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Predictors and Course of Daily Living Skills Development in Toddlers with Autism Spectrum Disorders

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Abstract

Self-sufficiency is central to child and family well-being. This report focuses on predictors of adaptive daily living skills (DLS) development in young children with ASD and whether DLS gains predict decreases in parenting stress. Participants were 162 toddlers with ASD and their parents, assessed at 3 annual timepoints. Hierarchical Linear Models showed that age, DQ, and autism symptom severity uniquely predicted initial DLS and DLS growth. Child problem behaviors predicted initial DLS only. DLS was associated with change in parenting stress above and beyond DQ, autism symptom severity, and problem behaviors. Children with lower IQ and more severe symptoms showed slower DLS gains. Given its relation to parenting stress, DLS are an important intervention target in young children with ASD.

Keywords

Autism spectrum disorders; Daily living skills; Adaptive behavior; Parenting stress

Introduction

The study of adaptive behavior has been central to clinical assessment of Autism Spectrum Disorders (ASD) and to advancing understanding of ASD through research. As such, the development of the Vineland Adaptive Behavior Scales (Sparrow et al. 1984), which measure the functional use of communication, social, daily living, and motor skills needed in every day life, has greatly improved our understanding of patterns of adaptive behavior in individuals with ASD. In this paper, we focus on the domain of daily living skills, defined as age-appropriate self-care activities needed to function at home and in the community, and which include behaviors such as washing, dressing, following safety rules, and completing household chores. In contrast to the social and communication domains of adaptive

behavior, in which one would expect to see deficits and delays among children with ASD due to the overlap in assessment of social and communicative impairments that characterize the core symptoms of ASD, daily living skills should be an area of relative strength, and commensurate with a child's mental age (Gilham et al. 2000; Volkmar et al. 1993). Yet, deficits in daily living skills have been found consistently in older children with ASD (e.g., Liss et al. 2001). Moreover, the development of daily living skills in young children with ASD has not been fully examined, despite evidence that daily living skills are delayed in these children (Perry et al. 2009).

Children with ASD do appear to make gains in daily living skills as they get older (Freeman et al. 1999) but studies of school-aged children show that these skills continue to be delayed compared to both age and IQ-matched children with non-ASD developmental delays (e.g., Carpentieri and Morgan 1996; Gilham et al. 2000; Liss et al. 2001; Schatz and Hamdan-Allen 1995). Furthermore, while autism severity, IQ, and age, have been found to independently relate to daily living skills in young children (Perry et al. 2009), there is little research on early predictors of daily living skills trajectories. A greater understanding of the development of daily living skills in young children with ASD may inform interventions designed to improve both child and family functioning. Increases in daily living skills may predict better long-term outcomes for young children with ASD (Sutera et al. 2007) as well as lower parenting stress (Hauser-Cram et al. 2001; Tomanik et al. 2004). Therefore, this study aimed to examine predictors and course of daily living skills in young children with ASD, as well as the relationship between daily living skills and parenting stress.

In many cases, individuals with ASD appear to have lower adaptive skills (including daily living skills) than others with their same IQ level, and that discrepancy increases as their IQ increases (e.g., Liss et al. 2001; Carpentieri and Morgan 1996; Freeman et al. 1999; Schatz and Hamdan-Allen 1995). Liss et al. (2001) found that IQ was predictive of adaptive behavior in lower-functioning groups of children with ASD, but autism symptoms, language, and verbal memory were better predictors of adaptive behavior in higher-functioning groups. Thus, while IQ may constrain learning of adaptive daily living skills among lower-functioning children with ASD, other child characteristics are creating barriers to adaptive functioning in higher-functioning children. Likewise, Perry et al. (2009) found that autism symptoms predict unique variance in daily living skills above and beyond IQ in young children with ASD.

In addition to the core symptoms of autism, children with ASD often display related impairments that can affect their functioning and create challenges for themselves and their families (e.g., Estes et al. 2009). Consistent with this, emotional and behavioral problems (e.g., anxiety, tantrumming, aggressive behavior, hyperactivity) have been found to predict unique variance in adaptive behavior above and beyond both IQ and autism symptoms in older children with intellectual disability (De Bildt et al. 2005). Child problem behaviors may make it difficult for parents to teach their children daily living skills even if the children have the cognitive ability to learn them. The results of these studies suggest that IQ, autism symptom severity, and problem behaviors may be important predictors of daily living skills development in young children with ASD.

Although deficits in daily living skills are common in children with ASD, they do not receive much attention in very young children, perhaps because most early intervention programs target language acquisition and/or social communication deficits in autism, or perhaps because parents have so many caregiving responsibilities that they find it simpler to perform tasks for their children than to teach and require them to routinely do the tasks themselves. However, teaching and requiring children to perform simple adaptive skills such as eating with a spoon or toilet training may reduce parenting stress (Hauser-Cram et al. 2001; Tomanik et al. 2004), and possibly give parents more time and energy to help their child with language and core autism symptoms or participate in pleasurable activities and routines with their child and family. There is emerging evidence that parenting can affect the social and communication development of children with ASD and other developmental delays (e.g., Landry et al. 1997; Siller and Sigman 2002), so reducing parenting stress may be essential to helping parents facilitate their children's development.

Therefore, the goal of the current study was to examine the development of daily living skills across 3 years in young children with ASD. We investigated the following questions: (1) What is the trajectory of daily living skills across early childhood in children with ASD? (2) Do age, developmental level (DQ), autism symptom severity, and problem behaviors predict unique variance in initial levels and trajectory of daily living skills? And (3) Do daily living skills predict unique variance in parenting stress above and beyond child IQ, autism symptoms, and problem behaviors?

Methods

Participants

Participants were 161 toddlers (mean age = 28.2 months, SD = 4.2; 128 (79.5%) boys and 33 (20.5%) girls) who were enrolled in a larger longitudinal study of developmental trajectories of young children and their parents (for additional details see *removed for blind review*). All children had been diagnosed with autism or Pervasive Developmental Disorder—Not Otherwise Specified (PDD-NOS). Diagnoses were assigned or confirmed using the Autism Diagnostic Interview-Revised (ADI-R; Lord et al. 1994), the Autism Diagnostic Observation Schedule-Generic (ADOS-G; Lord et al. 2000), and a clinical psychologist's clinical impression. The sample was very diverse with respect to autism severity, cognitive functioning and adaptive behavior (see Table 1). The participants were predominantly White (83%) and upper- to upper-middle class (70% had annual income >\$60,000. The majority (97%) of mothers had two or more years of college education and almost all mothers were married or living with their partner. Children were excluded from the study if they had been diagnosed with a known genetic disorder such as Fragile X, a medical disorder that could impact cognitive functioning (e.g., lead poisoning), or a physically handicapping condition.

Participants were included in this study if they completed two annual assessments; 161 (92%) of the original 175 returned for the Time 2 assessments. Participants who returned did not differ from participants who did not return on any of the main study variables or demographic variables other than family income; returning participants had a slightly higher income. Due to funding constraints, only the first 97 of the 161 participants were called back

for Time 3. These Time 3 participants had slightly higher incomes from Time 3 non-participants.

Procedures

Participating families were recruited through early intervention providers, physicians specializing in the diagnosis of ASD, local conferences, and events for families of children with ASD. Families with children between 18 and 33 months who had a diagnosis of ASD or were suspected of having a diagnosis of ASD were invited to participate in the study. Families completed two visits in each assessment year: a child visit, which took place in a laboratory setting, and a parent interview, which was completed in either an office setting or the parents' home. Parents were also asked to complete a questionnaire booklet which included the Brief Infant Toddler Social and Emotional Assessment (BITSEA; Briggs-Gowan and Carter 2006) among other measures. Families were followed annually with the same child assessments, interviews, and questionnaires.

The child session included the Autism Diagnostic Observation Schedule- Generic (ADOS-G; Lord et al. 2000) and the Mullen Scales of Early Learning (Mullen 1995). During the parent visit the Autism Diagnostic Interview-Revised (ADI-R; Lord et al. 1994) and the Vineland Adaptive Behavior Scales (VABS; Sparrow et al. 1984) were administered. Parents were compensated \$50 for participating in the larger study. All children were assessed for the first time between 18 and 33 months (Time 1), and assessed annually for two additional years (Time 2 and 3).

Measures

Autism Diagnostic Interview-Revised (ADI-R; Lord et al. 1994)—The ADI-R is an investigator-based, semi-structured informant interview for the diagnosis of ASD. Current research supports the use of the ADI-R with children with a mental age of less than 18 months (Lord et al. 2006; Risi et al. 2006). Items are coded on a zero to three scale, with zero indicating no ASD-specific atypical behavior present, and three indicating extremely atypical behavior. Consistent with Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; APA 1994) and ICD-10 diagnostic guidelines, the algorithm focuses on three areas: communication, social, and restricted and repetitive behaviors. Established cut-off scores for each area have been shown to adequately discriminate autistic individuals from a mental-age matched non-autistic comparison group of participants with language impairment and/or mental retardation (Lord et al. 1994). The measure yields acceptable internal consistency for each subscale. Diagnostic research criteria proposed by the Collaborative Programs of Excellence in Autism for young children were employed (Lord et al. 2006; Risi et al. 2006). Specifically, a classification of autism spectrum disorder was given to individuals who met criteria for autism on either the Social or Communication domains and were within two points on the other. A score of three or greater on the restricted and repetitive behaviors domain was required for a diagnosis of autism, but was not required for a diagnosis of PDD-NOS.

Autism Diagnostic Observation Schedule-Generic (ADOS-G; Lord et al. 2000)—The ADOS-G is a semi-structured, interactive observation designed to assess social and

communicative functioning in individuals who may have an ASD. One of four appropriate developmental modules is used, based on the child's language level. Children in this study were administered either Module 1 (preverbal or single words; $n = 154$) or Module 2 (phrase speech; $n = 7$). The ADOS social-communication score was standardized to allow for combined analysis of participants completing different modules. The assessment involves a variety of social presses. Established cut-off scores are used to differentiate autism, autism spectrum disorder, and non-autism spectrum participants. Inter-rater reliability on the ADOS-G was 0.90.

Vineland Adaptive Behavior Scales (VABS; Sparrow et al. 1984)—The VABS is a semi-structured interview used to assess adaptive behaviors. The Daily Living Skills (DLS) scale was used to assess daily living skills at Time 1, 2, and 3. Both standard and raw scores are reported in Table 1, but raw scores were used in all analyses to allow examination of change over time.

Mullen Scales of Early Learning (Mullen 1995)—The Mullen Scales of Early Learning provide an assessment of cognitive functioning. For this study, Early Learning Composite was used to assess developmental level (DQ), which is a measure similar to IQ comprised of scores on Visual Reception, Fine Motor, and Receptive and Expressive Language, and is a standardized score with a mean of 100 and standard deviation of 15.

The Brief Infant Toddler Social and Emotional Assessment (BITSEA; Briggs-Gowan and Carter 2006)—The BITSEA is a 42-item parent-report questionnaire that is used to quickly measure social or emotional problem behaviors and competencies in children aged 1–3 years. Parents rate the degree to which their child exhibited certain behaviors in the past month (0—not true/rarely, 1—somewhat true/sometimes, 2—very true/often). The BITSEA provides Problem and Competence Total Scores that can be compared to cut scores by sex and age. The BITSEA has acceptable reliability, with alphas ranging from 0.77 to 0.86 for the Problem domain and 0.68–0.84 for the Competence domain in this sample.

Parenting Stress Index (Short Form; PSI/SF; Abidin 1995)—The Parenting Stress Index Short Form assesses parenting stress in parents of children 3 months to 10 years. The PSI is comprised of 36 items pertaining to parental feelings and experiences, comprising four scales: Parental Distress, Parent–Child Dysfunctional Interaction, Difficult Child Characteristics, and Defensive Responding. Parents rate their agreement with each item on a 5 point Likert scale from 1 (Strongly Agree) to 5 (Strongly Disagree). The scales show high internal consistency, with alphas in this sample ranging from 0.78 to 0.89 at Time 1, 0.79–0.89 at Time 2, and 0.83–0.92 at Time 3.

Data Analytic Plan

Daily Living Skills Trajectory—Predictors of initial levels and trajectory of DLS were examined by conducting a multilevel growth model analysis using hierarchical linear modeling (HLM; Raudenbush and Bryk 2002). HLM analyses can accommodate missing data and unequal numbers of observations between participants because they model the

individual growth trajectories of each participant. HLM uses maximum likelihood estimation to impute missing observations at Level 1 (i.e. time points within subject trajectories). We included all participants who had at least two time points of data. Missing data at Level 2 were imputed for five children missing Time 1 BITSEA scores and 1 child missing a Time 1 Mullen score by regressing BITSEA scores on age, Mullen, and ADOS scores, and by regressing Mullen scores on age and ADOS scores.

First, an unconditional HLM model, containing just DLS intercept and slope, was conducted to examine change over time in DLS. Next, a conditional model was conducted, which consisted of two levels of analysis. Level 1 included the Daily Living Skills intercept (DLS at Time 1) and slope. Level 2 included the time-invariant predictors: Time 1 child age, Mullen composite score, ADOS social-communication composite score, and BITSEA problem score. Level 2 variables were centered around the grand mean, so that intercept coefficients could be interpreted as pertaining to the ‘average’ participant (e.g., participant with the mean age).

Relationship between Daily Living Skills and Parenting Stress—To examine the relationship between daily living skills and parenting stress, correlations between these measures at each time point were examined. Subsequently, a hierarchical regression model was conducted to examine daily living skills at Time 3 as a predictor of parenting stress at Time 3 after controlling for parenting stress at Time 1, child age, developmental level, and autism severity, and daily living skills at Time 1.

Results

Daily Living Skills Descriptives

DLS raw and standard (mean of 100, SD 15) scores are displayed in Table 1. While raw scores increased across the three time points, standard scores decreased, indicating that although participants gained skills, their rate of gain was slower than the norm. Additionally, while DLS standard scores were in the average range (85 or above) for 3.7% of participants at Time 1 and 3.1% at Time 2, by Time 3 no participants had DLS scores above 80.

Predictors of Daily Living Skills

Unconditional Model—An unconditional model was computed to examine the intercept and linear slope of DLS. The variable used to represent time was coded 0–2 for the three annual timepoints so that the intercept of the unconditional model represented DLS at Time 1, when children were 18–33 months of age. The intercept coefficient was 39.35 ($p = 0.00$), and the slope coefficient was 24.11 ($p = 0.00$), indicating that the mean level of DLS at time 1 was 39.35, with a significant linear increase of approximately 24.11 raw score points in each of the two subsequent years. There was a significant variance component both for intercept ($105.62, \chi^2(160) = 321.35, p = 0.00$) and slope ($101.05, \chi^2(160) = 350.41, p = 0.00$), indicating significant individual variability in both intercept and slope.

Conditional Model—The conditional model was used to examine Time 1 predictors of DLS intercept and slope (see Table 2). Child age and Mullen composite were both

significant positive predictors of Time 1 DLS (i.e. higher age and developmental level predicted higher DLS) while BITSEA problem score and ADOS severity were significant negative predictors (i.e. higher problems and autism severity predicted lower DLS).

ADOS severity and Mullen composite also significantly predicted unique variance in the DLS slope. Higher ADOS severity predicted a slower rate of change while higher Mullen scores predicted greater growth in DLS across Times 1–3. Although both age and BITSEA problem score contributed to initial DLS scores, they did not predict DLS slope above and beyond Mullen and ADOS scores.

DLS Correlations with Parenting Stress

Correlations between DLS, the three PSI subscales, and the PSI total at each time point are displayed in Table 3. The parent–child subscale was the only subscale related to DLS at Time 1, and was moderately correlated with DLS at Times 2 and 3 as well. The difficult child subscale and the total score were correlated with DLS at Times 2 and 3. The parent distress subscale was not significantly correlated with DLS at any time point. Overall, the relationship between DLS and parenting stress appeared to get slightly stronger over time.

Predictors of Parenting Stress

A hierarchical regression was performed to examine whether DLS predicted change over time in parenting stress; results are displayed in Table 4. Because all but one of the PSI subscales were found to be correlated with DLS, the PSI total score was used for this analysis. Only the 83 subjects who had the VABS and PSI at both Time 1 and 3 were included in this analysis. The results of the regression predicting total PSI score at Time 3 included the following 4 steps: (a) the Time 1 total PSI score, which allowed us to predict to the residual, or change, in parenting stress; (b) the child covariates at Time 1: age, Mullen composite score, ADOS social-communication score, and BITSEA problem behavior; (c) the Time 1 VABS score; and (d) the Time 3 VABS score.

Time 1 parenting stress accounted for 51% of the variance in Time 3 parenting stress, indicating a high degree of stability. None of the child covariates (age, Mullen score, ADOS score, and BITSEA problems) accounted for significant variance in Time 3 PSI after accounting for Time 1 PSI (i.e., change in parenting stress). Time 1 DLS also did not account for any variance in change in PSI, but Time 3 variance did predict an additional 11.5% of the variance in Time 3 PSI above and beyond Time 1 PSI, the child covariates, and Time 1 DLS. Thus, positive change in child DLS was related to a decrease in PSI scores after accounting for child age, developmental level, autism severity, and problem behaviors.

Discussion

The purpose of this study was to investigate the development of daily living skills in toddlers with ASD, predictors of daily living skills, and the relationship between daily living skills development and changes in parenting stress. Our first aim was to examine the trajectory of daily living skills across 2 years in young children with ASD. We found that, although the daily living skill standard scores decreased over time, the raw scores increased in a linear fashion. This is consistent with previous findings that children with ASD gain in

daily living skills over time, but do so at a slower rate than typically developing children (e.g., Freeman et al. 1999; Liss et al. 2001). Thus, the gap in daily living skills between children with ASD and TD children increases across early childhood.

Our second aim was to examine whether age, developmental level (DQ), autism symptom severity, and problem behaviors were associated with both initial levels and growth in daily living skills. Each of these variables accounted for unique variance in initial levels of daily living skills (when children were 18–33 months). It is not surprising that age predicted daily living skill raw scores, given our findings and previous findings that daily living skills increase with age in children with ASD (e.g., Freeman et al. 1999; Liss et al. 2001). The finding that DQ, autism symptom severity, and problem behaviors each accounted for unique variance in initial daily living skills supports previous findings that ASD severity and behavior problems predict daily living skills above and beyond IQ in young children with ASD (e.g., Perry et al. 2009). Children's ability to perform daily living skills is likely a combination of their ability to understand what is being asked of them, their ability to understand and perform the task itself, their ability/desire to comply with parental requests, and parental expectations regarding the routine performance of daily living skills.

Age, DQ, and autism symptom severity, but not problem behaviors predicted daily living skills trajectory. Children with higher DQ made more rapid gains in daily living skills, likely because they were able to learn and remember tasks at a faster rate. Likewise, children with lower autism symptom severity also made more rapid gains in daily living skills, indicating that core symptoms of autism, rather than simply the correlation between autism symptoms and lower developmental level, are related to children's ability to learn and perform daily living tasks. This is consistent with research showing that even children with high-functioning autism, and thus IQs in the normal range, still have great deficits in daily living skills (e.g., Liss et al. 2001). Communication and social deficits may prevent children from understanding what is being asked of them, and reduce their desire to perform skills to please their parents or receive social reinforcement. However, it is also possible that parents of children with lower IQ and/or higher levels of ASD symptoms have lower expectations for their behavior in the domain of daily living skills and therefore, are less likely to encourage their children to perform daily living tasks routinely.

Although behavior problems predicted Time 1 daily living skills, they were not predictive of daily living skills growth. These results indicate that while children with higher behavior problems are behind in daily living skills, they do not appear to gain skills at a slower rate than children with fewer behavior problems. It is possible that these behavior problems are not stable across the 2 years or that once children get a little older, it is easier for parents to teach them daily living skills despite their earlier problem behaviors. Furthermore, most of the children in this study received their first diagnosis of ASD proximal to the time of the first assessment and subsequently received intensive intervention that may have helped to reduce their problem behaviors and/or teach daily living skills to children with problem behaviors. However, it is also possible that reduced daily living skills exacerbated problem behaviors at Time 1 (e.g., children who are less independent and capable are more likely to become frustrated and upset when encountering daily living tasks). In either case, children with early problem behaviors appear to be relatively behind in daily living skills and do not

catch up to children without problem behaviors across early childhood. Follow-up studies examining the relationship between behavior problems and daily living skills over time, in children of different ages, would improve our understanding of this issue.

Finally, we examined predictors of change in parenting stress from Time 1 to Time 3. Baseline levels of children's age, IQ, autism symptom severity, child problem behaviors, and Time 1 daily living skills did not predict change in parenting stress. However, gains in daily living skills from Time 1 to Time 3 did predict decreases over time in parenting stress. It may be that parents' expectations of their children's abilities increase over time; for those parents whose children are showing relatively slower growth in daily living skills, the mismatch between their expectations and their children's skills creates higher levels of stress. Additionally, parents may be more focused on their children's autism symptoms and language when their children are first diagnosed and only later do they begin to become concerned about their children's deficits in daily living skills. However, based on our findings, it appears that children who are more self-sufficient by age 4–5 have parents whose parenting stress decreases, so gains in daily living skills may be a protective factor for families' well-being.

These findings have implications for intervention with young children with ASD and their families. Our finding that IQ and autism severity predict changes in daily living skills may indicate that caregivers and treatment providers may need to target their expectations at the child's developmental and autism level. However, it may also be an indication that daily living skills are relatively neglected in the treatment of children with lower IQ and/or higher autism severity; thus it should not be assumed that these children are unable to make gains in daily living skills. Furthermore, the finding that children with early problem behaviors gain skills at the same rate as children without problem behaviors indicate that they are able to acquire daily living skills. Targeted interventions may help them gain skills at a faster rate and catch up to their peers without problem behaviors. Each behavior comprised in the Daily Living Skills domain of the VABS is teachable and thus could likely be easily incorporated into treatment.

The 2 years post-diagnosis can be a stressful time for families of children with ASD, but our results suggest that increasing children's self-sufficiency may partially protect parents from increases in parenting stress. Given the marked variability in individual trajectories of these young children's daily living skills and the fact that these behaviors are modifiable, it is likely that for some families, targeting daily living skills in intervention is likely to improve family functioning and help parents to better facilitate their children's development.

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References

- Abidin, RR. The parenting stress index professional manual. 3. Lutz, Florida: Psychological Assessment Resources, Inc; 1995.
- Briggs-Gowan, MJ.; Carter, AS. The brief infant-toddler social & emotional assessment (BITSEA). San Antonio, Texas: Psychological Corporation, Harcourt Assessment; 2006.
- Carpentieri S, Morgan SB. Adaptive and intellectual functioning in autistic and nonautistic retarded children. *Journal of Autism and Developmental Disorders*. 1996; 26(6):611–620. [PubMed: 8986847]
- De Bildt A, Sytema S, Kraijer D, Sparrow S, Minderaa R. Adaptive functioning and behaviour problems in relation to level of education in children and adolescents with intellectual disability. *Journal of Intellectual Disability Research*. 2005; 49(9):672–681. [PubMed: 16108984]
- Estes A, Munson J, Dawson G, Koehler E, Zhou X, Abbott R. Parenting stress and psychological functioning among mothers of preschool children with autism and developmental delay. *Autism*. 2009; 13(4):375–387. [PubMed: 19535467]
- Freeman BJ, Del’Homme M, Guthrie D, Zhang F. Vineland adaptive behavior scale scores as a function of age and initial IQ in 210 autistic children. *Journal of Autism and Developmental Disorders*. 1999; 29(5):379–384. [PubMed: 10587884]
- Gilham JE, Carter AS, Volkmar FR, Sparrow SS. Toward a developmental operational definition of autism. *Journal of Autism and Developmental Disorders*. 2000; 30(4):269–278. [PubMed: 11039854]
- Hauser-Cram P, Warfield ME, Shonkoff JP, Krauss MW. Children with disabilities: A longitudinal study of child development and parent well-being. *Monographs of the Society for Research in Child Development*. 2001; 66(3 Serial No 266)
- Landry SH, Smith KE, Miller-Loncar CL, Swank PR. Predicting cognitive-language and social growth curves from maternal behaviors in children at varying degrees of biological risk. *Developmental Psychology*. 1997; 33(6):1040–1053. [PubMed: 9383626]
- Liss M, Harel B, Fein D, Allen D, Dunn M, Feinstein C, et al. Predictors and correlates of adaptive functioning in children with developmental disorders. *Journal of Autism and Developmental Disorders*. 2001; 31(2):219–230. [PubMed: 11450820]
- Lord C, Risi S, DiLavore PS, Shulman C, Thurm A, Pickles A. Autism from 2 to 9 years of age. *Archives of General Psychiatry*. 2006; 63:694–701. [PubMed: 16754843]
- Lord C, Risi S, Lambrecht L, Cook E, Leventhal B, DiLavore P, et al. The autism diagnostic observation schedule–generic: A standard measure of social and communication deficits associated with the spectrum of autism. *Journal of Autism and Developmental Disorders*. 2000; 30:205–223. [PubMed: 11055457]
- Lord C, Rutter M, LeCouteur A. Autism diagnostic interview–revised: A revised version of a diagnostic interview for caregivers of individuals with possible pervasive developmental disorders. *Journal of Autism and Developmental Disorders*. 1994; 24:659–685. [PubMed: 7814313]
- Mullen, EM. Mullen scales of early learning. Circle Pines, MN: American Guidance Service, Inc; 1995.
- Perry A, Flanagan HE, Geier JD, Freeman NL. Brief report: The vineland adaptive behavior scales in young children with autism spectrum disorders at different cognitive levels. *Journal of Autism and Developmental Disorders*. 2009; 39:1066–1078. [PubMed: 19234777]
- Raudenbush, SW.; Bryk, AS. Hierarchical linear models: Applications and data analysis methods. 2. Newbury Park, CA: Sage; 2002.
- Risi S, Lord C, Gotham K, Corsello C, Chrysler C, Szatmari P, et al. Combining information from multiple sources in the diagnosis of autism spectrum disorders. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2006; 45(9):1094–1103. [PubMed: 16926617]
- Schatz J, Hamdan-Allen G. Effects of age and IQ on adaptive behavior domains for children with autism. *Journal of Autism and Developmental Disorders*. 1995; 25(1):51–60. [PubMed: 7608034]
- Siller M, Sigman M. The behaviors of parents of children with autism predict the subsequent development of their children’s communication. *Journal of Autism and Developmental Disorders*. 2002; 32(2):77–89. [PubMed: 12058846]

- Sparrow, SS.; Balla, DA.; Cicchetti, DV. Vineland adaptive behavior scales. Circle Pines, MN: American Guidance Service, Inc; 1984.
- Sutera S, et al. Predictors of optimal outcome in toddlers diagnosed with autism spectrum disorders. *Journal of Autism and Developmental Disorders*. 2007; 37:98–107. [PubMed: 17206522]
- Tomanik S, Harris GE, Hawkins J. The relationship between behaviours exhibited by children with autism and maternal stress. *Journal of Intellectual and Developmental Disability*. 2004; 29(1):16–26.
- Volkmar FR, Carter AS, Sparrow SS, Cicchetti D. Quantifying social development in autism. *Journal of the American Academy of Child and Adolescent Psychiatry*. 1993; 32:627–632. [PubMed: 7684364]

Table 1

Descriptive statistics for demographic and main study variables

	Time 1			Time 2			Time 3		
	Mean (SD)	Range		Mean (SD)	Range		Mean (SD)	Range	
Child age at VABS	28.23 (4.16)	17–38 ^a		40.67 (4.29)	29–50		52.98 (4.47)	43–63	
Mullen composite	66.69 (16.73)	49–126		–	–		–	–	
Mullen verbal	57.31 (24.60)	14–120		–	–		–	–	
Mullen nonverbal	77.15 (17.69)	23–131		–	–		–	–	
ADOS social communication composite	55.51 (18.14)	22.11–90.34		–	–		–	–	
VABS composite score (standard score)	68.30 (21.32)	52–123		63.72 (9.82)	45–110		60.51 (10.51)	40–91	
VABS DLS (standard score)	69.01 (7.84)	57–117		65.04 (8.58)	47–103		60.67 (9.53)	36–80	
VABS DLS (raw score)	39.62 (13.00)	14–80		63.08 (23.82)	23–138		87.22 (30.97)	21–154	
BITSEA problem score	17.54 (7.78)	2–41		–	–		–	–	
PSI difficult child	30.18 (8.65)	13–52		32.31 (8.05)	13–51		32.38 (9.46)	14–56	
PSI Parent–Child dysfunctional	25.82 (6.51)	13–42		24.89 (6.71)	12–43		26.67 (6.83)	12–42	
PSI parent distress	27.85 (9.80)	12–58		29.55 (9.41)	12–55		30.46 (10.57)	14–54	
PSI total score	83.85 (20.72)	42–142		86.75 (20.14)	40–139		89.51 (22.86)	40–149	

^a While all children completed the Time 1 child visit (Mullen and ADOS) between 18 and 33 months, 1 parent interview (VABS) occurred at 17 months and 10 occurred between 34 and 38 months

Table 2

Results of conditional growth model predicting daily living skills

Variable	
Intercept	39.34 *** (0.82)
By age	1.47 *** (0.20)
By ADOS severity score	-0.11 * (0.06)
By Mullen composite	0.31 *** (0.06)
By BITSEA problems	-0.30 ** (0.11)
Slope	24.14 *** (0.88)
By age	-0.29 (0.23)
By ADOS severity score	-0.21 ** (0.06)
By Mullen composite	0.25 *** (0.06)
By BITSEA problems	-0.00 (0.13)

Coefficients are unstandardized and standard errors are in parentheses

*
 $p < 0.05$;**
 $p < 0.01$;***
 $p < 0.001$

Table 3

Correlations between daily living skills and PSI at each time point

	PSI difficult child	PSI Parent–Child	PSI parent distress	PSI total
Time 1 DLS ^a	-.076	-.210**	-.036	-.115
Time 2 DLS ^b	-.177*	-.189*	-.116	-.188*
Time 3 DLS ^c	-.283*	-.373*	-.082	-.267*

*
 $p < 0.05$;**
 $p < 0.01$ ^a
n = 157;^b
n = 151;^c
n = 87

Table 4

Regression analysis predicting change in parenting stress from child daily living skills

Outcome measures	β Final model	R^2
Step 1: Time 1 PSI	0.669***	0.511***
Step 2: Time 1 child covariates		0.021
Child age	-0.032	
Mullen composite	0.023	
ADOS severity	-0.024	
BITSEA problems	0.083	
Step 3: Time 1 DLS	0.449***	0.013
Step 4: Time 3 DLS	-0.546***	0.115***

*
 $p < 0.05$;**
 $p < 0.01$;***
 $p < 0.001$