to determine which model best approximates the observed data. Criteria of particular utility are the Akaike IC (Akaike, 1974), Bayesian IC (Stone, 1979), and adjusted Bayesian IC (Tofighi & Enders, 2007). When examining IC values between models, lower values indicate better fit. Statistical tests, such as the Lo-Mendell-Rubin test (Lo, Mendell, & Rubin, 2001; Nylund et al., 2007), Vuong-Lo-Mendell-Rubin test (Lo et al., 2001; Vuong 1989), and the Bootstrapped Likelihood-Ratio Test (Nylund et al., 2007), are also available and recommended for evaluating model fit in LCA. The Lo-Mendell-Rubin test (LMRT) and the Vuong-Lo-Mendell-Rubin test (VLMRT) compares the estimated model with a one less class model. The *p*-value obtained represents the probability that H0 is true, which is that the data have been generated with one less class. A significant *p*-value indicates that the estimated model is preferable (Lo et al., 2001; Nylund et al., 2007). The Bootstrapped Likelihood-Ratio Test (BLRT) determines whether an additional class improves the model, as indicated by a significant *p*-value (Nylund et al., 2007). While entropy is not a fit statistic, it is used to determine whether there is a good classification of individuals in the latent classes. Entropy values larger than .80 indicate good classification (Clark & Muthén, 2009).

Beyond these indexes, interpretability is a key criterion in determining the optimal number of classes. The final solution was considered on the basis of the sample's composition and previous findings from the literature. Therefore, the final number of classes was chosen based on a balance of parsimony, fit, and interpretability (Kline, 2011). Additionally, two other considerations were taken: No class should have a near-zero probability of membership, and a meaningful label should be assigned to each class. To calculate the probability that a case will fall in a particular latent class, the maximum likelihood method was used. Maximum likelihood estimates demonstrate a higher chance of accounting for the observed results.

Step 3: Adding potential predictor. Once the number of classes was selected, the covariate (ASD classification) was incorporated into the model. The possible change in latent classes with the addition of the covariates was considered. If the β parameters change substantially with the addition of the covariate, there may be evidence of lack of model fit. With larger samples, splitting the sample based on levels of the covariate and examining separate latent class models for each subsample would be worthwhile (Asparouhov, 2005; Nylund et al., 2007). Of course, this is not ideal with the current sample as it will reduce the sample size and overall power of the models. The log-likelihood test for the overall effect of the covariate was reported in the output. A significant *p*-value provides evidence that the covariate is a significant predictor of class membership. Research question 2 was answered by presenting the β parameters for the effect of the covariates, as well as odds ratios. Odds ratios were interpreted as the increase in odds membership in a particular latent class relative to the reference class given that a participant is in the ASD group. For example, children with ASD may be more likely to be in a behavioral class than a non-behavioral class.

Results

The results below are divided into two sections. The first section provides results of preliminary analyses, including descriptive statistics of sample characteristics and of indicators used in the model, as well as correlation analysis. The second section provides results of the LCA, which includes the model selection process, the addition of predictors, and reporting of parameters.

Preliminary Analysis

Results from group comparisons are presented in Table 1a. The sample consisted of 62 children without a classification of ASD and 108 children with a classification of ASD. Herein, these classification groups will be referred to as the non-ASD and ASD groups. With regards to the ASD severity, the ASD group had significantly higher ADOS comparison scores than the non-ASD group (ASD M = 6.64, SD = 1.75; non-ASD M =

1.97, *SD* = .89; $t(145.90) = 21.99$, $p < .001$). Age at referral was the only other child characteristic that differed by classification group (ASD *M* age = 3.88, SD = 1.03; non-ASD *M* age = 4.22, SD = .88; $t(168) = 2.17$, $p = .03$), indicating that children in the ASD group were assessed significantly earlier than children in the non-ASD group. There were no statistically significant differences between parents of children with and without ASD. Descriptive statistics from the full sample revealed that a little over a third (36.7%) of mothers reported having a high school degree or less. About 27% reported household incomes over $50,000. A large proportion of parents (79.5%) reported being married or living with a partner.

The seven CBCL narrow-band scales were dichotomized into categories of normative (*T*-scores < 65) and atypical (*T*-scores ≥ 65) behaviors. Table 1b shows frequency statistics of these indicators, divided into results from the full sample and by group. With regards to the full sample, scales with the highest endorsement of clinically significant behaviors were Emotionally Reactive (63.5%) and Withdrawn (69.4%). Scales of Somatic Complaints, Sleep Problems, Attention Problems, and Aggressive Behaviors showed a fairly even distribution of behaviors in the normative and atypical range. Chi-square tests were performed to compare the ASD and non-ASD groups of the same variables. Analyses revealed that significantly more children in the non-ASD group had atypical levels on the CBCL Anxious/Depressed scale than children in the ASD group, $X^2_{(1)} = 6.68$, $p = .01$. Also, significantly more children in the non-ASD group scored in the atypical range on the CBCL Somatic Complaints scale than children in the ASD group, $X^2_{(1)} = 5.89$, $p = .02$. No other significant comparisons were detected. Given these significant differences in behaviors by group, direct effects were considered in the model if ASD classification was shown to significantly predict class membership to ensure that these differences did not dominate latent class membership.

Correlational analysis between CBCL Narrow-Band Scales used in the model and covariates can be found in Table 1c. All correlations between indicators were significant and positive, ranging from .23 to .55, except for between Somatic Complaints and Withdrawn scales ($r(170) = .15$, $p = .06$). ASD classification on the ADOS and sleep problems was significantly negative correlated, in such that parent-reported Sleep Problems were associated with being in the non-ASD group. ADOS comparison scores were significantly correlated with Anxious/Depressed and Somatic Complaints, in such that parent reported concerns on these domains was associated with being in the non-ASD group.

Latent Class Analysis

Six models were estimated, representing a 1-class through 6-class solution, using 100 random sets of starting values to ensure that maximum-likelihood solution was identified for each model. In the model selection process, model fit indices were first examined, followed by the interpretability and parsimony of potential models. Model fit indices used for determining the number of classes included AIC, BIC, and aBIC, where smaller values suggest a better statistical model (Nylund et al., 2007). Nylund and colleagues (2017) recommended using the BIC when the sample is not large and the data are categorical. Thus, when values of these indices conflicted, the BIC index was considered more heavily in determining the optimal number of classes. Likelihood tests of model fit were also used to compare the model with k classes to a model with k-1 classes. Likelihood tests included the VLMRT, the LMRT, and the BLRT. A nonsignificant p-value suggests that the model with k-1 classes is sufficient, and that the added class is not necessary to the model. The BLRT has been recommended as a more reliable indicator for class selection (Nylund et al., 2007), and thus was given preference during the process. Lastly, entropy, a measure of overall precision, was included. Entropy values range between 0 and 1. Values greater than .8 provide evidence of high-class differentiation, or a high degree of homogeneity in individual responses on the indicators between latent classes in the model.

Research question 1. Fit indices for all baseline models are provided in Table 1d. The two-class model had the lowest BIC value. All three likelihood-ratio tests (i.e., VLMRT, LMRT, BLRT) of the two-class model were significant at the $p < .001$ level. A competing solution was the four-class model, which had lower AIC and aBIC values, as well as significant VLMR and LMR tests at the $p<.05$ level. However, the preferred indicator of information criteria (i.e., BIC), rejected the four-class model as the favored model. The information criteria and likelihood-ratio tests worsened after the fourth model, indicating that the addition of classes beyond four provides no improvement in fit. Entropy values were above .8 for all models with two through six-classes, indicating that all classes had evidence for differences between latent classes. Minimal change of entropy values was observed among models, ranging from .83 and .86. Taken together, the results shown in Table 1d indicate that a two-class model may represent the data best.

The four-class model was also eliminated based on interpretability and parsimony. An examination of the class proportions for the 4-class model showed that one class had a small class (6%) and three relatively evenly proportioned classes (27%, 38%, and 29%), as shown in Table 1d. It is recommended for parsimony that solutions with one or more very small classes should be reevaluated (Geiser, 2013), as it may be that such classes are over-distributed and thus more susceptible for misidentification. Another argument against the four-class solution is based on a close examination of response probabilities within latent classes. Three of the four classes contained boundary estimates, or conditional probabilities of exactly 0 or 1. Boundary parameter estimates can be problematic for both substantive and statistical reasons: They may imply an unrealistically perfect reliability of an indicator (Wurpts & Geiser, 2014); no confidence limits are available for boundary estimates (Galindo-Garre & Vermunt, 2006); and they may indicate issues with identification or a convergence to local likelihood maximum (Uebersax, 2000). These concerns were not present in the two-class solution. The two-class model was also the solution with the fewest number of classes that has an adequate overall goodness of fit (Nylund et al., 2007), and thus, was selected as the best fitting latent class model.

Next, individual bivariate standardized residual z-scores (> |1.96|) were examined for each pair of variables using the Tech10 output option in *Mplus*. None of the residuals were significant, and thus the assumption of conditional independence was not violated. An inspection of the parameter estimates from the two-class model suggests that the classes are distinguishable and meaningful labels can be applied to each. Table 1e shows the response probabilities for the two-class model (without covariates). Probabilities (ρ) above .7 or below .3 indicate high homogeneity. In other words, Probabilities above .7 indicate high endorsement of behavior problems in a given category. For example, the probability that a child in Class 2 will demonstrate atypical levels of emotionally reactive behaviors is .95, or 95%.

Research question 2. Covariates of ASD classification and severity were added to the two-class model. The covariates were first added individually, before both being included in the model. This ordered method was used to account for the strong correlation between ASD classification and severity. Table 1d shows that the two-class model with the addition of covariates (separately and together) did not substantially affect model fit. No modification indices were suggested. However, in examination of the regression estimates as shown in Table 1f, neither ASD classification nor severity were significant predictors of class membership ($p > .05$)[1]. Note that regression coefficients have been transformed into more easily interpreted odds ratios (exponentiated β). Thus, a two-class solution without covariates was selected for interpretation.

Class assignment. Table 1e shows the posterior (γ) and conditional (ρ) probabilities of the two-class solution. For the first class, the class membership probability was .44, and for the second class, it was .56. Class 1 consisted of high probabilities (>.70) of normative behaviors on scales of Emotionally Reactive, Anxious/Depressed, Somatic Complaint, Sleep Problems Attention Problems, and

[1] As neither covariate predicted class membership, direct effects between indicators that significantly differed by ASD group (Anxious/Depressed, Somatic Complaints) were not included in the model.

Aggressive Behaviors. Class 2 consisted of responses that endorsed high probabilities of atypical behaviors on scales of Emotionally Reactive, Withdrawn, Attention Problems, and Aggressive Behaviors. Combined, these results suggest that 44% young children in this sample fell in Class 1 and are likely to demonstrate a normative behavioral profile, and 56% of children fell in Class 2 and are likely to demonstrate a highly behavioral profile with specific areas of concern.

Discussion

The aim of this study was to determine if subtypes of behavior could be identified and further distinguished based on ASD classification and the severity of symptoms among young children. Using LCA, the results indicated that a two-class solution fit the data best. The classes were labelled as "Normative Behaviors" and "High Behaviors." The two classes were compared on ASD classification and severity. The results indicated that the classes did not differ based on these factors.

Behavioral Classes

One objective of this study was to find groups of behaviors that are similar among young children based on observed behavioral characteristics. LCA allowed the identification of the number of groups of behaviors and the prevalence of each group. Results revealed that a little more than half (56%) of the sample fell in a class characterized by atypical behaviors. Specifically, behaviors of preschool-aged children in this class are likely characterized by sudden mood changes, withdrawn behaviors, attention difficulties, and aggression. The manifestation of these behaviors, including aggression, may be explained by poor self-regulation. Children with emotion regulation difficulties may have trouble controlling their behavior when overwhelmed and have more difficulties maintaining attention (Eisenberg, Spinrad, & Eggum, 2010); both of these issues may lead to additional externalizing and internalizing behaviors. It is also likely that these behaviors led to mothers bringing these children to the screening clinic. If left untreated, upon entry to school, these behaviors may be misinterpreted by educators as defiant or deliberate. While this interpretation might be the case in some situations, given the combination of behaviors that emerged as prevalent in this class, these behaviors likely stem from ineffective management of emotional states in response to stress or overstimulation (Konstantareas & Stewart, 2006; Mazefsky & White, 2014)

The objective of this study was not to present the prevalence of diagnosable issues in young children. However, more than half of the sample was assigned to a subgroup that was characterized by atypical levels of behavioral and emotional dysregulation. This finding lends itself to enormous implications for early intervention efforts in preschool-aged youth. While many early childhood treatment programs focus on behavior, it may be beneficial to focus on *emotion regulation* as well (Southam-Gerow & Kendall, 2002). Therapeutic approaches that teach children how to identify problematic thoughts and how to respond appropriately to unwanted circumstances (i.e., acquiring coping strategies) should be implemented in common treatment programs for young children. Interestingly, emotion regulation impairments are associated with core symptom severity among children with ASD (Samson et al., 2014); however, ASD status was not predictive of the behavioral classes here.

Predictors of Behavioral Classes

There has been considerable evidence of a greater number of behavior problems among children with ASD and other developmental delays compared to typically developing children (e.g., Baker et al., 2002). Against study hypotheses, however, ASD classification and severity were not found to be predictive of behavioral classes. One possible explanation for this finding could be the homogeneity of young children in this sample. All children who presented to the clinic were referred for an autism assessment (or to "rule out" autism) because of developmental concerns. Prior to being scheduled an assessment, all families expressed a need for their child to receive an autism screening. In other words, all children included in this study likely had some shared behavioral issues that allowed them to "pass" the initial phone screen. Their mothers were concerned about their children's behavior. Further, preliminary analysis indicated no significant differences on five of seven scales on the CBCL based on ASD classification. Nevertheless, two distinct behavioral classes emerged from analyses.

Given that neither covariate of ASD significantly accounted for membership of behavioral classes, targeted interventions should move beyond allowing access to families and children based on diagnostic labels. The models using CBCL indicators showed that children from both groups may need help in better self-regulation, withdrawn behavior, and aggressive behaviors. This study clearly showed that behaviors – not labels – seem to matter at these early school ages.

Limitations and Considerations

The results of this exploratory investigation may help inform practice related to the various behavioral subgroups in young children with and without ASD. Indeed, the method of subgroup analysis used in this study has been shown to assist in intervention studies to determine how certain classes of syndromes might respond to differential treatment (Cooper & Lanza, 2014). However, validation data is needed to test these emerged classes and the clinical utility of findings. If confirmed with additional and larger datasets, diagnostic and community-based service providers may benefit from the knowledge of these combinations of emotional and behavioral syndromes observed in young children who are being considered for a diagnosis of autism, particularly as treatment programs are increasingly targeting specific behavioral symptoms (e.g., Tsakanikos, Costello, Holt, Sturmey, & Bouras, 2006; Wood et al., 2009).

Because data on behavior problems were collected using parent reports, results are subject to shared method variance and informant bias. Yet, data collection from a single informant is often a reality in clinics focused on screening young children. Additionally, the ADOS was utilized, in part, to account for shared method variance, as it was conducted by an examiner. Further, studies have shown that parent-reported concerns of child behavior problems provide invaluable information. For example, in 2003, Glascoe conducted a study of 472 parents and their children, ranging from 21 months to 8 years of age, recruited from Head Start Programs. Of this sample, 84% had below threshold scores on parent-reported measures of behavior problems. Logistic regression identified that parent-reported behavior problems and social skills were predictive of mental health issues, while other issues of self-help, motor skills, and school skills did not contribute to predictions of mental health problems. Further, parental concerns of behavior problems and social skills were 68% sensitive to mental health status and 66% specific to correctly identifying children without mental health problems, suggesting that parental concerns of behavior problems provide instrumental information. Also, caregiver depression has been shown to correlate with ratings of child behavior problems in studies of clinical and community samples (Downey & Coye, 1990; Goodman & Gotlib, 1999). Studies support a bidirectional relationship between caregiver well-being (e.g., stress) and child behavior problems (Neece, Green, & Baker, 2012), lending support for efforts to assess and treat parenting stress in order to lead to improved behavior problems. However, caregiver well-being (that is, depression or stress) is not often assessed as part of an autism screening, including in the screening protocol for this study. Future studies may wish to include measures of parental depression or stress in latent models so as to prevent biased reporting of behavior problems.

The use of demographic variables (e.g., ethnicity, gender, income, education) should be tested to assess whether other individual variables influence the categories of emerged classes. Moreover, given the emergence of a class characterized by emotion dysregulation, future studies may wish to understand the predictive role of children's cognitive ability on behavioral classes. Poor language and cognitive impairments may worsen a child's ability to effectively communicate and control emotions.

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Chapter II. Appendix: Tables and Figures

Table 1a

Descriptive Statistics for Sample Characteristics

Demographic Variables	$N = 170$	No ASD ($n = 62$)	ASD ($n = 108$)	t / X^2
Child age, *M* (*SD*)	4.0 (1.0)	4.2 (.9)	3.9 (1.0)	**2.17***
Child gender, % (*n*)				2.06
Females	20.0 (34)	25.8 (16)	16.7 (18)	
Males	80.0 (136)	74.2 (46)	83.3 (90)	
Child ethnicity, % (*n*)				2.79 †
African American	5.3 (9)	8.1 (5)	3.7 (4)	
Asian	1.2 (2)	1.6 (1)	.9 (1)	
Caucasian	22.9 (39)	17.7 (11)	25.9 (28)	
Latino	50.0 (85)	59.7 (37)	44.4 (48)	
Other	19.4 (33)	12.9 (8)	23.1 (25)	
Prefer not to answer	1.2 (2)	0.0 (0)	1.9 (2)	
Child enrolled in school, % (*n*)	46.7 (77)	55.9 (33)	41.5 (44)	3.15 †
Family income, % (*n*)				.89
< $50,000	65.8 (79)	69.6 (32)	63.5 (47)	
≥ $50,000	26.7 (32)	26.1 (12)	27.0 (20)	
Mother education, % (*n*)				1.29
High School diploma or below	36.7 (58)	42.4 (25)	33.3 (33)	
Higher than High School	63.3 (100)	57.6 (34)	66.7 (66)	
Married/Living with partner, % (*n*)	79.5 (105)	70.2 (33)	84.7 (72)	3.91 †

Note. Bolded text denotes significance.
* $p < .05$, † $p < .10$

Table 1b

Frequency Table for CBCL Narrow-Band Scales by ASD Status

Indicators of Latent Class	Code	Label	Frequency, %			X^2
			Full sample (*N*=170)	non-ASD (*n*=62)	ASD (*n*=108)	
ER	1	Normative	36.5	28.6	41.1	2.70
	2	Atypical	63.5	71.4	58.9	
A/D	1	Normative	61.8	49.2	69.2	**6.68***
	2	Atypical	38.2	50.8	30.8	
SC	1	Normative	56.5	44.4	63.6	**5.89***
	2	Atypical	43.5	55.6	36.4	
W	1	Normative	30.6	34.9	28.0	.89
	2	Atypical	69.4	65.1	72.0	
SP	1	Normative	58.8	50.8	63.6	2.67
	2	Atypical	41.2	49.2	36.4	
AtP	1	Normative	41.8	38.1	43.9	.55
	2	Atypical	58.2	61.9	56.1	
AgB	1	Normative	49.4	42.9	53.3	1.72
	2	Atypical	50.6	57.1	46.7	

Note. CBCL = Child Behavior Checklist (Achenbach & Rescorla, 2000). ER = Emotionally Reactive. A/D = Anxious/Depressed. SC = Somatic Complaints. W = Withdrawn. SP = Sleep Problems. AtP = Attention Problems. AgB = Aggressive Behaviors.

* $p < .05$

Table 1c

Correlations Between CBCL Narrow-Band Indicators and Covariates

Variables	1	2	3	4	5	6	7
1. ER	--						
2. A/D	.52***	--					
3. SC	.34***	.41***	--				
4. W	.32***	.37***	.15 †	--			
5. SP	.41***	.38***	.18 *	.32 ***	--		
6. AtP	.40***	.30***	.17 *	.37 ***	.37***	--	
7. AgB	.55***	.46***	.23**	.47 ***	.47***	.52***	--
ASD classification	-.06	-.11	-.12	.01	-.18*	-.07	-.05
ADOS comparison score	-.13	-.20*	-.19*	.07	-.13	-.06	-.10

Note. ER = Emotionally Reactive. A/D = Anxious/Depressed. SC = Somatic Complaints. W = Withdrawn. SP = Sleep Problems. AtP = Attention Problems. AgB = Aggressive Behaviors.

ASD classification = non-ASD group (0), ASD group (1)

ADOS comparison score = scores range from 1 (low severity) to 10 (high severity)

*** $p < .001$, ** $p < .05$, * $p < .01$, † $p < .10$

Table 1d

Comparison of Baseline Models

No. of Classes	AIC	BIC*	aBIC	VLMRT *p*-value	LMRT *p*-value	BLRT* *p*-value	E
1	1602.44	1624.39	1602.23	--	--	--	--
2	1348.97	**1396.00**	1348.51	**<.001**	**<.001**	**<.001**	.84
3	1338.74	1410.87	1338.04	.10	.11	.01	.83
4	**1335.72**	1432.93	**1334.78**	.01	.01	.04	83
5	1340.68	1462.98	1339.49	.55	.56	.67	.85
6	1348.16	1495.54	1346.72	.62	.63	.86	**.86**
with covariate – ASD classification							
2	1347.88	1398.06	1347.39	<.001	<.001	<.001	.84
with covariate – ASD severity							
2	1311.11	1360.81	1310.15	<.001	<.001	<.001	.84
with covariates – ASD classification and severity							
2	1246.55	1289.40	1244.59	<.001	<.001	<.001	.83

Note. * BIC and BLRT have been recommended as preferred indicators in the class selection process among competing models.
aBIC = sample size adjusted Bayesian information criterion. LMRT = Lo-Mendell-Rubin Adjusted Test. VLMRT = Vuong-Lo-Mendell-Rubin test. BLRT = Bootstrapped Likelihood-Ratio Test. E = Entropy. BF = Bayes Factor Pairwise Comparison Test.

Table 1e

Prevalence Proportions of the Sample as a Function of the Number of Latent Classes

No. of Classes	1	2	3	4	5	6
1	1.0	**.44**	.46	.06	.06	.06
2	--	**.56**	.39	.27	.40	.02
3	--	--	.15	.38	.02	.15
4	--	--	--	.29	.22	.37
5	--	--	--	--	.29	.11
6	--	--	--	--	--	.28

Note. Bolded text denotes proportion of classes in a two-class solution

Table 1f

Prevalence and Conditional Probabilities of a Two-Class Solution

Variable	Response	Class 2 (44%)	Class 1 (56%)
		Conditional Probability of Atypical Behaviors	
Emotionally Reactive	Normative	**.75**	.05
	Atypical	.25	**.95**
Anxious/Depressed	Normative	**.96**	.33
	Atypical	.04	.67
Somatic Complaints	Normative	**.77**	.39
	Atypical	.23	.61
Withdrawn	Normative	.56	.10
	Atypical	.44	**.90**
Sleep Problems	Normative	**.89**	.34
	Atypical	.11	.66
Attention Problems	Normative	**.71**	.17
	Atypical	.29	**.83**
Aggressive Behaviors	Normative	**.90**	.16
	Atypical	.10	**.84**

Table 1g

Effects of Covariates on Latent Classes of Behavior Problems

No. of Classes	Covariate	*Est.*	*SE*	*p*-value	*OR*
2	ASD classification	-.61	.38	.11	1.84
2	ASD severity	.00	.01	.66	1
2	ASD classification	-.09	.17	.61	.91
	ASD severity	.98	1.05	.35	2.66

Note. Est. = Estimates. SE = Standard Error. OR = Odds Ratio.
ASD Classification = Non-ASD (0), ASD (1)
Using Reference Class 1 ("Normative Behavioral Class")

Table 1h

Classification Probabilities: Two-Class Model of Behavior Problems

Class	1	2
1. Normative Behaviors	**.97**	.04
2. High Behaviors	.06	**.94**

Note. Values indicate probabilities of most likely class membership (column) by latent class modal assignment (row). Bolded values indicate average posterior probabilities.

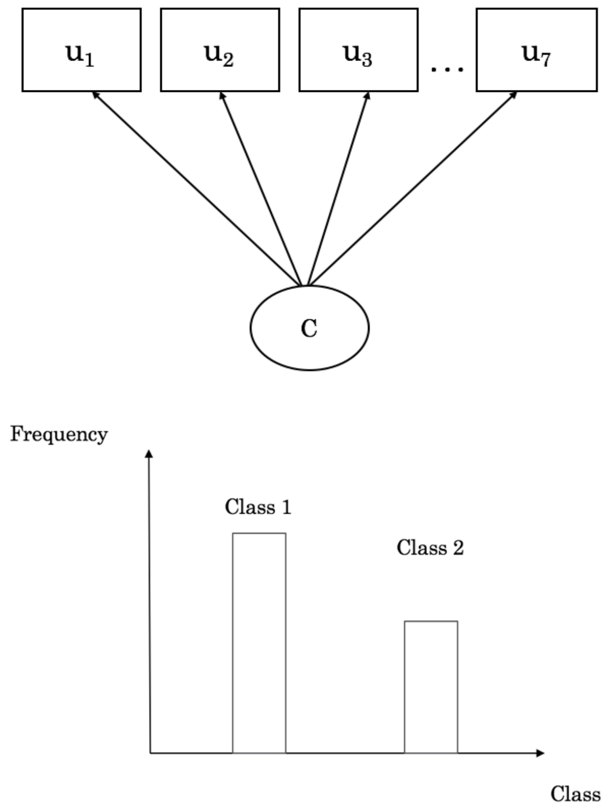
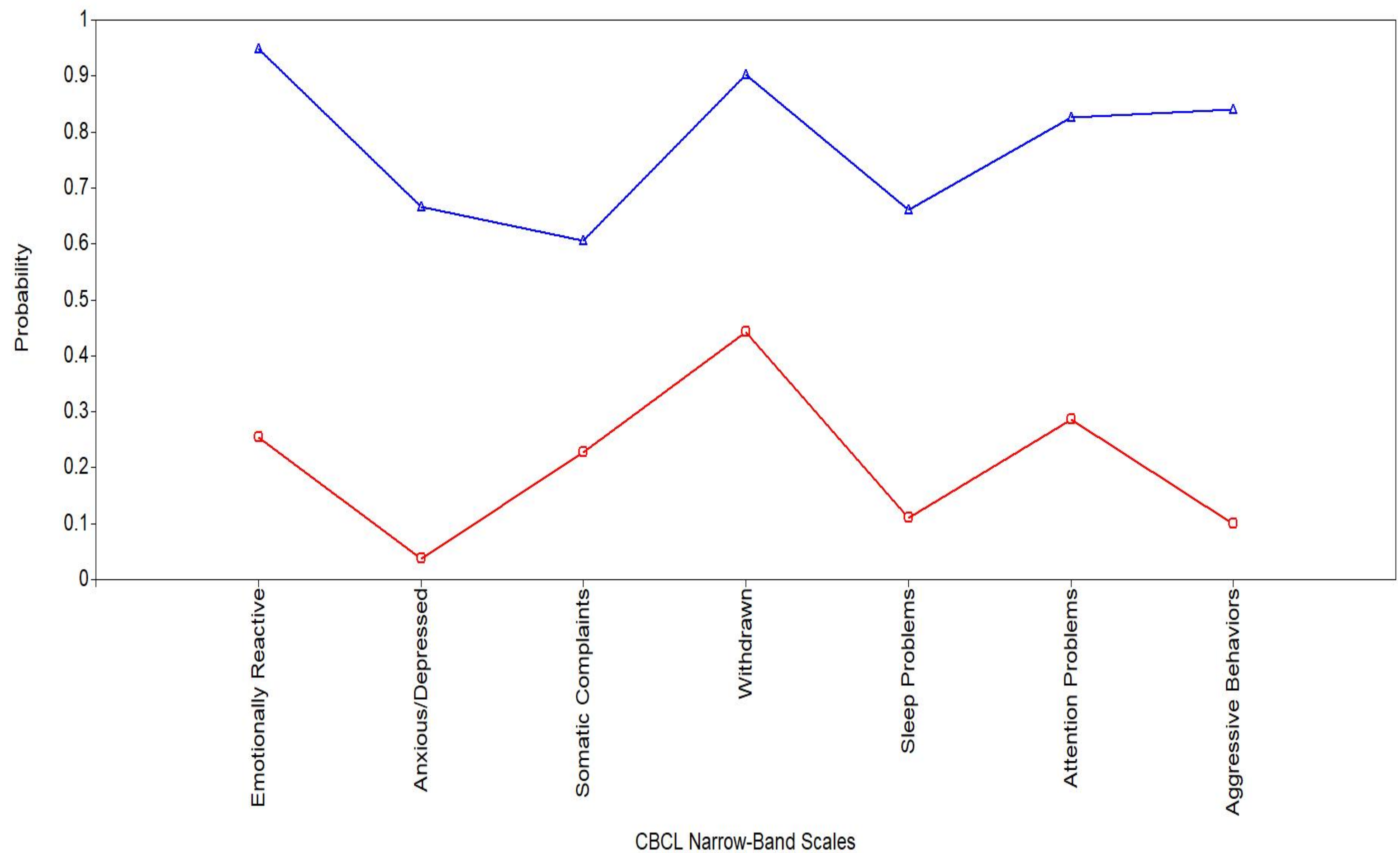


Figure 1a. *General Latent Class Analysis Diagram (right) and Frequency Distribution (left)*

Figure 1b. *Two-Class Model of Behavior Problems Among Preschool-Aged Children*



CHAPTER III. Childhood to Adolescence

Study 2. Stability and Interplay of Behavior Problems and Social Skills in Youth with and without Intellectual Disability

Background of the Study

Children with intellectual and developmental delays often have high levels of reported behavior problems (Baker et al., 2003; Einfeld & Tonge, 1992). For parents and teachers, co-occurring behaviors can be of equal or greater concern than core features of the disability (Baker & Blacher, 2015; Blacher, Howell, Lauderdale-Littin, DiGennaro Reed, & Laugeson, 2014). In addition, behavior problems may affect important areas of development, such as learning acquisition (Pearson et al., 2006). This study was an examination of the longitudinal relations between behavior problems and social skills among youth with and without intellectual disability from childhood through adolescence.

Association Between Behavior Problems and Social Skills

In typically developing populations, problematic social relationships have been thought to have cascading effects on behavior problems. For instance, a child who is aware of his difficulties to fit in with peers may feel frustrated about his lack of social competence, which may worsen existing behavior problems. These behaviors may manifest as aggression, for example. In turn, the development of these behaviors may interfere with the child’s ability to make friends over time, particularly in later years when certain behaviors may perpetuate a negative reputation among peers. In their comprehensive review, Boivin and colleagues (2005) documented the link between experiences of peer rejection and externalizing behavior problems in childhood.

Indeed, certain psychosocial variables may explain the development of behavior problems. Many children and adolescents with intellectual disability (ID) report experiencing peer rejection, social isolation, and feelings of loneliness. Recently, in the only systematic review of its kind, Alexandra and colleagues (2018) found that the average prevalence of loneliness was approximately 45% among persons with intellectual and developmental disabilities. Additional research supports the link between loneliness and internalizing domains, including depression, in this population (Heiman, 2001; O'Hara, McCarthy, & Bouras, 2010; Lunsky, 2004).

Utilizing samples of adults with ID, Matson's research team examined the association between behavior problems and socialization. In a study of 856 adults with ID (*M* age = 39.8 years), Matson and colleagues (1998) divided the sample by the presence or absence of elevated internalizing behavior problems. Results revealed that adults with ID with internalizing behaviors displayed more externalizing behaviors (e.g., stereotypic behaviors, self-injurious behaviors) and more social problems, relative to adult with ID without internalizing behaviors. In a subsequent study of 302 adults with ID (*M* age = 51.64), Matson et al. (2009) found that specific symptoms of impulsivity, mania, and anxiety were related to negative social behaviors. With a focus on adulthood, these studies of persons with ID highlight the influence of behaviors on negative social outcomes.

Longitudinal Relations Between Behavior Problems and Social Skills

In an epidemiological study of behavior problems in 578 children and adolescents with ID (ages 5 to 19.5 years), Einfeld and colleagues (2006) used a growth curve analysis and found that while levels of behavior problems remained high from early childhood to late adolescence, behavioral issues seemed to decrease over time. Significant subgroup differences also emerged: Changes in behavior problems seemed to differ by gender and severity of ID (i.e., mild to severe). Male participants in the study showed a greater decrease in significant internalizing behaviors than females, and behavior problems decreased more for participants with mild ID than those with severe or profound ID. Results from this longitudinal study also indicated that, whereas behavior problems improved for some over time, scores on a measure of social relatedness (i.e., lack of affect, unhappiness, aloofness, resistance to being touched) worsened. A possible explanation for this finding includes overlapping effects between domains of social relatedness in this study with autistic-like symptoms, which are common in ID populations (Christensen et al., 2016). It is also possible that the decrease in demonstrated social engagement may reflect the increasingly complex social relationships that youth face as they age (White et al., 2009).

Further longitudinal investigation into the transactional effects of behavior problems and social skills is warranted. As of this writing, no studies have expanded on the Einfeld et al. (2006) study to investigate the possible relation among behavior problems and social skills over time in samples of school-aged children and adolescents with ID. This relation has been examined in young children with developmental delays (e.g., Baker, Fenning, Crnic, Baker & Blacher, 2007), as well as in older children and adolescents with typical development (Bornstein, Hahn, & Haynes, 2010).

In a study of 172 children with and without developmental delays, Baker and colleagues (2007) investigated potential predictors at child age 4 of social skills at child age 6. Data were collection instruments included the *Child Behavior Checklist* (CBCL; Achenbach & Resorla, 2000), a parent-reported measure of child behavior problems, and the *Social Skills Rating System* (SSRS; Gresham & Elliot, 1990), a teacher-reported measured of social skills. Children with delays demonstrated significantly more behavior problems at age 4 and lower social skills at age 6 compared to children with typical development (TD). Furthermore, results from stepwise regression analyses indicated that early child behaviors predicted later social skills for the typically developing children but not for children with delays.

In a study using 3-waves of data from typically developing youth (ages 4, 10, and 14 years), Bornstein and colleagues (2010) investigated the relations among internalizing behaviors, externalizing behaviors, and social competence. Controlling for child IQ and maternal education, results revealed that children who exhibited high levels of internalizing behaviors at age 4 maintained high levels of internalizing behaviors at age 10 and developed high levels of externalizing behaviors at age 14. Further, children with lower social competence at age 4 showed more externalizing and internalizing behaviors throughout late childhood and early adolescence. The findings in this study demonstrated a longitudinal link between poor social competence and later behavior problems, suggesting that in early childhood social skills may play a protective role against behavioral maladjustment in adolescence. To note, Bornstein and colleagues (2010) did not detect a transactional effect in which early behavior problems predicted later social competence, which is inconsistent with the findings reported by Baker et al. (2007). It is difficult to compare results across these studies due to the differing age groups of the samples and the inclusion or exclusion of children with ID.

The Present Study

Previous studies have examined the cross-sectional associations between behavior problems and social skills, with some longitudinal studies mapping the linked trajectories of these domains. Based on these previous reports from ID and TD samples, attention to social skills in the context of behavioral development is lacking but well-deserved, particularly in longitudinal research. Further, few studies have specifically examined these trends in samples that include youth with intellectual disability. Thus, the present study investigated the development of behavior problems and the transactional relations between behavior problems and social skills across childhood and adolescence, spanning nearly a decade of school-age years. Youth social skills comprised a key construct in the understanding of behavior problems over time.

Nested path analysis models were applied to determine the most parsimonious and plausible patterns of lagged relations across time between the two constructs of interest. Analyses began at 6 years, as it is the start of formal schooling, and continued to age 15, a period in which social dynamics are thought to increase in complexity. Altogether, childhood and adolescence mark significant periods of behavioral and social developmental transformations. Research questions for Study 2 include: (1) How do behavior problems and social skills relate from early childhood to adolescence, while controlling for disability status? (2) And what is the direction of effect over time?

Among previous studies of youth with ID, a major methodological challenge has been the over-reliance on parent reports. Thus, in the current study, mother, father, and teacher data will be utilized to examine the developmental patterns of behavior problems and social skills. Best clinical practice urges the use of multiple sources of information when attending to the assessment of child behavioral concerns (Voelker, Shore, Lee, & Szuszkiewicz, 2000). Multiple informant data will be included to capture child behavior problems and social skills from varying perspectives and contexts. Parents and teachers observe children in their most natural environments, and thus each reporter provides meaningful information about the social and behavioral development of children. Measurement designs using data from multiple informants are also considered best methodological practice (Achenbach, McConaughy, & Howell, 1987; Rescorla et al., 2013; De Los Reyes et al., 2013). When a single measure from a single reporter is used, the possibility arises that monomethod bias, or shared method variance, inflates the relations between variables measured. While the current evaluation uses the same measures (i.e., CBCL and SSRS) for each construct over time, the ratings were collected from multiple reporters, and thus correlations were less likely to be inflated.

Results of this study may contribute to the literature by increasing our understanding of behavioral and social outcomes throughout development, as well as providing support for programs that target these domains. For example, young children with poor social interaction skills may be at risk for later problem behaviors (e.g., anxiety, depression, aggression), particularly as increasingly complex social demands may be intensifying this relation. In addition, if prosocial behaviors in early years prove to be a protective factor against problem behaviors during development, findings from this study may encourage the development of evidence-based social skills programs for school-aged youth with ID, something few researchers have accomplished as most programs are exclusively for young children.

Methodology

Procedures

Data were drawn from the Collaborative Family Study (CFS), a multisite, longitudinal study assessing children from ages 3 to 15 years (Eunice Kennedy Shriver National Institute of Child Health and Human Development Grant # HD34879-1459). The Institutional Review Boards of each collaborating university (University of California, Riverside, UCR; University of California, Los Angeles, UCLA; and Pennsylvania State University, PSU) approved all study procedures. The core study identified youth with intellectual disability (ID) or typical development (TD) to examine family processes, child emotion regulation, and behavior problems and mental disorders in youth with and without ID. Families of children with ID were recruited through diagnostic and intervention service providers and community agencies serving individuals with developmental delays as well as schools. Families of children with TD were recruited through preschools and daycare programs. Additional recruitment of families and children took place during two waves, at child age 5 and 13.

Following approval by all appropriate IRBs, parents and their children participated in an in-person assessment visit that lasted two to three hours. The visit began with reviewing procedures, answering questions, and obtaining informed consent from parents and assent from youth, when appropriate. Parent data for the present study (measures of behavior problems, social skills, and family demographics) were obtained from assessments with the families during the visit. Once the child reached school age, during each visit, parents were also asked to give consent to their child's teacher to provide information about the child and his/her behaviors at school. Once consent and contact information were obtained, teachers were mailed corresponding study measures to complete. Families and teachers received an honorarium for their participation.

Participants

Families were first assessed at age 3 (intake): Children in the ID group were primarily in the mild to moderate range (n = 115, M IQ = 59.97, SD = 12.71) of cognitive delay on the *Bayley Scales of Infant Development* (Bayley, 1993), and were excluded if they could not walk or had profound delays at intake. Children in the TD group scored in the range of normal cognitive development (n = 145, M IQ = 104.39, SD = 11.55), and were excluded from the TD group if they had any type of disability or were born prematurely. Once included in the study, cognitive functioning was again assessed using the *Stanford-Binet Intelligence Scale* (Thorndike, Hagan, & Sattler, 1986) at child age 5. Because it is difficult to obtain reliable and valid assessment data from very young children (Shepard, Kagan, & Wurtz, 1998), IQ scores at age 5 were considered a more reliable indicator of cognitive ability. Participants in the current study were classified as cognitively delayed or not delayed, based on the administration of the Standford-Binet cognitive assessment at age 5. The present sample (*N*=203) was comprised of all families for whom data were available on the primary measures at six time points (child ages 6-9 and 13-15 years). Table 2a shows sample demographic information based on measures collected at child age 5.

Measures

Demographic variables. Child and family demographics (i.e., child gender, ethnicity, parental marital status), including data on family socioeconomic status (i.e., income, education, occupation), were provided by parents at age 3 and updated at each time point. Demographic information at age 5 was used for this study. Demographic variables that differed between ID and TD groups, such as maternal and paternal education, were included as covariates when those variables were related to the outcome variables of interest.

Stanford-Binet Intelligence Scale – Fourth Edition (Thorndike et al., 1986). Child cognitive functioning was assessed using the *Stanford-Binet* at child age 5 during the lab visit. During administration, the examiner adjusts the starting points based on the child's developmental level. Thus, this widely used instrument is well-suited for evaluating children with developmental delays. The composite standard IQ score (population M = 100; SD =15) was produced by using the eight sub-tests most appropriate for children age 5. These subtests were: Vocabulary, Comprehension, Absurdities, Pattern Analysis, Copying, Quantitative, Bead Memory, and Memory for Sentences. In terms of psychometrics, evidence supporting reliability (the consistency of test results) and validity (the extent to which a test measures what it is designed to measure) is strong (Thorndike et al., 1986). Glutting (1989) reported high internal consistency, and as reported in the technical manual (Thorndike et al., 1986), there is sufficient evidence for validity. The *Stanford-Binet* has also been well validated in ID populations (e.g., Dacey, Nelson, & Stoeckel, 1999).

Vineland Adaptive Behavior Scales (Sparrow, Balla, & Cicchetti, 1984). Adaptive functioning was assessed to further establish diagnostic group membership. The *Vineland Adaptive Behavior Scales* (VABS) was administered as a semi-structured parent interview at child age 5. The overall adaptive composite (population M = 100; SD = 15) was utilized. The composite score is comprised of Communication, Daily Living Skills, and Socialization domains. The VABS instrument has an internal consistency from .75 to .80 and Cronbach's alpha of .93 (Sparrow et al., 1984).

Children in the present study were classified as having ID if they fell in the categories of ID or borderline ID based on criteria set forth in the *Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition* (DSM-IV-TR; APA, 2000). Thus, children in the ID group had (1) a score ≤84 on the Stanford-Binet Intelligence Scale – Fourth Edition (Thorndike et al., 1986) and (2) a score ≤84 on the VABS. Participants with IQs ranging from 71 to 84 (i.e., in the borderline range) were classed in the ID group based on prior research demonstrating similarities in the difficulties faced by those with borderline intellectual functioning and those with ID in this sample (Fenning, Baker, Baker, & Crnic, 2007). Participants were included in the TD group if: (1) they received a score greater than or equal to 85 on both the *Stanford-Binet*

(Thorndike et al., 1986) and the *VABS* (Sparrow et al., 1984), and (2) if they had no previous history of a disability or prematurity at birth.

Child Behavior Checklist (CBCL) and Teacher Report Form (TRF) for Ages 6-18 Years (Achenbach & Rescorla, 2001). Child behavior problems were assessed by parents (mothers and fathers) and teachers on the *Child Behavior Checklist* (CBCL/6-18; Achenbach & Rescorla, 2001) and *Teacher Report Form* (TRF; Achenbach & Resorla, 2001), respectively, from child ages 6 to 15 years. The school-aged versions of the CBCL and TRF includes 113-items. Items that differed between the two rater forms are context specific (e.g., disrupts class discipline). Respondents are asked to rate statements that characterize the child's behavior in the past two months using a 3-point scale (0= not true, 1=somewhat/sometimes true, 2=very/often true). Example items include: acts too young for his/her age; argues a lot; and there is very little that he/she enjoys.

The CBCL yields a total behavior problems scale, two broad band scales (Externalizing and Internalizing), seven narrow-band scales, and six clinical scales that map onto DSM diagnoses. The TRF provides scores for a total problems scale, two broad band scales (Externalizing and Internalizing), and eight narrow-band scales. Higher scores on subscales indicate greater levels of psychopathology. The CBCL empirically based scales have alpha coefficients from .78 to .97 (Achenbach & Rescorla, 2001). The TRF empirically based scales have alpha coefficients from .72 to .97 and reliability from .60 to .96 (Achenbach & Resorla, 2001). For the purposes of the present study, T-scores for Total Behavior Problems, Internalizing Behaviors, and Externalizing Behaviors (M=50; SD=10) were used.

Social Skills Rating System (SSRS; Gresham & Elliot, 1990). The *Social Skills Rating System* (SSRS) is a widely used measure of social functioning and interpersonal skills for children and adolescents (age 3-18) and has been identified as one of the most popular social functioning rating scales (Crowe, Beauchamp, Catroppa, & Anderson, 2011). The SSRS offers a parent and teacher form, both of which were completed at the 6 time points included in this study (ages 6, 7, 8, 9, 13, and 15). Items from the parent form include: starts conversations rather than waiting for someone to talk first; speaks in an appropriate tone of voice at home; and receives criticism well. Distinct items from the teacher report include: invites others to join in activities and responds appropriately when pushed or hit by other children. Respondents are asked to assess the child's social behavior on a 3-point scale (0=Never, 1=Sometimes, 2=Very often). The measure yields raw and standard scores on the Social Skills and Problem Behaviors scales. Teacher forms also provide a domain for Academic Competence.

The current study utilized the Social Skills Standard Scores (M=100, SD=15), which is comprised of subdomains of Responsibility, Cooperation, Self-Control, Assertiveness, and Empathy. High scores on the Social Skills scale indicate better social functioning. The parent form of this measure has high test-retest reliability (r = .84), as well as adequate internal consistency for the Social Skills domain, ranging from .83 to .94 (Gresham & Elliot, 1990). The teacher form has shown similar psychometrics, with a test-retest reliability of .87 and internal consistency of .97 (Karatas, Sag, & Arslan, 2015). Coefficients alpha were .93 for teacher forms and .90 for parent forms (Gresham & Elliot, 1990).

Social Skills Improvement System – Rating Scales (SSIS; Gresham & Elliot, 2008). The *Social Skills Improvement System* (SSIS), the updated version of the SSRS (Gresham & Elliot, 1990), provides an assessment of social skills and problem behaviors of children and adolescents (ages 6-18). The SSIS requires parents and teachers to rate the frequency of behaviors on a 4-point scale (0=Never, 1=Seldom, 2=Often, and 3=Almost Always). The SSIS parent and teacher form replaced the SSRS forms at adolescent age 15, and thus, the SSIS Social Skills Standard score at age 15 was used to correspond with the SSRS at other time points. The scale includes items related to social skills, and includes subscales of Communication, Cooperation, Assertion, Responsibility, Empathy, Engagement, and Self-Control. High scores indicate better social functioning.

With regard to the change in instrument use, the SSRS and SSIS differ on following features. Compared to the SSRS, the SSIS: (a) contains fewer subscale items, (b) additional rating dimensions; (c) additional points on scales (i.e., from a 3-point to 4-point rating scale); (d) more items on the social skills and problem behavior scales; and (e) fewer items on the academic competence scale (Gresham, Elliott, Vance, & Cook, 2011). Gresham and colleagues (2011) compared the two instruments on reliability and validity and found that both the SSRS and SSIS had high internal consistency and high validity, although the SSIS is considered superior to the SSRS with regards to internal consistency. A strong correlation (r=.74) between the SSRS and SSIS on the Social Skills scale, utilized in this study, was found in their report (Gresham et al., 2011). Further, both versions of the Gresham and Elliot (1990; 2008) instruments have been utilized in previous longitudinal analyses (e.g., McKown, Russo-Ponsaran, Allen, Johsnon, & Warren-Khot, 2015). Finally, in the current investigation, correlations on mother, father, and teacher reports between the SSRS at age 13 and SSIS at age 15 on Social Skills were all moderate (.50, .60, and .47, respectively) and significant (*p*'s<.001). Thus, the current study utilized the SSRS over 5 time points (ages 6-13) and the SSIS at the last time point (age 15), and findings were interpreted with caution.

Data Analytic Plan

The research questions posed in this study were addressed using cross-lagged analysis, a technique of structural equation modeling (SEM), in order to test the directionality in the relationship between behavior problems and social skills across every other time point (ages 6, 7, 8, 9, 13, and 15). Cross-lagged analyses move beyond simpler forms of correlational analyses by establishing the nature and direction of predictive relations between variables at multiple time points (Biesanz, 2012; Little, 2013). As such, this analysis increases internal validity. However, Little (2013) cautions against interpreting resulting causal statements as stronger than those made based on experimental research.

Rather than using observed variables to inform each construct or manifest variable in the SEM model, three indicators of mother, father, and teacher report were utilized as a parcel. A parcel is a mathematical combination summarizing multiple variables into one. Although there is debate over the use of parcels (Little, Cunningham, Shahar, & Widaman, 2002), there are key advantages to using parcels instead of items. Psychometrically, parcels have higher reliability, greater communality (i.e., factor loadings are stronger), and a higher ratio of common-to-unique factor variance. In terms of model estimation and fit, models using parcels instead of items have fewer parameter estimates, lower indicator-to-subject ratio, and reduced sources of sampling error (Little, 2013).

With regards to parcel construction, Little (2013) recommends that items or indicators be averaged rather than summed to create a parcel; this will result in parcels with similar metrics and comparable means and variances. Thus, parcels were created by averaging three indicators per construct at each time point. Indicators were formed by using the DEFINE statement in Mplus® version 8.1 (Muthén & Muthén, 1998-2018).

Covariates. Previous research indicates that significant differences in behavior problems and social skills exist between youth with intellectual disability or typical development. Thus, in the present study, disability status was included as a binary covariate (0 = TD, 1 = ID). Covariates may have confounding influences that could inflate or conceal a hypothesized relationship. Disability status was initially entered into models as a full partial control, which is recommended when there are more than two time points in longitudinal SEM (Little, 2013), but nonsignificant covariate paths were later pruned from the model for parsimony.

To identify other possible confounding variables, sample demographic variables were subjected to independent sample *t* tests by disability group. Variables that were significantly different between ID and TD groups were subsequently correlated with variables used in the models. Those variables that were significantly associated with the outcome variables were used in the SEM model to statistically control for or remove their influence (Little, 2013).

Model building steps. Research questions were examined using SEM, which is advantageous in its use of testing paths of influence between multiple variables across multiple time points, as well as to model measurement error of repeated measures (Kline, 2011). Kline (2011) outlined six steps of model building that will be followed in this study: (1) model specification (hypotheses are represented by symbols describing parameters of SEM); (2) evaluation of whether the model is identified (whether the model is theoretically possible); (3) selection of measures and data collection; (4) model estimation (the evaluation of model fit, interpretation of parameters, and comparison of models); (5) presentation of results and interpretations; and (6) report final results once re-specification is complete. Mplus was utilized for the model building process.

A series of models was fitted to the data in order to examine relations of interest. The hypothesized full cross-lagged model for behavior problems and social skills is described graphically in Figure 2a. This is a two-variable, six wave cross-lagged model with disability status as the covariate. In this model diagram, significant covariate paths are only shown at Time 1 for readability. The hypothesized model depicted in Figure 2a shows general behavior problems, but the process will be performed with models for externalizing and internalizing behavior problems, separately, to determine whether or not the associations were the same or different when parsing behavior into these types.

A series of nested models was fitted to the data. Stability paths were tested from one time point to the next for problem behaviors and social skills, and synchronous (or simultaneous) relations relations between problem behaviors and social skills were tested at each time points. Specifically, the following models were assessed:

1. A model that includes stability effects only (cross-lagged associations are hypothesized not to exist)
2. A model specifying the stability effects and the unidirectional relationships between behavior problems and social skills (a behavior-driven model, in which social skills are hypothesized not to affect behavior problems, but behavior problems are hypothesized to affect social skills)
3. A model specifying the stability effects and the unidirectional relationships between social skills and behavior problems (a social skills-driven model, in which behavior problems are hypothesized not to affect social skills, but social skills are hypothesized to affect behavior problems)
4. Fully reciprocal, cross-lag model specifying the stability effects and bidirectional relationships between behavior problems and social skills

These models were then tested with the addition of the hypothesized covariate. The selected model may benefit from respecification, including the removal of nonsignificant paths that do not compromise the theoretical rationale for including them in the first place; this is otherwise known as model trimming. However, such respecifications have been advised against if the initial model already fits well (MacCallum, Browne, & Sugawara). Thus, empirical and theoretical justifications for doing so would be provided.

Model fit indices were recorded for each tested model. While several fit statistics are identified in the SEM literature, fit statistics utilized in the present study were selected based on their widespread use and empirical support. Fit indexes included: root mean square error of approximation (RMSEA; Browne & Cudeck, 1993; Steiger, 1990), Comparative Fit Index (CFI; Benter, 1990), Tucker-Lewis Index (TLI; Tucker & Lewis, 1973), Akaike's Information Criterion (AIC; Akaike, 1987), and Bayesian Information Criterion (BIC; Raftery, 1993; Schwartz, 1978). The RMSEA value, with its 90% confidence interval, is an index of parsimony. As such, it is sensitive to the number of parameters estimated in the model. Values less than .05 indicate good fit; values as high as .08 indicate reasonable fit; values above .08 indicate mediocre fit; and values above .10 indicate poor fit (Browne & Cudeck, 1993; Hu & Bentler, 1999). CFI and TLI values are most commonly used in the SEM research to determine improvements among nested model (Byrne, 2012). Values greater than .90 indicate good fit, and values between .95 to 1.0 indicate excellent model fit. CFI values are constrained to fall between 0 and 1; in contrast, TLI values are non-normed values that may exceed 1.0. AIC and BIC values reflect model fit and parsimony. Between the two criteria, BIC penalizes more complex models (i.e., based on degrees of freedom or the number of parameters). Smallest AIC and BIC values represent the best model fit among nested models. The model chi-square will be used as the most basic measure of absolute fit, with nonsignificant values indicating that the model is consistent with the covariance data (Bryne, 2012). Additionally, if the ratio between the chi-square value and the degrees of freedom is less than 3, the model is considered to fit the data well (Schreiber, Nora, Stage, Barlow, & King, 2006). Chi-square test has been found to be related to sample size (Bryne, 2012), particularly with sample sizes larger than 200. Lastly, the chi-square difference test will be used to determine overall fit as parameters are removed. The difference test considers the subtracted chi-square value and associated degrees of freedom between two hierarchical models. The difference in the degrees of freedom is used to find the cut-off value based on the chi-square distribution. If the difference in the chi-square exceeds the cut-off value, this indicates that the difference in chi-square is significant. A significant difference test indicates that the model with removed constraints resulted in a better fitting model (Raykov & Marcoulides, 2006). All fit statistics mentioned are computed and provided by *Mplus*.

Assumptions. Longitudinal modeling assumes the following features: (1) Variables are measured across three or more time points; (2) Scores have the same units across time and measure the same construct at each time point; and (3) Measurements at each time point occurred at the same interval. The CFS data used in the present study meets these assumptions. First, six waves of CFS data will be utilized. Second, based on the previous literature, both behavior problems and social skills have been shown to change over time, and reliable and valid assessments are being used to measure these constructs across time. Lastly, data were collected from participants at specific time points, ages 6, 7, 8, 9, 13, and 15. Additionally, in cross-lagged path models specifically, manifest variables are typically assumed to have no measurement error (Raykov & Marcoulides, 2006), but measurement residuals can be estimated with four or more times of measurement. Measurement error can confound results of structural equation modeling. While this is a difficult assumption to check, the instruments used for the variables (CBCL/TRF: Achenbach & Resorla, 2001; SSRS/SSIS: Gresham & Elliot, 1990; 2008) have been widely used to measure these constructs and have sound psychometric properties (see Measures section).

Missing data. The larger CFS study took place over a span of 10 time points, with data collected at child ages 3, 4, 5, 6, 7, 8, 9, 12, 13, and 15. As is often the case in longitudinal research, the CFS dataset contains some missing or incomplete data. At child age 12, measures of interest to this particular study were not collected from participants, and thus were not included in analyses. Participants who were recruited during adolescent ages 13 and 15 were not included in analyses as there were only two waves of data collected, and demographic information at age 5 were clearly not available in these cohorts. There were eighteen participants who had fewer than three time points of data. These cases were omitted from analyses to allow for a more accurate parameter estimates of the change over time.

Maximum likelihood (ML) was used to address incomplete data missing at random (MAR). MAR means that missing data do not depend on unobserved values in the data but do depend on the observed data (Little & Rubin, 1989; Radenbush & Bryk, 2002; Singer & Willet, 2003). Using ML, parameters are estimated with missing data present and all information is utilized to inform values and standard errors of parameters (Little, 2013). To note, there are multiple types of ML estimators, though the majority of SEM models can operate with the standard ML. Estimation methods are affected by the type of variables used in the model and on normality (Kline, 2011; Ullman, 2001). With regards to the use of parcels, Kline (2011) suggests checking the distribution of parcels first. If parcels are normal, then the default ML estimator is appropriate. Thus, parceled data were properly screened and checked for normality.

Descriptive Data Analysis

The data were first examined for outliers using *SPSS*® Version 24.0 (IBM Corp, 2016). Data points that were more than three standard deviations above or below the mean were considered outliers. As suggested by Cohen and colleagues (2003), the outliers were constrained to three standard deviations from the mean in order to reduce the influence of extreme data points. The data was screened and met for assumptions of normality.

Table 2a shows comparisons between the ID and TD group on sample characteristics at child age 5. On child variables, group differences were found on IQ and adaptive behavior scores. T-tests revealed that children in the TD group had higher IQ scores, $t(126.05)=20.48$, $p<.001$, and higher adaptive behavior scores, $t(175.64)=19.61$, $p<.001$; this was by design, of course, in selecting these two groups for study. Maternal and paternal education were also shown to significantly differ, with mothers and fathers in the TD group having had more years in school, $t(185)=2.27$, $p=.03$ and $t(157) = 2.11$, $p=.03$, respectively. No group differences were found on other variables (i.e., school enrollment, family income, marital status, employment).

Descriptive statistics (means, standard deviations, and disability-group comparisons) were performed on all outcome variables at each time point and separately by informant. Because the ID and TD groups were uneven in sample size and were assumed to have unequal variances, two-sample statistics were performed using Welch's t-tests (Welch, 1947). *CBCL Total Behavior Problems* (Table 2b): Group differences existed at each time point and by each informant (p's<.05), except for at age 7 by father report, $t(91.18)=1.98$, $p=.05$. Significant results on this scale suggest that the ID group had higher scores than the TD group from ages 6 to 15. *CBCL Internalizing Behavior Problems* (Table 2c): Group differences existed across all ages as per Teacher Report (p’s$<.05$); teachers endorsed higher internalizing scores in the ID group than the TD group. As per Mother and Father reports, there were no significant differences on Internalizing scores across all age points, except at age 8 in which mothers of youth with ID endorsed significantly higher Internalizing scores than mothers of youth with TD ($p<.05$). *CBCL Externalizing Behavior Pro*blems (Table 2d): Mothers, fathers, and teachers endorsed significantly higher externalizing behavior problems in the ID group than TD at each time point, except at age 13 for Teacher reports ($p>.05$). This time point has the smallest sample size. It is possible that, with a larger sample and more power, teachers at age 13 would also endorse the ID group as having more externalizing behavior problems than the TD group. *SSRS/SSIS Social Skills* (Table 2e): Significant group differences exist on all scales (p’s$<.05$), such that the ID group had lower social skills scores than the TD group, except for: at age 7 on Father report, at age 13 on Father and Teacher reports, and at age 15 on Teacher report ($p>.05$).

Correlational analyses. In order to explore the strength and direction between observed variables, several correlation analyses were conducted. First, correlations between raters (mothers, fathers, and teachers) for each variable and at each time point were performed (Table 2f). *CBCL Total Behavior Problems*: A significant positive agreement between mother and father reports was shown, ranging .51 - .64 at each time point, except at child age 7 in which mothers and fathers showed a significant but weak association (*r* (121) = .24, *p* = .01). Mothers and teachers showed a significant moderate to strong relationship, with correlations ranging from .45 to .58. Correlations between fathers and teachers ranged from .35 to .55 and were significant at all time points, except at child age 7 (*r* (92) = .18, *p* = .09). *CBCL Internalizing Behaviors:* Mothers and fathers showed significant positive agreement, ranging from .34 to .52, across ages 6 to 15. Mothers and teachers showed significant but weak correlations from child age 6 to 9. During adolescents (at child age 13 and 15), there was not a significant association between mothers and teachers (*r* (73) = .19, *p* = .10 and *r* (84) = .10, *p* = .35, respectively). Similarly, fathers and teachers showed a significant relationship across child age 6 to 9, but not significant associations at adolescent ages 13 and 15 (*r* (52) = .13, *p* = .34 and *r* (69) = .21, *p* = .08, respectively). *CBCL Externalizing Behaviors:* Mothers and fathers showed significantly strong associations at each time point, ranging from .52 - .63. Mothers and teachers showed significant but slightly weaker associations, ranging from .31 - .56. Fathers and teachers showed a significantly moderate relationship from age 6 to 9, and again at age 15. At age 13, the association between fathers and teachers approached significance at age 13 (*r* (52) = .27, *p* = .06). Cross-informant correlation estimates from the present study are slightly higher than those reported by Achenbach and Rescorla (2001). *SSRS/SSIS Social Skills*: Lastly, agreement between mothers and fathers on the SSRS/SSIS was significant at each time point but showed weak to moderate associations (.11 - .57). Significant correlations between mothers and teachers ranged from .38 to .50. At age 13 on the SSRS/SSIS, the correlation between mothers and teachers was approaching significance (*r* (68) = .22, *p* =.07). This might reflect the smaller sample size in this cell, or due to the four-year time gap between age 9 and age 13. Between fathers and teachers, significant correlation coefficients ranged from .27 to .52. At child age 7 on the SSRS/SSIS, the correlation between fathers and teachers was not significance (r (92) = .11, p = .31). To note, at age 13, there were smaller cell sizes for correlational analyses between informants. For example, there was a cell size of 45 between fathers and teacher reports on the CBCL at age 13. Thus, weaker results at this time point may reflect the smaller sample size in this cell, or the four-year time gap between age 9 and 13.

Next, correlational analyses were performed to test for stability across time (Table 2g). All correlations across time for mother- and father-reported behavior problems and social skills were significant at the p<.001 and p<.01 level, respectively, indicating that there was stability over time. While teacher participants changed across the timespan of the study, data obtained on measures of behavior problems and social skills was relatively stable across ages 6 to 15, with a few exceptions. The correlation for the TRF Externalizing Behaviors scale from age 9 to 13 was not significant (r(60)=.14, p=.29), as well as for the TRF Internalizing Behaviors scale from age 13 and 15 (r(54)=.24, p=.08).

At each time point, potential control variables (i.e., parental education) were determined by correlating them with the outcome variable used in each model. Table 2h provides correlations between possible covariates (disability status, maternal education, and paternal education) with parcels of internalizing behavior problems and social skills at each time point. Disability status was significantly associated with internalizing behaviors and social skills at each time point, except at age 7 when the correlation with internalizing behaviors approached significance ($r(119)=.17$, $p=.06$). All correlations were in the expected direction; that is, ID status was associated with higher behavior problems and lower social skills. Parental education did not significantly correlate with internalizing behaviors or social skills. Thus, correlational analysis revealed that maternal and paternal education did not need to be controlled for when considering internalizing behavior problems and social skills.

Table 2i provides correlations between possible covariates of the model with externalizing behavior problems. Disability status and parental education were correlated with externalizing behaviors and social skills each time point. There were significant correlations between the disability status and externalizing behavior problems, as well as social skills, at each time point (all p's $<.001$). All significant correlations were in the expected direction; meaning, ID status was associated with higher behavior problems and lower social skills. Paternal education did not correlate with externalizing behaviors, and thus was not entered into the model as a control variable.

Results

This study addressed two research questions related to the continuity and interplay between behavior problems and social skills over time from early childhood to adolescence. Explanations of model specifications (e.g., imposed constraints) can be found in the footnotes.

Cross-lagged model for internalizing behavior problems

Table 2k presents model fit indices in the sequentially constructed models, testing hypothesized relations between internalizing behavior problems and social skills. Table

2l shows standardized estimates for Models A through D, and Table 2m shows standardized estimates for Models E through G. In **Model A**[2], the fully reciprocal model (without a covariate) was tested. The chi-square value was not significant ($\chi^2_{(54)} = 64.43$, $p = .16$), indicating that the model was consistent with the covariance data. Other indices demonstrated very good fit: RMSEA = $.04_{(.00;\ .07)}$, CFI = .99, TLI = .98. With regards to standardized estimates, internalizing behavior problems and social skills showed high stability across time, with all stability coefficients significant at the $p < .001$ level. There was a significant zero-order association between internalizing behavior problems and social skills at age 6 ($\beta = -.54$, $p < .001$), as well as a significant within-time association at age 13 ($\beta = -1.32$, $p = .04$). There was a significant negative cross-path effect of age 13 internalizing behaviors on age 15 social skills ($\beta = -.31$, $p < .01$). No other paths were significant.

Next, paths from earlier social skills to later behavior problems are removed. The model difference test is a test of the paths deleted. Thus, in **Model B**, behavior-driven paths were tested by removing cross-paths from earlier social skills to later behavior problems from the reciprocal model (Model A). Thus, the emphasis of Model B was the paths from earlier behavior problems to later social skills only. The nonsignificant change in χ^2 (Model A versus Model B) suggests that both models fit equally well ($\Delta\chi^2_{(5)} = 1.31$, $p = .93$). This means that the parameters in question can be eliminated, and Model B with

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[2] Loadings were fixed to 1 over time. Unique variances of latent variables and indicators were constrained to equality over time. In addition, autoregressive paths from ages 6 to 7, ages 7 to 8, and ages 8 to 9 were constrained to equality over time, and paths from ages 9 to 13 and ages 13 to 15 were constrained to reflect the four- and two-year time gap, respectively. These constraints were retained from Model A through Model D.

fewer freely estimated parameters can be accepted. Criteria of model fit were also within very good guidelines: RMSEA = $.03_{(.00;\ .06)}$, CFI = .99, and TLI = .99. In Model B, stability and cross-sectional estimates remained similar to those observed in Model A (p's $< .001$). The negative cross-path effect from age 13 internalizing behaviors on age 15 social skills remained significant ($\beta = -.31$, $p < .01$). No other paths were significant.

In **Model C**, social skills-driven paths were tested by removing cross-paths from earlier internalizing behavior problems to later social skills from the reciprocal model (Model A). Criteria of model fit are within very good guidelines: RMSEA = $.04_{(.00;\ .07)}$, CFI = .98, TLI = .98. These fit statistics are fairly similar to those of Model A. Further, the nonsignificant change in χ^2 between Model C and Model A (fully reciprocal model) suggests that both models may fit equally well ($\Delta\chi^2_{(5)} = 9.46$, $p = .09$)[3]. When comparing Model C to Model B (behavior-driven model), fit statistics for Model C are slightly worse (i.e., higher RMSEA, AIC, and BIC values). As a result, Model B was observed as the better fitting model thus far. Significant within-time associations between internalizing behavior problems and social skills in Model C were evident at age 6 ($\beta = -.57$, $p < .001$), age 7 ($\beta = -1.30$, $p = .03$), and at age 13 ($\beta = -1.29$, $p = .02$). There were no significant cross-paths.

In **Model D**, longitudinal stability paths for internalizing behavior problems and social skills were tested. That is, all cross-paths were removed from Model A. Fit statistics demonstrated good model fit: RSMEA = $.04_{(.00;.06)}$, CFI = .98, TLI = .98;

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[3] To note, the p-value for $\Delta\chi^2$ approached significance and may have reached significance at the $p < .05$ level with a larger sample.

however, these indices were slightly worse than those for Model B, the best fitting model thus far. Additionally, AIC and BIC values were higher for Model D than Model B. Similar to previously tested models, in Model D, all parameter estimates were positive and significant (p's<.001). Within-time relations between internalizing behaviors and social skills were evident at age 6 ($\beta = -.58$, $p < .001$), at age 7 ($\beta = -1.31$, $p = .02$), and at age 13 ($\beta = -1.24$, $p = .02$).

Altogether, in examination of these nested models, Model B (behavior-driven model) was determined as the best fitting model. Model B showed a predictive path between behavior problems at age 13 to social skills at age 15, while eliminating the causal relationships from social skills to behavior problems over time. While all tested models demonstrated very good model fit statistics, Model B had slightly better indices compared to other models: the RMSEA was slightly lower; the RMSEA confidence interval was more narrow; and the upper limit of RMSEA was lower. In addition, TLI was slightly higher, and AIC and BIC values were the smallest for Model B. The chi-square value to degrees of freedom ratio was also smallest in Model B.

Subsequently, disability status was incorporated into Model B as a control variable[4]. The direct influence of the covariate on internalizing behaviors and social skills

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[4] Maternal and paternal education were considered as potential covariates. However, the strength of association between parental education and outcome variables was tested and showed low nonsignificant correlations across all time points (Table 2h). Thus, these variables were not entered into the model. Disability status was significantly correlated with the outcome variables at each time point (p's < .05) and, thus, was included in the model because of statistical and theoretical justifications. As recommended by Little (2013), when conducting longitudinal SEM with more than two time points, covariates can be controlled for at each time point (full partial). Disability status was regressed on latent variables at each time point. Nonsignificant paths were later pruned.

was tested, initially at each time point, in **Model E.** The behavior-driven model with disability status as a covariate was a better fitting model, as demonstrated with a nonsignificant chi-square, $\chi^2_{(59)} = 61.75$, $p = .38$, as well as exceptional absolute and comparative model fit indices: RSMEA = $.02_{(.00;\ .05)}$, CFI = 1.00, TLI = 1.00. The model produced similar parameter estimates: Autoregressive estimates were positive and significant (p's < .001). Within-time associations between internalizing behaviors and social skills were evident at age 6 ($\beta = -.48$, $p < .001$) and at age 13 ($\beta = -1.15$, $p = .03$). The cross-path from internalizing behaviors at age 13 to social skills at age 15 remained significant and negative ($\beta = -.34$, $p < .01$).

In an effort to fit a more parsimonious model with improved fit indices, Model E was respecified, first by fixing nonsignificant covariate paths to zero (i.e., from disability status to ages 7, 8, 9, 13, and 15), resulting in **Model F**. Model F yielded a nonsignificant $\Delta\chi^2$. Criteria of model fit were still within very good guidelines: RMSEA = $.03_{(.00;\ .06)}$, CFI = .99, and TLI = .99. By pruning nonsignificant covariate effects, the model fits were about the same, and the parameter estimates were about the same. This model was again respecified by fixing nonsignificant within-time relations to zero between internalizing behavior problems and social skills at ages 7, 8, 9, and 15 (**Model G**). While Model G was smaller (i.e., had more fixed parameters fixed) than Model F, fit indices slightly worsened. Thus, Model F was selected as the final model, and additional respecifications were not performed. Additionally, Model F was selected over Model E to avoid overcontrol of covariates (i.e., the inclusion of too many covariate paths that may lead to tempered effects). See Figure 2c for the final model of internalizing behaviors and social skills (Model F).

For the final model, as shown in Table 2n, for Model F (of Internalizing Behavior Problems), all factor loading estimates of internalizing behavior problems were .87 or above and loading estimates of social skills were .85 or above. Figure 2b shows Q-Q plots of residuals for parcels of internalizing behaviors and social skills. All stability paths remained significant at the $p < .001$ level (see Table 2m), indicating that earlier ratings of internalizing behavior problems and social skills were highly predictive of later ratings of internalizing behavior problems and social skills, respectively. In addition, there was one significant cross path from age 13 internalizing behavior problems to age 15 social skills ($\beta = -.35$, $p < .01$). Further, disability status had a significant positive effect on age 6 internalizing behavior problems ($\beta = .25$, $p < .01$), and an even stronger significant negative effect on age 6 social skills ($\beta = -.52$, $p < .001$). These results indicate that internalizing behavior problems were rated higher, and social skills ratings were lower, for children with ID in this sample than children with TD.

Cross-lagged Model for Externalizing Behavior Problems

Table 2o presents model fit indices in the sequentially constructed models, testing hypothesized relations between externalizing behavior problems and social skills. Table 2p shows standardized estimates for Model A through Model D, and Table 2q shows standardized parameters from Model E through Model G. In **Model A**[5], the fully

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[5] Indicator loadings were fixed to 1 over time. The unique variance of latent variables and indicators were constrained to within-construct equality over time. Autoregressive paths were constrained to within-construct equality over time for one-year, four-year, and two-

reciprocal model for externalizing behavior problems and social skills (without a covariate) was tested. Results of this model indicated good fit. The chi-square statistic was not significant ($\chi^2_{(49)}$ = 60.00, p = .18), indicating that the model was consistent with the covariance data. Other indices demonstrated very good fit: RMSEA = $.03_{(.00;\ .06)}$, CFI = .99, and TLI = .99. Standardized estimates indicated that externalizing behavior problems and social skills were highly stable across time, with all stability coefficients significant at the $p < .001$ level. There was a significant within-time association between internalizing behaviors and social skills at age 6 (β = -.66, $p < .001$) and at age 8 (β = -.67 p = .02). There was a significant positive cross-lagged effect from age 9 social skills on age 13 externalizing behaviors (β = .32, p = .03) and a significant negative cross-lagged effect from age 13 behavior problems to age 15 social skills (β = -.34, p = .01). No other paths were significant at the $p < .05$ level.

In **Model B**, behavior-driven paths were tested by removing cross-paths from earlier social skills to later behavior problems from the fully reciprocal model (Model A). The nonsignificant change in χ^2 (Model A versus Model B) suggests that both models may fit equally well. Criteria of model fit are also within very good guidelines: RMSEA = $.04_{(.00;\ .06)}$, CFI = .99, and TLI = .99. In Model B, stability and cross-sectional estimates remained similar to those observed in Model A (p's<.001). The significant path from

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year time intervals. These constraints were retained from Model A through Model D. To note, the auto-regressive path constraints differed from the model of internalizing behaviors, in which model constraints specifically dictated time intervals. When such model constraints were attempted for externalizing behaviors, the model demonstrated very poor fit: RMSEA=$.17_{(.16\text{-}.19)}$, CFI=.75, TLI=.69.

behavior problems to social skills in Model A (i.e., from ages 13 to 15) remained significant in Model B (β = -.37, p = .01).

In **Model C**, social skills-driven paths were tested by removing cross-paths from earlier behavior problems to later social skills from the reciprocal model (Model A). The change in χ^2 was significant ($\Delta\chi^2_{(5)}$ = 11.75, p = .04), suggesting that Model B with more freely estimated parameters fits the data better than Model C. RMSEA also slightly increased, though model fit was still within very good guidelines: RMSEA = $.04_{(.00;\ .07),}$ CFI = .99, and TLI = .99. Within-time associations were significant and negative at age 6 (β = -.68, p<.001), age 7 (β = -.95, p = .04), age 8 (β = -1.01, p = .01), and age 9 (β = -1.03, p = .03). The path from age 9 social skills to age 13 externalizing behavior problems was significant and positive (β = .30, p = .04). Additionally, the path from age 13 social skills to age 15 externalizing behavior problems was significant and negative (β = -.25, p = .03).

In **Model D**, autoregressive paths for externalizing behavior problems and social skills were tested. That is, all cross-paths were removed from Model A. Model D demonstrated very good model fit: RSMEA = $.04_{(.00;\ .07)}$, CFI = .99, and TLI = .99. However, there was a significant $\Delta\chi^2$ for the comparison with Model B (social skills-driven) and Model C (behavior-driven), which suggests that Model D is not the better fitting model. Moreover, RMSEA values were slightly worse than Models A and B. All parameter estimates were positive and significant (p's<.001). Similar to Model C, within-time relations between externalizing behaviors and social skills were evident at age 6 (β =

-.68, $p < .001$), age 7 ($\beta = -.96$, $p = .04$), age 8 ($\beta = -.98$, $p = .02$), and age 9 ($\beta = -1.20$, $p = .02$).

Models A to B were compared for fit to determine which would be used to test effects of the covariate, disability status. Model A and B had equivalent RMSEA values and bounds, as well as equivalent CFI and TLI values. AIC and BIC were marginally lower in Model B. Thus, both models fit the data approximately to the same degree, empirically. However, the parameter estimates of Model A (shown in Table 2o) appear illogical. Specifically, social skills at age 9 has a significant *positive* cross-effect on externalizing behaviors at age 13. This relation implies that positive social skills in middle childhood predicts greater violations of behavioral norms in early adolescence, which goes against general consensus within the literature that social performance deficits are related to externalizing behaviors. Given this unreasonable effect, Model B (behavior -driven) was retained to test hypothesized relations based both on model fit and theory.

A successive model testing approach was taken, beginning with **Model E** in which a covariate path was added to each construct at every time point. The behavior-driven model with disability status as a covariate showed good fit, as demonstrated by a nonsignificant chi-square ($\chi^2_{(54)} = 60.46$, $p = .24$), as well as very good model fit indices: RSMEA = $.03_{(.00;\ .06)}$, CFI = .99, and TLI = .99. The model produced similar autoregressive estimates as prior models (p's < .001). Within-time associations between externalizing behaviors and social skills were evident at age 6 ($\beta = -.57$, $p < .001$). The cross-path from age 13 behavior problems and age 15 social skills was significant at the p

< .001 level ($\beta = -.39$, $p = .01$). Further, covariate effects were significant to the first time points (p's < .001) in the expected direction.

Model E was respecified, by fixing nonsignificant covariate paths to zero, resulting in **Model F**. Model F yielded very good model fit indices, similar to Model E: RMSEA = $.03_{(.00;\ .06)}$, CFI = .99, and TLI = .99. AIC and BIC values were lower than Model E, which included nonsignificant covariate paths. Significant parameter estimates were comparable to Model B, in which there was a significant negative cross-effect between behavior problems at age 13 and social skills at age 15, as well as a cross-path significant at the $p < .10$ level from behavior problems at age 7 to social skills at age 8. This cross-path from age 7 behavior problems neared significant in prior Models A and B. Lastly, this model was again respecified by fixing nonsignificant within-time relations to zero between externalizing behavior problems and social skills (**Model G**). Model G resulted in worse fit indices, though still in the adequate range: RMSEA = $.04_{(.00\text{-}.07)}$, CFI = .98, and TLI = .98. Additionally, the chi-square difference statistic between Model G and Model F was significant, indicating that Model G with fewer freely estimated parameters did not fit the data better. Thus, Model F was identified as the final model. See Figure 2d for Q-Q plots of residuals and 2e for the final model of externalizing behaviors and social skills (Model F).

In the final model[6], all stability paths remained significant at the $p < .001$ level, indicating that earlier ratings of externalizing behavior problems and social skills were

[6] As shown in Table 2r, for Model F (Externalizing Behavior Problems), all factor loading estimates of externalizing behavior problems were .92 or above, and loading estimates of social skills were .87 or above.

highly predictive of later ratings of externalizing behavior problems and social skills, respectively. Within-time associations between latent variables were significant at age 6 ($\beta = -.57$ $p < .001$). A significant behavior-driven path estimate was found from adolescent age 13 to 15, indicating that higher externalizing behaviors at age 13 predicted lower social skills at age 15. Further, disability status had a significant effect on age 6 externalizing behavior problems ($\beta = .44$, $p < .001$) and age 6 social skills ($\beta = -.63$, $p < .001$), indicating that externalizing behavior problems were rated higher, and social skills ratings were lower, for children with ID in this sample than children with TD.

Discussion

The primary goal of this study was to examine the longitudinal relations of behavior problems and social skills from early childhood to adolescence. As these constructs were measured by parents and teachers and used in models as a statistical aggregate, findings from this study represent an overall view of the development of behavior problems and social skills over time. Behavior problems were separately analyzed as internalizing and externalizing behaviors. The Total Behavior Problems scale on the CBCL has been examined in previous studies (e.g., Baker et al., 2007). For example, Baker and colleagues (2007) utilized the current study sample at earlier time points and found that total behavior problems predicted later social skills for typically developing children. While analyses of total behavior problems could have been informative, the total scale represents multiple dimensions of behavior problems (e.g., internalizing and externalizing domains). Parcels, as used in this study, are recommended for use with unidimensional indicators (Little et al., 2002). Relations were tested while controlling for youth disability status.

Stability of Behavior Problems and Social Skills

Atypical levels of behavior problems have long been observed among youth with intellectual disabilities. Structural equation modeling indicated that earlier domains of behavior problems and socials predicted later domains. Further, the stability of these relationships was significantly accounted for by disability status. In other words, controlling for disability status at age 6, children who began with higher behavior problems continued to demonstrate behavior problems over time. The same pattern was observed for social skills, in which children who started with higher (or lower) social skills maintained this level through adolescence, regardless of disability status. The stability of behavioral and social outcomes suggests that early intervention prior to age 6 may be most advantageous to their longitudinal course.

Predictive Relations of Behavior Problems and Social Skills

When hypothesized relations between behavior problems and social skills were examined, a behavior-driven pattern was observed, in such that higher behavior problems at adolescent age 13 significantly predicted lower social skills at age 15. Surprisingly, this study did not find predictive paths from social skills to behavior problems, unlike the findings from Bornstein and colleagues (2010) which showed that social skills at age 4 predicted later internalizing and externalizing behavior problems. Moreover, some intervention studies have demonstrated the link between social skills and behavior problems. Tse and colleagues (2007) conducted a 12-week social skills treatment and found not only gains in social competence but also decreases in behavior problems after intervention. However, the participants in this study had autism rather than ID. Additionally, peer rejection and victimization has been shown to be one of the strongest predictors of internalizing concerns, such as anxiety and depression (Ladd, 2006; Perren & Alsakr, 2009; Pedersen, Vitaro, Barker, & Borge, 2007). Nevertheless, while transactional paths were not observed, findings from this study showed that internalizing and externalizing behaviors may predict social difficulties in adolescence. As these constructs were analyzed in separate models, the next few sections will expand on their respective results.

Internalizing behavior problems. The influence of internalizing problems on social difficulties has been demonstrated in previous studies of younger samples (e.g., Eisenberg et al., 2001; Eisenhower et al., 2007; Hymel et al., 1990; Rubin, Coplan, & Bowker, 2009), though none have accomplished this using participant data spanning almost ten years. Hymel et al. (1990) found that internalizing problems in middle childhood were significantly related to social domains, including poor peer acceptance and social isolation. Further, young typically developing children who exhibit internalizing behaviors often experience sadness, low attentional control, and low impulsivity (Eisenberg et al., 2001), which in turn may negatively affect socialization efforts and successful social interactions. The results in the present study suggested no such pattern in early or middle childhood. To note, in Hymel et al (1990) and in Eisenberg et al (2001), mean sample ages did not exceed 10.6 years. Nevertheless, it is plausible that symptoms of anxiety and depression, for example, inhibit adolescents from developing social relationships, engaging in prosocial behaviors, and exploring independence (e.g., separation from parents and greater attachment to peers) during adolescent years. Indeed, social skills as assessed by the SSRS measures areas of assertion and engagement with regards to peers. Thus, if adolescents are experiencing high levels of internalizing behaviors (e.g., withdrawn), it may be very difficult to initiate social interactions or respond to peers.

Externalizing behavior problems. Also similar to the model with internalizing behaviors, a behavior-driven model was identified, in such that externalizing behavior problems at age 13 predicted poor social skills at age 15. Surprisingly, in the present study, externalizing behavior problems did not demonstrate a negative impact on social skills in earlier years. Previous studies of children have shown that externalizing behaviors (e.g., inattention, aggression) often predict social difficulties (Murphy, Laurie-Rose, Brinkman, & McNamara, 2007). Research on children with ADHD is perhaps most convincing of this relationship (Andrade, Brodeur, Waschbusch, Stewart, & McGee, 2009; Graziano, Geffken, & McNamara, 2011). ADHD is defined as persistent, substantial, and inappropriate levels of inattention, hyperactivity, and impulsivity (APA, 2013). Children with ADHD have been shown to experience high rates of peer rejection (Hoza, 2007), poor peer nominations (Pelham & Fabiano, 2008), and fewer reciprocal friendships (Hoza et al., 2005).

One explanation for the absence of this finding in ages 6 to 9 years is the use of disability status as a control variable, rather than a grouping variable. It may be that children with ID who have higher behavioral and social concerns than children with TD show different patterns. Future studies with larger samples of children with and without ID should validate these findings and compare results of longitudinal relations between disability groups. Moreover, while controlling for disability, behavioral and social observations may be perceived as more age-appropriate, and thus having a minimal impact, in early childhood rather than in adolescence.

Practical Implications

A central finding from this longitudinal study is the association between behavior problems and social skills in adolescence. While it is important to note that the sample size during these time points was smaller than earlier time points, this finding is consistent with previous work during adolescent years (e.g., Allen, Marsh, McFarland, McElhaney, & Land, 2002; Bagwell, Molina, Pelham, & Hoza, 2001), showing the distinct roles of specific behavior problems in relation to developing social skills in adolescence. One of the important implications of this findings is that they suggest a need to focus intervention efforts in adolescence. Future studies on behavioral treatments for adolescents should include measures of social skills to test improvements of social functioning as a result of the intervention. Additionally, given the prominent pathway of behavior problems to social skills in adolescence, it may be important to examine moderating influences of social, environmental, and biological factors critical to adolescent development.

From a clinical perspective, understanding the specific context in which youth display behavior problems may assist in providing appropriate services by tailoring the intervention to the setting. Indeed, some behaviors are more prevalent in certain contexts than others (e.g., home versus school or social environments). When measuring context-specific behavioral concerns, some clinicians have advocated for multi-informant assessments, while others have called their use into question (e.g., De Los Reyes et al., 2015). Based on their review, De Los Reyes and colleagues (2015) ask whether assessment reports using data from both parents and teachers "provide incrementally valid information, relative to use of any one informant's report." While the objective of the present study was not to address questions related to the validity of multi-informant assessment, the structural equation models were tested using an aggregate of parent and teacher data. The rationale for utilizing the data in this way comes from empirical evidence showing that parcels have higher reliability, fewer parameter estimates, and reduced sources of sampling error (Little, 2013). Yet, it is possible that the combined perspectives may have negated expected relationships (e.g., early social skills predicting later behavior problems). Future studies could examine these models using data from a specific informant to understand possible differences in observations across informant perspectives versus conjoined perspectives.

When interpreting results, one important consideration is sample size. A common byproduct of longitudinal studies is incomplete or missing data. Once cases were removed (i.e., due to missing data at three or more time points), the sample size in the present dataset at child age 6 was relatively small (i.e., 179 mothers, 139 fathers, and 126 teachers) for structural equation models. The proportion of missing data increased with each subsequent time points. At age 13, missingness was particularly noticeable due to a gap in measurement. To address this, full maximum likelihood was used to ensure that the results did not diverge greatly from what we would see if all data were present. Nevertheless, future studies should replicate these models with larger samples.

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CHAPTER III. Appendix: Tables and Figures

Table 2a

Sample Characteristics at Child Age 5

Variable	Total sample (N = 185)	ID (n = 70)	TD (n = 115)	t/X^2
Child IQ, *M* (*SD*)	87.5 (24.4)	**61.2 (14.7)**	**103.6 (12.0)**	**20.48*** **
Child VABS Score, *M* (*SD*)	88.8 (24.8)	**63.4 (12.1)**	**104.3 (16.2)**	**19.61*** **
Child Gender, % (*n*)				.38
Female	40.0 (74)	37.1 (26)	41.7 (48)	
Male	60.0 (111)	62.9 (44)	58.3 (67)	
Child ethnicity, %(*n*)				.11
African American	7.6 (14)	8.6 (6)	7.0 (8)	
Asian	1.6 (3)	1.4 (1)	1.7 (2)	
Caucasian	62.2 (115)	57.1 (40)	65.2 (75)	
Latino	15.1 (28)	18.6 (13)	13.0 (15)	
Other	13.5 (25)	14.3 (10)	13.0 (15)	
Family income, %(*n*)				.19
≥ $50,000	54.9 (100)	52.9 (37)	56.1 (64)	
< $50,000	45.1 (83)	47.1 (33)	43.9 (50)	
Mother highest grade completed, *M*(*SD*)	15.1 (2.37)	**14.5 (2.40)**	**15.4 (2.31)**	**2.38** **
Father highest grade completed, *M*(*SD*)	15.3 (2.87)	**14.6 (2.62)**	**15.7 (2.95)**	**2.21***
Mother marital status, %(*n*)				.84
Married	83.8 (155)	82.9 (58)	84.3 (97)	
Separated/Divorced	9.2 (17)	7.1 (5)	10.4 (12)	
Never Married	7.0 (13)	10.0 (7)	4.2 (6)	
Father marital status, %(*n*)				.11
Married	95.5 (150)	94.5 (52)	96.1 (98)	
Separated/Divorced	1.3 (2)	1.8 (1)	1.0 (1)	
Never Married	3.2 (5)	3.6 (2)	2.9 (3)	
Mother works outside the home, % (*n*)	56.2 (104)	51.4 (36)	59.1 (68)	1.04
Dad works outside the home, % (*n*)	93.0 (145)	92.7 (51)	93.1 (95)	.01

Note. Bolded text denotes significance. *** $p < .001$. **$p<.05$. * $p < .01$
VABS = *Vineland Adaptive Behavior Scales* (Sparrow et al., 1984).
ID = Intellectual disability. TD = Typical development.

Table 2b

Descriptive Statistics: CBCL/TRF Total Behavior Problems T-Scores

Variable	Total		ID Group		TD Group		ID vs TD
	N	M (SD)	*n*	M (SD)	*n*	M (SD)	*t*
Age 6							
Mother	179	53.96 (10.11)	70	57.79 (9.76)	109	51.50 (9.60)	**4.25*** **
Father	139	51.55 (10.49)	45	57.84 (9.07)	94	48.54 (9.81)	**5.36*** **
Teacher	126	52.43 (10.51)	49	58.80 (7.18)	77	48.38 (10.32)	**6.68*** **
Age 7							
Mother	178	53.98 (10.84)	69	58.09 (9.74)	109	51.39 (10.74)	**4.20*** **
Father	125	50.48 (11.30	42	53.17 (10.34)	83	49.12 (11.58)	1.91 †
Teacher	137	54.12 (10.58)	54	60.20 (8.64)	83	50.16 (9.86)	**6.29*** **
Age 8							
Mother	165	53.24 (11.33)	61	59.16 (10.20)	104	49.76 (10.52)	**5.61*** **
Father	126	50.99 (10.38)	41	57.34 (9.23)	85	47.93 (9.51)	**5.25*** **
Teacher	131	52.45 (10.37)	49	59.02 (7.02)	82	48.52 (10.09)	**7.00*** **
Age 9							
Mother	169	53.67 (11.12)	62	58.92 (10.49)	107	50.63 (10.35)	**5.00*** **
Father	132	49.91 (11.64)	43	56.30 (9.28)	89	46.82 (11.45)	**4.73*** **
Teacher	130	52.80 (9.99)	45	59.73 (7.41)	85	49.13 (9.22)	**6.66*** **
Age 13							
Mother	121	51.27 (11.17)	41	56.88 (9.88)	80	48.40 (10.74)	**4.22*** **
Father	78	48.32 (11.45)	21	54.48 (9.92)	57	46.05 (11.22)	**3.03** **
Teacher	72	53.15 (8.78)	22	58.27 (7.15)	50	50.90 (8.53)	**6.66*** **
Age 15							
Mother	124	48.60 (11.38)	43	54.35 (10.54)	81	45.54 (10.66)	**4.40*** **
Father	89	48.18 (12.58)	25	55.60 (11.47)	64	45.28 (11.86)	**3.72*** **
Teacher	84	51.63 (9.34)	34	57.50 (8.13)	50	47.64 (7.94)	**5.53*** **

Note. Bolded text denotes significance. *** $p < .001$. ** $p < .01$, * $p < .05$. † $p < .10$ CBCL = Child Behavior Checklist (Achenbach & Rescorla, 2001). TRF = Teacher Report Form (Achenbach & Rescorla, 2001).

Table 2c

Descriptive Statistics: CBCL/TRF Internalizing Behavior Problems T-Scores

Variable	Total		ID Group		TD Group		ID vs TD
	N	M (SD)	*n*	M (SD)	*n*	M (SD)	*t*
Age 6							
Mother	182	51.41 (9.94)	71	51.76 (10.56)	111	51.19 (9.57)	.38
Father	152	49.56 (10.42)	52	51.25 (10.35)	100	48.68 (10.40)	1.45
Teacher	136	49.51 (9.59)	56	54.16 (8.34)	80	46.25 (9.08)	**6.17*** **
Age 7							
Mother	180	51.19 (10.62)	70	51.74 (11.31)	110	50.84 (10.20)	.56
Father	147	49.24 (10.22)	50	49.82 (10.35)	97	48.94 (10.20)	.49
Teacher	152	51.88 (10.71)	57	56.05 (9.88)	95	49.37 (10.45)	**3.90*** **
Age 8							
Mother	166	51.23 (10.88)	61	53.72 (11.42)	105	49.79 (10.34)	**2.27***
Father	127	49.48 (9.18)	41	51.63 (9.14)	86	48.45 (9.07)	1.84 †
Teacher	146	50.69 (9.71)	53	54.98 (8.74)	93	48.25 (9.42)	**4.26*** **
Age 9							
Mother	172	51.70 (10.72)	62	53.48 (11.23)	110	50.69 (10.34)	1.65
Father	133	49.18 (10.36)	43	50.95 (8.88)	90	48.33 (10.94)	1.37
Teacher	140	50.96 (10.13)	50	55.72 (10.05)	90	48.32 (9.22)	**4.41*** **
Age 13							
Mother	122	50.39 (11.08)	41	53.20 (11.84)	81	48.98 (10.47)	2.01 †
Father	84	48.27 (9.89)	22	51.59 (10.26)	62	47.23 (9.57)	1.80 †
Teacher	73	52.66 (9.60)	22	57.14 (7.21)	51	50.73 (9.92)	**2.73*** **
Age 15							
Mother	124	48.38 (10.32)	43	50.19 (11.75)	81	47.72 (9.41)	1.43
Father	91	48.41 (11.67)	26	51.77 (12.54)	65	47.06 (11.12)	1.76 †
Teacher	86	51.94 (9.70)	36	55.92 (9.34)	50	49.08 (9.00)	**3.42** **

Note. Bolded text denotes significance. CBCL = Child Behavior Checklist (Achenbach & Rescorla, 2001). TRF = Teacher Report Form (Achenbach & Rescorla, 2001).
*** $p < .001$. ** $p < .01$, * $p < .05$

Table 2d

Descriptive Statistics: CBCL/TRF Externalizing Behavior Problems T-Scores

Variable	Total		ID Group		TD Group		ID vs TD
	N	M (SD)	*n*	M (SD)	*n*	M (SD)	*t*
Age 6							
Mother	182	53.57 (9.99)	71	56.59 (9.16)	111	51.64 (10.06)	**3.35****
Father	152	51.63 (9.96)	52	56.00 (9.16)	100	49.35 (9.64)	**4.10*****
Teacher	136	52.81 (9.26)	56	56.89 (7.18)	80	49.95 (9.51)	**4.62*****
Age 7							
Mother	180	53.91 (10.83)	70	57.47 (9.40)	110	51.65 (11.10)	**3.64*****
Father	147	52.15 (10.29)	50	56.56 (8.22)	97	49.88 (10.54)	**3.91*****
Teacher	152	52.38 (8.96)	57	57.11 (7.85)	95	49.55 (8.40)	**5.51 *****
Age 8							
Mother	166	52.67 (11.04)	61	57.85 (9.85)	105	49.66 (10.61)	**4.93*****
Father	127	51.15 (9.82)	41	56.76 (8.88)	86	48.48 (9.14)	**4.82*****
Teacher	146	52.21 (9.38)	53	56.19 (8.33)	93	49.95 (9.23)	**4.07*****
Age 9							
Mother	172	52.87 (10.63)	62	57.35 (10.63)	110	50.34 (9.81)	**4.37*****
Father	133	49.90 (10.72)	43	55.65 (9.24)	90	47.16 (10.32)	**4.59*****
Teacher	140	51.78 (8.63)	50	56.28 (7.68)	90	49.28 (8.14)	**4.98*****
Age 13							
Mother	122	49.49 (9.76)	41	53.05 (9.10)	81	47.69 (9.64)	**2.95****
Father	84	47.11 (9.96)	22	53.14 (8.68)	62	44.97 (9.85)	**3.52****
Teacher	73	51.41 (8.40)	22	51.73 (9.42)	51	51.27 (8.02)	.21
Age 15							
Mother	124	47.70 (10.82)	43	50.81 (11.36)	81	46.07 (10.21)	**2.38***
Father	91	47.57 (10.45)	26	52.04 (9.97)	65	45.78 (10.16)	**2.67****
Teacher	86	50.62 (7.74)	36	53.75 (8.25)	50	48.36 (6.55)	**3.38****

Note. Bolded text denotes significance. *** $p < .001$. ** $p < .01$. * $p < .05$. † $p < .10$
CBCL = Child Behavior Checklist (Achenbach & Rescorla, 2001). TRF = Teacher Report Form (Achenbach & Rescorla, 2001).

Table 2e

Descriptive Statistics: SSRS/SSIS Social Skills Standard Scores

Variable	Total		ID Group		TD Group		ID vs TD
	N	M (SD)	*n*	M (SD)	*n*	M (SD)	*t*
Age 6							
Mother	179	93.11 (19.03)	70	82.00 (17.95)	109	100.25 (16.11)	**7.07*** **
Father	139	90.71 (17.20)	55	80.73 (15.13)	94	95.48 (16.11)	**5.15*** **
Teacher	125	96.87 (14.55)	49	89.02 (12.93)	76	101.93 (13.30)	**3.08** **
Age 7							
Mother	178	94.78 (18.60)	69	84.55 (17.68)	109	101.25 (16.17)	**6.47*** **
Father	125	92.72 (16.90)	42	90.52 (16.37)	83	93.83 (17.15)	1.03
Teacher	136	97.79 (15.16)	53	88.08 (13.76)	83	103.99 (12.58)	**4.52*** **
Age 8							
Mother	165	95.24 (18.82)	62	83.82 (16.90)	103	102.12 (16.49)	**6.84*** **
Father	129	94.78 (16.77)	42	83.69 (15.92)	87	100.14 (14.44)	**5.86*** **
Teacher	131	97.95 (13.57)	49	90.67 (13.23)	82	102.30 (11.86)	**2.44* **
Age 9							
Mother	165	98.01 (18.03)	61	88.10 (17.06)	104	103.82 (15.99)	**5.95*** **
Father	131	95.76 (16.77)	42	86.93 (16.40)	89	99.93 (15.07)	**4.48*** **
Teacher	128	97.09 (15.93)	44	87.55 (16.15)	84	102.08 (13.40)	**3.33** **
Age 13							
Mother	115	99.48 (14.45)	35	92.91 (13.23)	80	102.35 (14.09)	**3.37** **
Father	79	96.49 (14.27)	21	92.71 (14.03)	58	97.86 (14.22)	1.43
Teacher	72	96.86 (14.72)	22	89.92 (11.41)	50	99.92 (15.06)	.76
Age 15[a]							
Mother	121	94.42 (14.96)	42	90.10 (14.41)	79	96.72 (14.82)	**2.36* **
Father	85	89.27 (15.67)	24	82.83 (15.33)	61	91.80 (15.18)	**2.45* **
Teacher	81	96.84 (12.85)	33	93.09 (11.43)	48	99.42 (13.24)	1.76

Note. Bolded text denotes significance. *** $p < .001$. ** $p < .01$. * $p < .05$. † $p < .10$
SSRS = Social Skill Rating Scale. SSIS = Social Skills Improvement System

Table 2f

Correlations Between Raters on Behavior Problems and Social Skills

Variable	Age 6	Age 7	Age 8	Age 9	Age 13	Age 15
	r	*r*	*r*	*r*	*r*	*r*
CBCL/TRF –Total T-Score						
M – F	.51**	.24*	.64**	.54**	.61**	.62**
M – T	.55**	.45**	.55**	.58**	.45**	.47**
F – T	.46**	.18 †	.48**	.49**	.35*	.44**
CBCL/TRF – Internalizing T-Score						
M – F	.45**	.52**	.44**	.46**	.34*	.53**
M – T	.24*	.17*	.32**	.37**	.19 †	.10
F – T	.22*	.21*	.22*	.41**	.13	.21 †
CBCL/TRF – Externalizing T-Score						
M – F	.52**	.60*	.63**	.63**	.61**	.62**
M – T	.56**	.38**	.49**	.50**	.31*	.41**
F – T	.48**	.47**	.45**	.44**	.27 †	.51**
SSRS/SSIS [a] – Social Skills Standard Score						
M – F	.54**	.20*	.55**	.56**	.25*	.57**
M – T	.50**	.53**	.42**	.38**	.22	.39**
F – T	.47**	.11	.52**	.27**	.30*	.31*

Note. CBCL = Child Behavior Checklist. SSRS = Social Skills Rating Scale. SSIS = Social Skills Improvement System. M – F = Correlations between Mother and Father report. M – T = Correlations between Mother and Teacher report. F – T = Correlations between Father and Teacher report.

*** p<.001. ** p<.01. * p<.05. † p<.10

Table 2g

Stability of Measures Across Ages 6 to 15

Measure – Rater	Age 6 to 7	Age 7 to 8	Age 8 to 9	Age 9 to 13	Age 13 to 15
	r	*r*	*r*	*r*	*r*
CBCL/TRF Internalizing					
Mother	.66***	.73***	.76***	.70***	.52***
Father	.57***	.65***	.73***	.70***	.68***
Teacher	.39***	.38***	.33***	.32*	.24 †
CBCL/TRF Externalizing					
Mother	.75***	.83***	.84***	.80***	.62***
Father	.74***	.84***	.86***	.73***	.80***
Teacher	.62***	.57***	.50***	.14	.54***
SSRS/SSIS Social Skills					
Mother	.83***	.85***	.84***	.65***	.50**
Father	.41***	.36***	.76**	.48***	.58***
Teacher	.64***	.67***	.56***	.45***	.47***

Note. CBCL = Child Behavior Checklist. TRF = Teacher Report Form. SSRS = Social Skills Rating Scale. SSIS = Social Skills Improvement System.
*** $p < .001$. ** $p < .01$. * $p < .05$. † $p < .10$.

Table 2h

Correlation Matrix of Internalizing Behaviors, Social Skills, and Potential Control Variables (Disability Status and Parental Education)

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1. INT 6	---											
2. INT 7	.66***	---										
3. INT 8	.70***	.73***	---									
4. INT 9	.75***	.76***	.75***	---								
5. INT 13	.62***	.70***	.69***	.80***	---							
6. INT 15	.47***	.58***	.62***	.70***	.66***	---						
7. SS 6	-.44***	-.29**	-.45***	-.48***	-.39*	-.32*	---					
8. SS 7	-.47***	-.46***	-.50***	-.55***	-.58***	-.47***	.83***	---				
9. SS 8	-.38**	-.45***	-.49***	-.43***	-.56***	-.36*	.86***	.83***	---			
10. SS 9	-.47***	-.48***	-.54***	-.54***	-.42*	-.42**	.79***	.85***	.81***	---		
11. SS 13	-.42**	-.48***	-.50**	-.49**	-.60***	-.46**	.60***	.58***	.66***	.59***	---	
12. SS 15	-.42**	-.48***	-.54***	-.62***	-.57***	-.68***	.68**	.59***	.67***	.66***	.75***	---
ID status	.28**	.17 †	.28 **	.24*	.33*	.31*	-.61***	-.52***	-.58***	-.50***	-.38**	-.31*
Mom edu	-.03	-.12	.02	.03	-.03	-.16	.09	.07	.08	.06	.09	.03
Dad edu	-.05	-.15	-.11	-.17	-.11	-.17	.11	.11	.07	.17	.15	.12

Note. All outcome variables shown in this table are parcels.
INT = internalizing behavior problems SS = social skills. ID = intellectual disability. edu = education.
*** $p < .001$. ** $p < .01$. * $p < .05$. † $p < .10$

Table 2i

Correlation Matrix of Externalizing Behaviors, Social Skills, and Potential Control Variables (Disability Status and Parental Education)

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1. EXT 6	--											
2. EXT 7	.85***	--										
3. EXT 8	.84***	.87***	--									
4. EXT 9	.84***	.84***	.86***	--								
5. EXT 13	.76***	.72***	.77***	.71***	--							
6. EXT 15	.72***	.70***	.73***	.74***	.79***	--						
7. SS 6	-.62***	-.56***	-.56***	-.55***	-.21	-.47***	--					
8. SS 7	-.63***	-.64***	-.61***	-.59***	-.39*	-.45***	.83***	--				
9. SS 8	-.61***	-.64***	-.65***	-.62***	-.38*	-.44*	.86***	.83***	--			
10. SS 9	-.57***	-.55***	-.54***	-.63***	-.16	-.46**	.79***	.85***	.81***	--		
11. SS 13	-.35*	-.28	-.37*	-.38*	-.38*	-.39*	.60***	.58***	.66***	.59***	--	
12. SS 15	-.60***	-.48***	-.64***	-.64***	-.57***	-.67***	.68**	.59***	.67***	.66***	.75***	--
ID status	.38***	.43***	.45***	.39***	.34**	.42***	-.61***	-.52***	-.58***	-.50***	-.38**	-.31*
Mom edu	.03	.00	-.04	.06	-.10	-.22 †	.09	.07	.08	.06	.09	.03
Dad edu	-.09	-.18 †	.02	-.08	-.08	-.10	.11	.11	.07	.17	.15	.12

Note. All outcome variables shown in this table are parcels.
EXT = externalizing behavior problems SS = social skills. ID = intellectual disability. edu = education.
*** $p < .001$. ** $p < .01$. * $p < .05$. † $p < .10$

Table 2j

Descriptive Statistics of Outcome Variables Used in the Model

Variables	*n*	*M (SD)*	Skewness (SD)	Kurtosis (SD)
INT 6	108	49.68 (6.98)	.49 (.23)	-.13 (.46)
INT 7	119	50.45 (7.69)	.52 (.22)	-.05 (.44)
INT 8	106	50.18 (7.31)	.00 (.24)	-.58 (.47)
INT 9	102	50.63 (8.07)	.27 (.24)	-.22 (.47)
INT 13	52	50.35 (6.83)	.27 (.33)	-.75 (.65)
INT 15	69	49.41 (7.55)	.29 (.29)	-.78 (.57)
EXT 6	108	52.63 (8.17)	.53 (.23)	-.16 (.46)
EXT 7	119	52.53 (8.09)	.21 (.22)	-.74 (.44)
EXT 8	106	51.31 (8.40)	.35 (.24)	-.54 (.47)
EXT 9	102	50.92 (8.01)	.46 (.24)	-.25 (.47)
EXT 13	52	49.29 (7.36)	.36 (.33)	-.46 (.65)
EXT 15	69	48.63 (8.18)	.45 (.29)	-.48 (.57)
SS 6	90	94.40 (13.86)	-.41 (.25)	-.23 (.50)
SS 7	90	95.59 (12.27)	-.02 (.25)	-.21 (.50)
SS 8	100	97.13 (13.05)	-.32 (.24)	-.13 (.48)
SS 9	90	98.78 (12.77)	-.26 (.25)	-.27 (.50)
SS 13	45	98.50 (9.94)	.28 (.35)	-.50 (.70)
SS 15	60	94.87 (11.47)	-.12 (.31)	-.63 (.61)

Note. INT = internalizing behavior problems. EXT = externalizing behavior problems. SS = social skills

Table 2k

Model Fit: Panel Analysis of Internalizing Behavior Problems and Social Skills

Model fit	Model A Cross-lag panel model	Model B Behavior-driven model	Model C Social skills-driven model	Model D Stability effects model	Model E Behavior-driven model with covariate	Model F* Behavior-driven model with covariate: Removed nonsig. covariate effects	Model G Behavior-driven model with covariate: Removed nonsig. covariance paths
# of free parameters	36	31	31	20	43	33	29
RMSEA (90% C.I.)	.04 (.00-.07)	.03 (.00-.06)	.04 (.00-.07)	.04 (.00-.06)	.02 (.00-.05)	.03 (.00-.06)	.04 (.00-.06)
CFI	.99	.99	.98	.98	1.00	.99	.98
TLI	.98	.99	.98	.98	1.00	.99	.98
AIC	6850.34	6841.64	6849.80	6920.35	6801.83	6797.57	6886.15
BIC	6959.20	6935.38	6943.54	6938.06	6931.85	6897.36	6794.36
χ^2 (df) *p* value	64.43 (54) .16	65.74 (59) .26	73.89 (59) .09	75.82 (64) .15	61.75 (59) .38	77.49 (69) .23	86.38 (73) .14
Comparison	--	*vs Mod. A*	*vs Mod. A*	*vs Mod. B*	--	*vs Mod. E*	*vs Mod. F*
$\Delta\chi^2$ (df) *p* value		1.31 (5) .93	9.46 (5) .09	10.08 (5) .07 *vs Mod. C* 1.93 (5) .86		15.74 (10) .11	8.89 (4) .06

Note. * Model F was identified as the final model.
RMSEA = Root Mean Square Error of Approximation. C.I. = Confidence Interval. CFI = Comparative Fit Index. TLI = Tucker Lewis Index. df = degrees of freedom. $\Delta\chi^2$ = change in chi-square value and degrees of freedom. Mod. = Model. nonsig. = nonsignificant.

Table 21

Standardized Parameter Estimates: Panel Analysis of Internalizing Behavior Problems and Social Skills (Models A through D)

Path	Time Points	**Model A** Cross-lag panel model	**Model B** Behavior-driven model	**Model C** Social skills-driven	**Model D** Stability effects model
		β (SE)	β (SE)	β (SE)	β (SE)
Stability effects					
Internalizing Behavior Problems (IBP)	Age 6-7	.94 (.06) ***	.96 (.02) ***	.94 (.06) ***	.95 (.02) ***
	Age 7-8	.98 (.06) ***	.96 (.02) ***	.96 (.06) ***	.95 (.02) ***
	Age 8-9	.91 (.06) ***	.96 (.02) ***	.89 (.06) ***	.95 (.02) ***
	Age 9-13	.99 (.09) ***	.96 (.02) ***	.94 (.09) ***	.95 (.02) ***
	Age 13-15	.92 (.08) ***	.96 (.02) ***	.91 (.09) ***	.95 (.02) ***
Social Skills (SS)	Age 6-7	.95 (.05) ***	.95 (.05) ***	.97 (.01) ***	.97 (.01) ***
	Age 7-8	.95 (.05) ***	.94 (.05) ***	.97 (.01) ***	.96 (.02) ***
	Age 8-9	.91 (.05) ***	.91 (.05) ***	.97 (.01) ***	.96 (.02) ***
	Age 9-13	.92 (.11) ***	.90 (.11) ***	.95 (.02) ***	.94 (.02) ***
	Age 13-15	.70 (.08) ***	.70 (.09) ***	.94 (.03) ***	.94 (.03) ***
Cross-effects					
IBP → SS	Age 6-7	-.03 (.09)	-.03 (.09)	--	--
	Age 7-8	-.03 (.08)	-.03 (.08)	--	--
	Age 8-9	-.08 (.08)	-.08 (.08)	--	--
	Age 9-13	-.02 (.16)	-.05 (.15)	--	--
	Age 13-15	-.31 (.11) **	-.31 (.11) **	--	--
SS → IBP	Age 6-7	-.02 (.10)	--	-.03 (.10)	--
	Age 7-8	.03 (.10)	--	.02 (.10)	--
	Age 8-9	-.09 (.09)	--	-.10 (.09)	--
	Age 9-13	.06 (.13)	--	-.02 (.13)	--
	Age 13-15	-.06 (.11)	--	-.05 (.12)	--

Note. β = standardized coefficient. SE = standard error.
*** *p* < .001. ** *p* < .01. * *p* < .05.

Table 2m

Standardized Parameter Estimates: Panel analysis of Internalizing Behavior Problems and Social Skills (Models E through G)

Path	Time Points	**Model E** Behavior-driven model with covariate	**Model F** Behavior-driven model with covariate: Removed nonsignificant covariate effects	**Model G** Behavior-driven model with covariate: Removed nonsignificant covariance paths
		β(SE)	β(SE)	β(SE)
Stability effects				
Internalizing Behavior Problems (IBP)	Age 6-7	.97 (.03) ***	.97 (.02) ***	.97 (.01) ***
	Age 7-8	.93 (.03) ***	.97 (.01) ***	.97 (.01) ***
	Age 8-9	.96 (.03) ***	.97 (.01) ***	.97 (.01) ***
	Age 9-13	.95 (.04) ***	.97 (.02) ***	.97 (.02) ***
	Age 13-15	.96 (.04) ***	.97 (.02) ***	.97 (.02) ***
Social Skills (SS)	Age 6-7	1.01 (.06) ***	.93 (.05) ***	.93 (.05) ***
	Age 7-8	.92 (.06) ***	.93 (.05) ***	.93 (.05) ***
	Age 8-9	.93 (.06) ***	.91 (.05) ***	.91 (.05) ***
	Age 9-13	1.06 (.13) ***	.89 (.10) ***	.89 (.10) ***
	Age 13-15	.73 (.09) ***	.67 (.08) ***	.67 (.08) ***
Cross-effects				
IBP → SS	Age 6-7	-.04 (.09)	-.07 (.08)	-.07 (.08)
	Age 7-8	.02 (.08)	-.07 (.07)	-.07 (.07)
	Age 8-9	-.05 (.08)	-.09 (.07)	-.10 (.07)
	Age 9-13	-.07 (.15)	-.08 (.15)	-.08 (.15)
	Age 13-15	-.34 (.12) **	-.34 (.10) **	-.34 (.09) **
Covariate effects				
with IBP	Age 6	.25 (.10) **	.25 (.08) **	.25 (.08) **
with SS	Age 6	-.64 (.07) ***	-.52 (.10) ***	-.62 (.06) ***

Note. β = standardized coefficient. SE = standard error.
*** $p < .001$. ** $p < .01$. * $p < .05$.

Table 2n

Estimates of Factor Loadings (Model F - Internalizing Behavior Problems)

Variables	*Unst.*	*St.*	SE	R^2
INT 6	1.00	.87	.02	.75
INT 7	1.00	.87	.02	.76
INT 8	1.00	.88	.02	.77
INT 9	1.00	.88	.02	.78
INT 13	1.00	.87	.02	.76
INT 15	1.00	.88	.02	.77
SS 6	1.00	.92	.02	.85
SS 7	1.00	.92	.02	.84
SS 8	1.00	.91	.02	.83
SS 9	1.00	.91	.02	.83
SS 13	1.00	.85	.03	.73
SS 15	1.00	.89	.03	.79

Note. Unst. = Unstandardized. St. = Standardized. SE = Standard Errors

Table 2o

Model Fit: Panel Analysis of Externalizing Behavior Problems and Social Skills

Model fit	Model A Cross-lag panel model	Model B Behavior-driven model	Model C Social skills - driven model	Model D Stability effects model	Model E Behavior-driven model with covariate	Model F* Behavior-driven model with covariate: Removing nonsig. covariate effects	Model G Behavior-driven model with covariate: Removing nonsig. covariance paths
# of free parameters	41	36	36	31	48	39	34
RMSEA (90% C.I.)	.03 (.00-.06)	.03 (.00-.06)	.04 (.00-.07)	.04 (.00-.07)	.03 (.00-.06)	.03 (.00-.06)	.04 (.00-.07)
CFI	.99	.99	.99	.99	.99	.99	.98
TLI	.99	.99	.99	.99	.99	.99	.98
AIC	6729.05	6725.39	6729.80	6725.68	6673.81	6664.54	6671.76
BIC	6853.03	6834.25	6838.66	6819.42	6818.95	6782.47	6774.57
χ^2 (df) *p* value	55.37 (49) .25	61.71 (54) .22	67.12 (54) .13	80.00 (59) .12	60.46 (54) .24	69.20 (63) .28	86.42 (68) .07
Comparison $\Delta\chi^2$ (df) *p* value	--	*vs Mod. A* 6.34 (5) .27	*vs Mod. A* 11.75 (5) .04	*vs Mod. B* 18.29 (5) <.01 *vs Mod. C* 12.88 (5) .02	--	*vs Mod. E* 8.74 (9) .46	*vs Mod. F* 17.22 (5) <.01

Note. * Model F was identified as the final model.
RMSEA = Root Mean Square Error of Approximation. C.I. = Confidence Interval. CFI = Comparative Fit Index. TLI = Tucker Lewis Index. df = degrees of freedom. $\Delta\chi^2$ = change in chi-square value and degrees of freedom. Mod. = Model. nonsig. = nonsignificant.

Table 2p

Standardized Parameter Estimates: Panel Analysis of Externalizing Behavior Problems and Social Skills (Model A through D)

Path	Time Points	**Model A** Cross-lag panel model	**Model B** Behavior-driven model	**Model C** Social skills-driven model	**Model D** Stability effects model
		β (SE)	β (SE)	β (SE)	β (SE)
Stability effects					
Externalizing Behavior Problems (EBP)	Age 6-7	.97 (.05) ***	.96 (.01) ***	.96 (.05) ***	.96 (.01) ***
	Age 7-8	.95 (.04) ***	.96 (.01) ***	.95 (.05) ***	.96 (.01) ***
	Age 8-9	.96 (.05) ***	.96 (.01) ***	.95 (.05) ***	.96 (.01) ***
	Age 9-13	1.17 (.10) ***	.95 (.02) ***	1.16 (.10) ***	.95 (.02) ***
	Age 13-15	.85 (.07) ***	.96 (.01) ***	.79 (.08) ***	.96 (.01) ***
Social Skills (SS)	Age 6-7	.98 (.06) ***	.99 (.06) ***	.97 (.01) ***	.97 (.01) ***
	Age 7-8	.87 (.05) ***	.88 (.05) ***	.97 (.01) ***	.97 (.01) ***
	Age 8-9	.99 (.06) ***	1.01 (.06) ***	.97 (.01) ***	.97 (.01) ***
	Age 9-13	.97 (.15) ***	.98 (.14) ***	.93 (.03) ***	.94 (.03) ***
	Age 13-15	.72 (.10) ***	.67 (.11) ***	.96 (.02) ***	.96 (.02) ***
Cross-effects					
EBP → SS	Age 6-7	.03 (.08)	.04 (.09)	--	--
	Age 7-8	-.15 (.07) †	-.14 (.07) †	--	--
	Age 8-9	.03 (.08)	.05 (.08)	--	--
	Age 9-13	.05 (.21)	.05 (.20)	--	--
	Age 13-15	-.34 (.13) *	-.37 (.14) *	--	--
SS → EBP	Age 6-7	.00 (.07)	--	-.00 (.07)	--
	Age 7-8	-.02 (.07)	--	-.02 (.07)	--
	Age 8-9	-.01 (.07)	--	-.02 (.07)	--
	Age 9-13	.32 (.14) *	--	.30 (.15) *	--
	Age 13-15	-.19 (.10) †	--	-.25 (.11) *	--

Note. β = standardized coefficient. SE = standard error.
† p<.10. * p<.05. ** p<.01. *** p<.001.

Table 2q

Standardized Parameter Estimates: Panel Analysis of Externalizing Behavior Problems and Social Skills (Model E through G)

Path	Time Points	**Model E** Behavior-driven model with covariate	**Model F** Behavior-driven model with covariate: Removed nonsignificant covariate effects	**Model G** Behavior-driven model with covariate: Removed covariance paths
		β(SE)	β(SE)	β(SE)
Stability effects				
Externalizing Behavior Problems (EBP)	Age 6-7	.92 (.03) ***	.96 (.01) ***	.97 (.01) ***
	Age 7-8	.94 (.03) ***	.96 (.01) ***	.97 (.01) ***
	Age 8-9	.95 (.03) ***	.96 (.01) ***	.97 (.01) ***
	Age 9-13	.97 (.05) ***	.95 (.02) ***	.96 (.01) ***
	Age 13-15	.96 (.04) ***	.96 (.01) ***	.97 (.01) ***
Social Skills (SS)	Age 6-7	1.05 (.07) ***	1.02 (.06) ***	1.01 (.06) ***
	Age 7-8	.88 (.06) ***	.89 (.05) ***	.86 (.05) ***
	Age 8-9	.99 (.07) ***	1.02 (.06) ***	.99 (.06) ***
	Age 9-13	1.17 (.16) ***	1.17 (.15) ***	1.15 (.14) ***
	Age 13-15	.72 (.10) ***	.71 (.10) ***	.68 (.09) ***
Cross-effects				
EBP → SS	Age 6-7	.02 (.10)	.07 (.09)	.04 (.09)
	Age 7-8	-.12 (.08)	-.13 (.07) †	-.18 (.07) *
	Age 8-9	.09 (.09)	.06 (.08)	.02 (.08)
	Age 9-13	.02 (.19)	.02 (.19)	-.03 (.18)
	Age 13-15	-.39 (.13) **	-.36 (.13) *	-.42 (.12) **
SS → EBP	Age 6-7	--	--	--
	Age 7-8	--	--	--
	Age 8-9	--	--	--
	Age 9-13	--	--	--
	Age 13-15	--	--	--
Covariate effects				
with EBP	Age 6	.39 (.08) ***	.44 (.07) ***	.44 (.07) ***
with SS	Age 6	-.65 (.06) ***	-.63 (.06) ***	-.63 (.06) ***

Note. β = standardized coefficient. SE = standard error.
† *p*<.10. * *p*<.05. ** *p*<.01. *** *p*<.001.

Table 2r

Estimates of Factor Loadings (Model F - Externalizing Behavior Problems)

Variables	*Unst.*	*St.*	SE	R^2
EXT 6	1.00	.94	.01	.88
EXT 7	1.00	.94	.01	.88
EXT 8	1.00	.94	.01	.89
EXT 9	1.00	.94	.01	.89
EXT 13	1.00	.93	.02	.86
EXT 15	1.00	.94	.01	.89
SS 6	1.00	.92	.02	.84
SS 7	1.00	.91	.02	.82
SS 8	1.00	.92	.01	.84
SS 9	1.00	.91	.02	.83
SS 13	1.00	.87	.03	.75
SS 15	1.00	.90	.02	.81

Note. Unst. = Unstandardized. St. = Standardized. SE = Standard Errors

Table 2s

Correlations Between Raters on Behavior Problems and Social Skills – ID Group

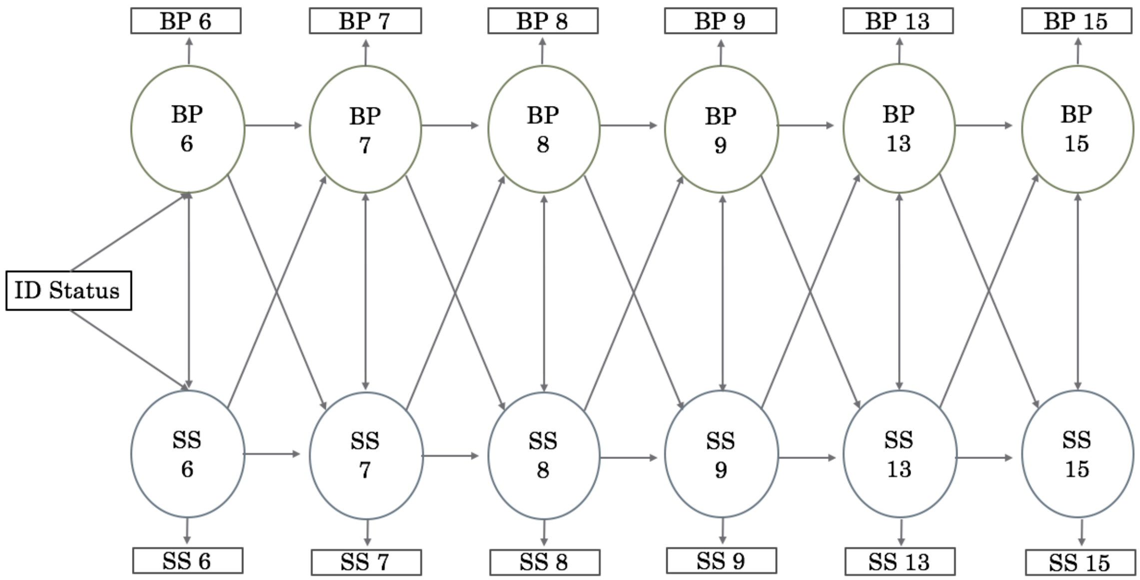
Variable	Age 6	Age 7	Age 8	Age 9	Age 13	Age 15
	r	*r*	*r*	*r*	*r*	*r*
Internalizing						
M – F	.19	.20 †	.48 ***	.48 ***	.58 ***	.61 ***
M – T	.09	-.06	.22 †	.12	.01	.57 ***
F – T	-.16	-.01	.22 †	.04	.47 ***	.52 ***
Externalizing						
M – F	-.05	.18	.47 ***	.47 ***	.57 ***	.61 ***
M – T	-.08	-.07	.23 †	.13	.57 ***	.70 ***
F – T	-.16	-.02	.23 †	.05	.47 ***	.51 ***
Social Skills						
M – F	.16	.21 †	.41 ***	.47 ***	.53 ***	.60 ***
M – T	-.08	-.09	.20 †	.01	.43 ***	.71 ***
F – T	-.25 *	.04	.25 *	-.06	.37 **	.53 ***

Table 2t

Correlations Between Raters on Behavior Problems and Social Skills – TD Group

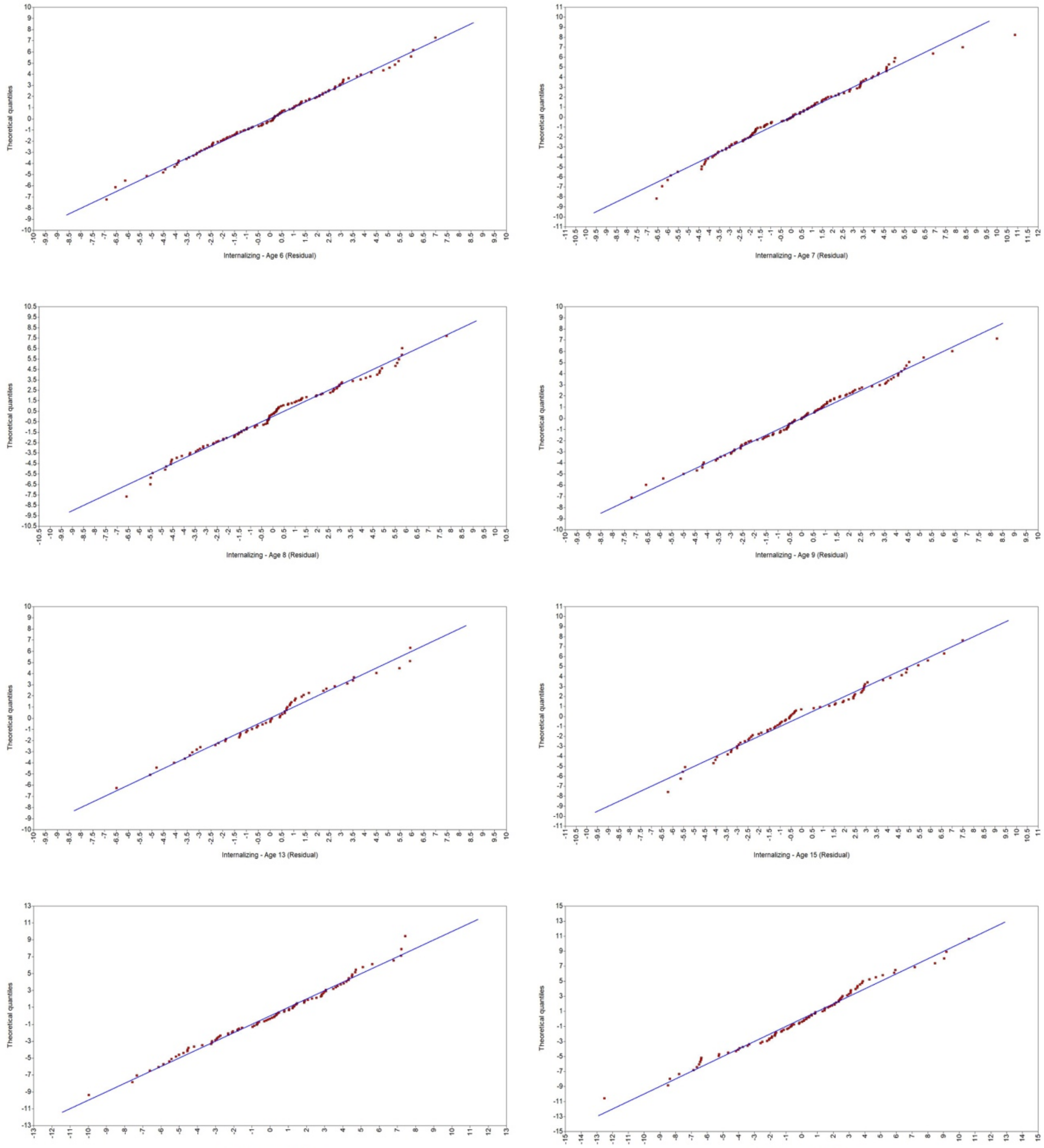
Variable	Age 6	Age 7	Age 8	Age 9	Age 13	Age 15
	r	*r*	*r*	*r*	*r*	*r*
Internalizing						
M – F	.28 **	.31 ***	.55 ***	.24 **	.70 ***	.74 ***
M – T	.05	.19 *	.06	.06	.58 ***	.57 ***
F – T	.06	-.02	.15	.16 †	.37 ***	.67 ***
Externalizing						
M – F	.29 **	.32 **	.55 ***	.25 **	.71 ***	.74 ***
M – T	.04	.20 *	.06	.06	.58 ***	.57 ***
F – T	.06	-.02	.15	.16 †	.38 ***	.67 ***
Social Skills						
M – F	.15	.08	.42 ***	.28 **	.56 ***	.65 ***
M – T	.12	.17 †	.07	.04	.58 ***	.53 ***
F – T	.11	.02	.28 **	.20 *	.31 **	.55 ***

Figure 2a *Proposed Structural Model*



Note. Arrows denote paths tested for significance at $p < .05$.
BP = Behavior Problems: Child Behavior Checklist/Teacher Report Form (CBCL/TRF; Achenbach & Rescorla, 2001). SS = Social Skills: Social Skills Rating System/Social Skills Improvement System (SSRS/SSIS: Gresham & Elliot, 1990; 2008). ID Status: 0 = TD, 1 = ID.

Figure 2b *Q-Q Plots of Residuals for Model F (Internalizing Behavior Problems and Social Skills*



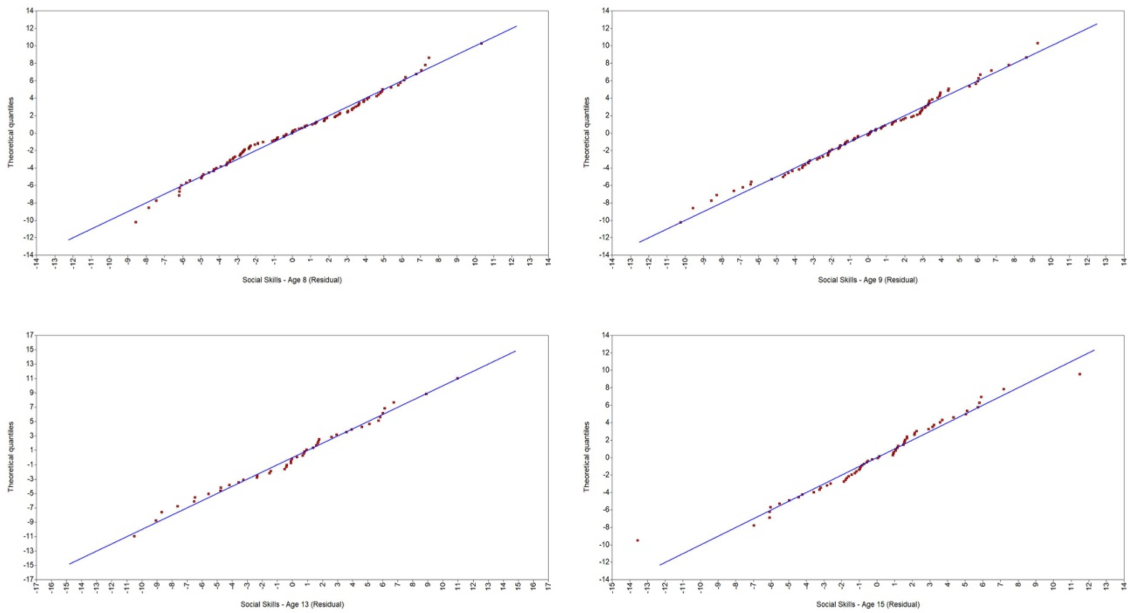
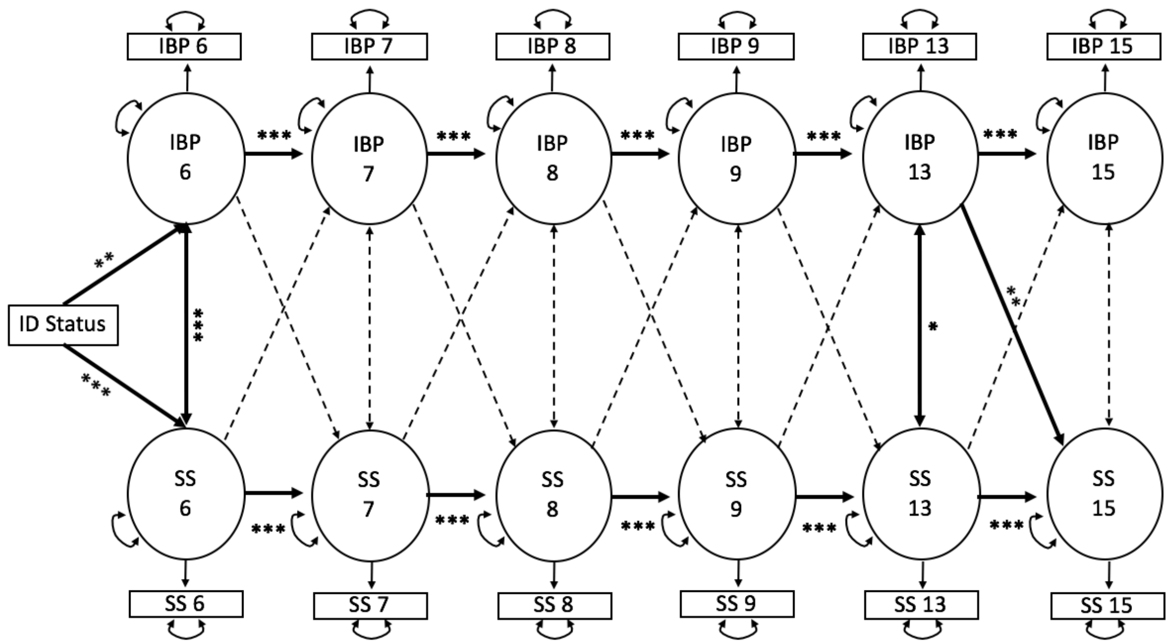
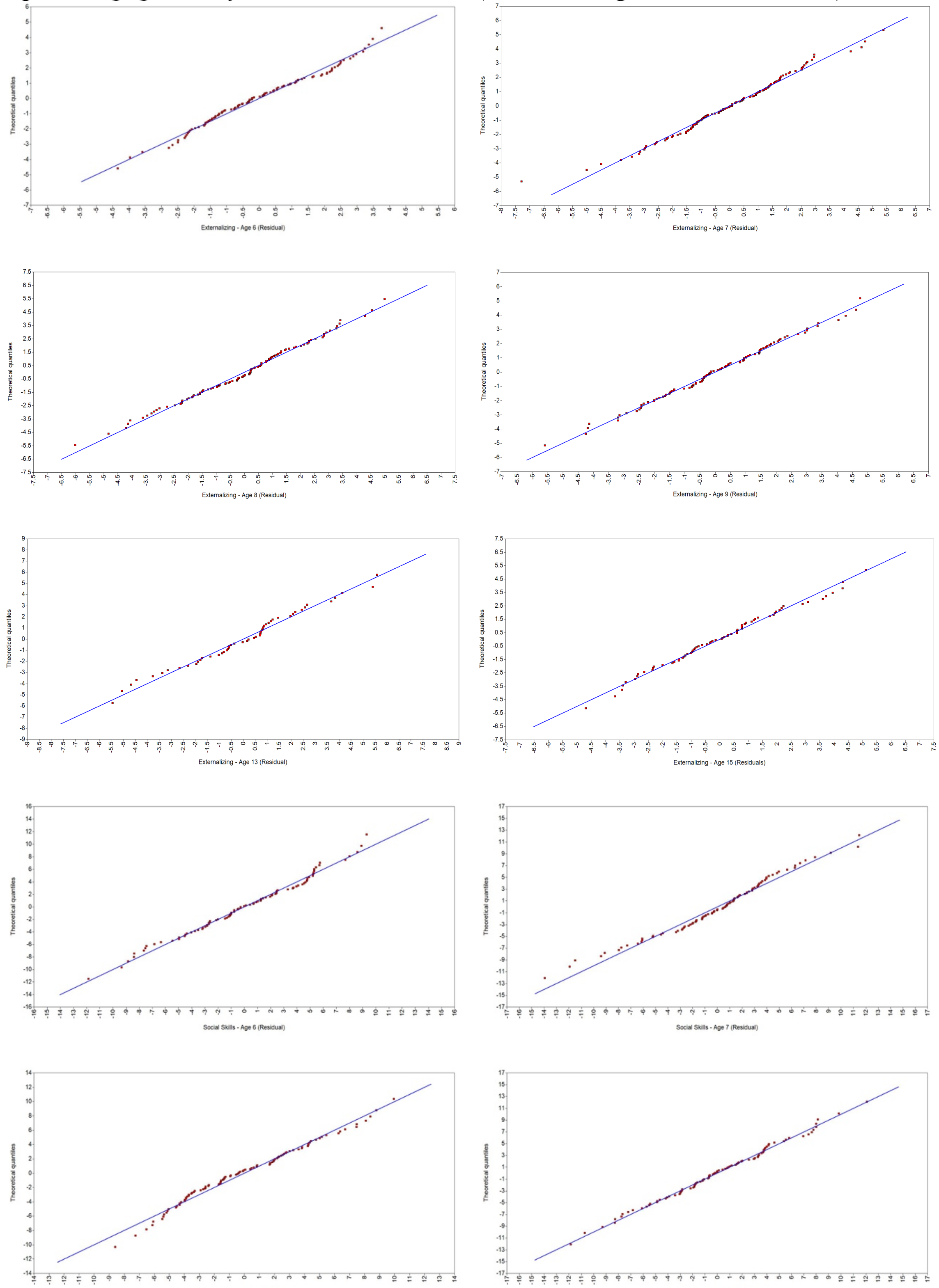

Theoretical quantiles
Social Skills - Age 8 (Residual)
Theoretical quantiles
Social Skills - Age 9 (Residual)
Theoretical quantiles
Social Skills - Age 13 (Residual)
Theoretical quantiles
Social Skills - Age 15 (Residual)

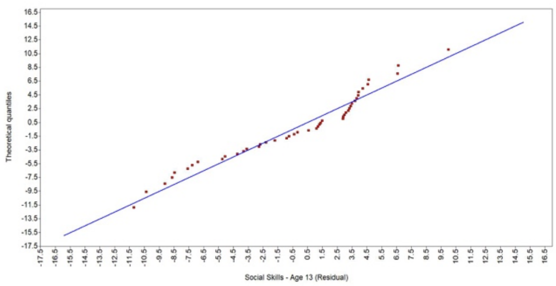
Figure 2c *Final Model of Internalizing Behaviors and Social Skills from Ages 6 to 15*



Note. Arrows denote tested paths. Bold arrows signify significant paths at the $p < .05$. Dashed lines signify nonsignificant paths. *** $p < .001$, ** $p < .01$, * $p < .05$.
IBP = Internalizing Behavior Problems: Child Behavior Checklist/Teacher Report Form (CBCL/TRF; Achenbach & Rescorla, 2001). SS = Social Skills: Social Skills Rating System/Social Skills Improvement System (SSRS/SSIS: Gresham & Elliot, 1990; 2008).
ID Status: 0 = TD, 1 = ID.

Figure 2d *Q-Q Plots of Residuals in Model F (Externalizing Behavior Problems)*




Theoretical quantiles
Social Skills - Age 13 (Residual)

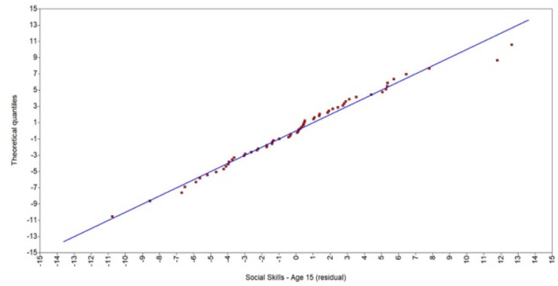
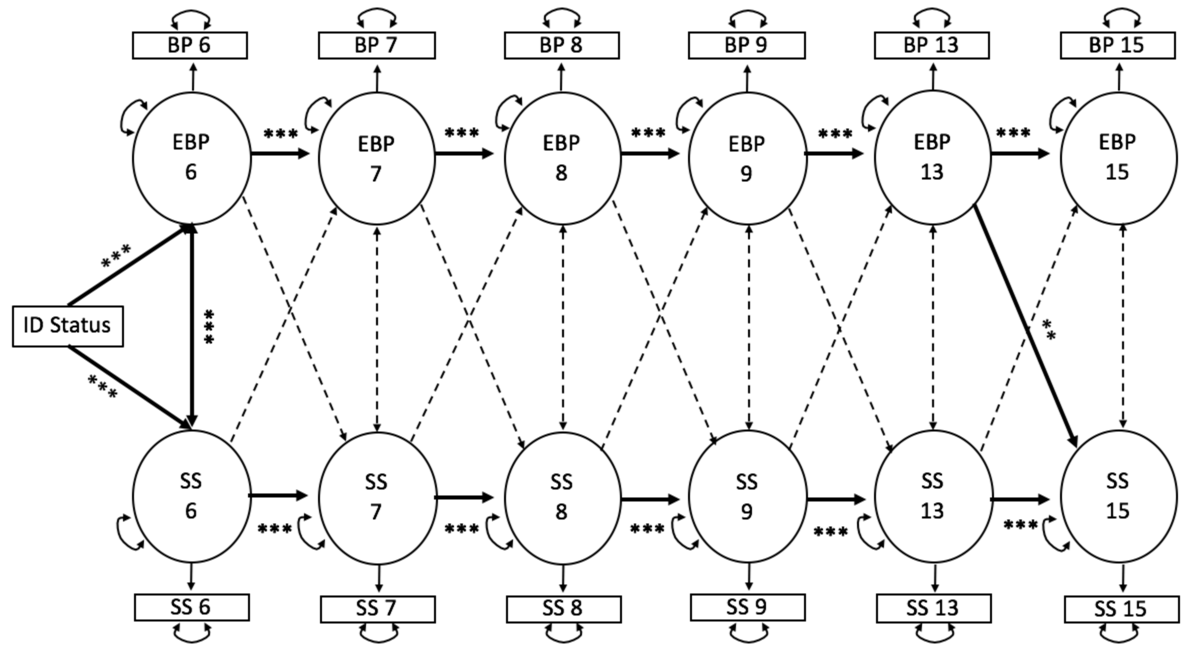

Theoretical quantiles
Social Skills - Age 15 (residual)

Figure 2e. *Final Model of Externalizing Behavior Problems and Social Skills from Ages 6 to 15*



Note. Arrows denote tested paths. Bold arrows signify significant paths at the $p < .05$. Dashed lines signify nonsignificant paths. *** $p < .001$, ** $p < .01$, * $p < .05$.
IBP = Internalizing Behavior Problems: Child Behavior Checklist/Teacher Report Form (CBCL/TRF; Achenbach & Rescorla, 2001). SS = Social Skills: Social Skills Rating System/Social Skills Improvement System (SSRS/SSIS: Gresham & Elliot, 1990; 2008). ID Status: 0 = TD, 1 = ID.