# Engagement in Vocational Activities Promotes Behavioral Development for Adults with Autism Spectrum Disorders

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## Abstract

This study examined the bidirectional relations over time between behavioral functioning (autism symptoms, maladaptive behaviors, activities of daily living) and vocational/educational activities of adults with autism spectrum disorders (ASD). Participants were 153 adults with ASD (M age = 30.2 years) who were part of a larger longitudinal study. Data were collected at two time points separated by 5.5 years. Cross-lag models were used, which accounted for stability over time while testing both directions of cross-lagged effects. Results suggested that greater vocational independence and engagement was related to subsequent reductions in autism symptoms and maladaptive behaviors, and improvements in activities of daily living. Relations between earlier behavioral variables (symptoms, behaviors, and activities of daily living) and later vocational independence were not statistically significant.

### Keywords

Autism spectrum disorder; Adult; Vocation; Autism symptoms; Behavior problems; Activities of daily living

## Introduction

Autism spectrum disorders (ASD) are a class of neurodevelopmental disorders defined by impairments in social functioning and communication (Dawson 2008; Landa et al. 2007). Although the vast majority of research in ASD has focused on early childhood, there is increasing recognition that ASD is a life-long disorder, with impairments that limit quality of life throughout adulthood. However, little is known about the factors that might promote positive adult development for these individuals. Given the prevalence of ASD (1 in 88

children; Centers for Disease Control and Prevention 2012), as well as the paucity of evidence-based interventions to improve outcomes for adults with ASD (Dove et al. 2012; Taylor et al. 2012), investigation of the factors that promote positive outcomes in adulthood is highly significant. The present study takes a developmental approach by examining the bidirectional relations over time between two important aspects of adult life for individuals with ASD: behavioral functioning and vocational activities.

Although there appears to be improvement, on average, in the behavioral development of adults with ASD, more recent research suggests that behavioral change follows many different pathways, and is likely influenced by the environment experienced by these adults. Changes in autism symptoms—encompassing such behaviors as restricted interests, repetitive behaviors, communication impairments (verbal and non-verbal), and difficulties with social interactions—have been examined using both retrospective and prospective designs. Studies that have compared early childhood symptom ratings to "current" symptom ratings using the Autism Diagnostic Interview-Revised (ADI-R; Lord et al. 1994) have generally found that parents report fewer symptoms in adolescence and adulthood than when their child was very young (Fecteau et al. 2003; McGovern and Sigman 2005; Piven et al. 1996; Seltzer et al. 2003). Clinical follow-up studies have also shown modest improvement in autism symptoms from early childhood to adulthood (Billstedt et al. 2007; Howlin et al. 2000, 2013; Mawhood et al. 2000).

Although not a part of the diagnostic criteria of ASD, maladaptive behaviors are often exhibited by people with ASD (Aman et al. 2003; Hollander et al. 2003; Lecavalier 2006; Shea and Mesibov 2005) and are a primary source of stress for their parents (Hastings 2003; Hastings and Brown 2002; Lecavalier et al. 2006; Tomanik et al. 2004). Maladaptive behaviors interfere with day-to-day functioning and include such behaviors as self-injury, aggression, and uncooperative behaviors. Concurrent with the improvements in autism symptoms, our research has found reduction of maladaptive behaviors during adolescence and adulthood, on average (Lounds et al. 2007; Shattuck et al. 2007; Taylor and Seltzer 2010). This pattern of improvement was also reported by Tonge and Einfeld (2003), who observed reductions in maladaptive behaviors over an 8-year period for children with autism.

However, our ongoing research (Shattuck et al. 2007; Smith et al. 2012; Taylor and Seltzer 2010; Woodman et al., under review) has revealed significant individual differences in patterns of behavioral change during adolescence and adulthood. In terms of autism symptoms, for example, the percentage of adults with ASD who improved over a 4.5-year period was in part a function of the type of symptom being examined, ranging from only 26 % for nonverbal communication to 59 % for repetitive behaviors (Shattuck et al. 2007). Although there was significantly more improvement than decline, there were substantial numbers of adults whose symptoms did not change over the study period. Similarly, although improvement over time was found on average for maladaptive behaviors (Taylor and Seltzer 2010), over one-half of the adults with ASD had scores that did not change, and a minority had maladaptive behaviors that worsened throughout adulthood (Shattuck et al. 2007).

It may be that having stimulating vocational activities, or the lack thereof, is one factor that can help account for the variability in change in behavioral development over time for adults with ASD. Although this hypothesis has not yet been tested directly, it is suggested by previous studies. First, Taylor and Seltzer (2010) found that autism symptoms and maladaptive behaviors were significantly improving while youth with ASD were in high school, but that improvement slowed (and in some cases even stopped) after high school exit. A similar result was reported by Smith and colleagues (Smith et al. 2012), who found that functional independence in activities of daily living (encompassing such skills as personal care, housekeeping, and meal preparation) improved throughout adolescence, but improvement slowed when individuals with ASD were in their early 20 s and plateaued by their late 20 s. Not coincidentally, the years immediately after high school exit are a time when youth with ASD are at greatest risk for disengagement from vocational or educational activities, with one national study finding that over one-half of youth with ASD had no educational or paid employment activities in the first 2 years after high school exit (Shattuck et al. 2012). Thus, it may be this disengagement that influences slowing of improvement in behaviors.

Our work comparing change in behavioral development for adults with ASD who have an intellectual disability to those who do not have an intellectual disability provides further evidence for the link between vocational activities and behavioral change. Youth with ASD who did not have an intellectual disability experienced the greatest slowing of improvement in symptoms and behaviors after high school exit (Taylor and Seltzer 2010); these same youth were the most likely to have no vocational or educational activities at this time (Taylor and Seltzer 2011). Although a number of studies have found ties between vocational activities and behavioral factors such as autism symptoms, maladaptive behaviors, and independence in activities of daily living for adults with ASD (Eaves and Ho 2008; Farley et al. 2009; Howlin et al. 2004; Taylor and Mailick 2013; Taylor and Seltzer 2011), all of them have either a) examined vocational activities and behavior characteristics measured at the same point in time; or b) examined the relations between earlier behavioral characteristics (often focusing on behaviors measured in early childhood, such as level of language or IQ) and later vocational activities (Billstedt et al. 2007; Eaves and Ho 2008; Gillberg and Steffenburg 1987; Howlin et al. 2004; Lord and Bailey 2002). In each of these studies, level of vocational activity achieved by the adult was conceptualized as being influenced by behavioral characteristics. However, the direction of effects may be the reverse; i.e., it is possible that more independent vocational activities might lead to subsequent improvements in autism symptoms, maladaptive behaviors, and activities of daily living, but this has not yet been investigated.

There is a rich tradition of research on the effects of employment (or lack of employment) among adults without disabilities; however, these questions have yet to be examined among adults with ASD or other developmental disabilities. Among typically-developing adults, competency in work activities is one of the strongest predictors of psychological well-being, stronger than financial autonomy, romantic and peer relationships, and educational competency (Schulenberg et al. 2004). Being laid off or fired from one's job places adults at increased risk for a host of personal, psychological, and familial problems (Blustein 2008; Hansen 2005; McKee-Ryan et al. 2005; Murphy and Athanasou 1999; Paul and Moser

2009). The effects of unemployment, under-employment, and job loss for adults with ASD (or other developmental disabilities) have not yet been studied.

Determining the direction of effects between behavioral functioning and vocational independence for adults with ASD is important from both a conceptual and applied perspective. Currently, theory is largely lacking in the literature on vocational activities for individuals with disabilities, with little attention given to the mechanisms associated with the development of vocational independence and even less focus on how environmental changes (such as entry into new vocational experiences) may influence the adult behavioral phenotype for individuals with ASD. Empirically-tested conceptual models of vocational independence for individuals with ASD are needed in order to inform policy regarding best practice. If greater vocational independence is related to subsequent improvements in symptoms and behaviors, then strong evidence would be provided for the importance of employment and meaningful vocation in the lives of adults with ASD.

### The Present Study

The present study employed a developmental psychopathology approach (Cicchetti and Toth 2009) to examine the interplay between the behavioral development of adults with ASD and an important aspect of their environment—post-secondary vocational and educational activities. Using longitudinal data, we examined the developmental processes that underlie outcomes for adults with ASD, with a focus on the timing of the relations between behavioral change and vocational activities (Cicchetti and Toth 2009; Sroufe and Rutter 1984). Given the broad spectrum of vocational activities that adults with ASD participate in, as well as the substantial instability in vocational activities over time (Taylor and Seltzer 2012), we were able to test whether the positive effects of employment observed in typically developing adults are also present in an ASD sample.

Thus, the aim of the present study was to examine the bidirectional relations between vocational activities and behavioral change in adults with ASD. This study is a follow-up to our recent analyses (Taylor and Mailick 2013), which used multilevel modeling to examine the individual trajectories of vocational activities, measured 6 times over a 10-year span. We found that for adults with ASD, on average, independence in vocational activities was declining over the study period, although substantial heterogeneity in trajectories was observed. Further, the strongest predictors of vocational independence were the behavioral characteristics of the adult with ASD. However, because the conceptual model motivating that study focused on change in vocational activities over time, with vocational activities as the outcome of interest (as is typical in disability research), we did not analyze the lagged relationships between earlier vocational activities and later behaviors. That is, we did not examine whether earlier vocational independence predicted later daily living skills, autism symptoms, or maladaptive behaviors. It may be, as we originally conceptualized, that having fewer daily living skills and/or more maladaptive behaviors or autism symptoms sets an adult with ASD on a path of limited vocational options that is compounded over time. Alternatively, however, it may be that adults who are in unstimulating work environments (or who do not have structured daytime activities) lose daily living skills and have symptoms and behaviors that worsen over time. Using a developmental approach to

untangle the direction of effects between vocational activities and behavioral change represents an important next step in this line of research, as the answers to these questions have critical implications for treatment by suggesting maximally effective intervention targets.

In the present study, we used cross-lagged panel analyses (Kenny 1975), with two time points of data separated by 5.5 years, to examine the reciprocal influences of vocational activities and behavioral development of adults with ASD, while also controlling for continuity over time in both of these variables. This type of analysis has a long tradition in developmental research of elucidating the mutual influences between an individual and his or her environment (e.g., Bradley et al. 1979; Clarke-Stewart 1973). Using cross-lagged panel analysis, we simultaneously tested both directions of effects to determine whether (a) fewer autism symptoms and maladaptive behaviors and greater independence in activities of daily living are related to subsequent improvement in vocational activities, or (b) greater vocational independence leads to subsequent improvements in behaviors.

## Method

### Sample and Procedure

The present analysis used a subsample ($n = 153$) drawn from our larger longitudinal study of families of adolescents and adults with ASD ($N = 406$; Seltzer et al. 2011). The criteria for inclusion in the larger study were that the son or daughter with ASD was age 10 or older (age range = 10–52 at the beginning of the study), had received an ASD diagnosis (autistic disorder, Asperger disorder, or pervasive developmental disorder-not otherwise specified) from an educational or health professional, and had a researcher-administered ADI-R (Lord et al. 1994) profile consistent with the diagnosis. Nearly all of the sample members (94.6 %) met the ADI-R lifetime criteria for a diagnosis of autistic disorder. Case-by-case review of the other sample members (5.4 %) determined that their ADI-R profile was consistent with their ASD diagnosis (i.e., meeting the cutoffs for reciprocal social interaction and repetitive behaviors for Asperger disorder, and for reciprocal social interaction and either impaired communication or repetitive behaviors for PDD-NOS). Half of the participants lived in Wisconsin ($n = 202$) and half in Massachusetts ($n = 204$). We used identical recruitment and data-collection methods at both sites. Families received information about the study through service agencies, schools, and clinics; those who were interested contacted a study coordinator and were subsequently enrolled. Six waves of data have thus far been collected and are available for analysis: four waves collected every 18 months from 1998 to 2003, spanning a 4.5-year period; a fifth wave collected in 2008; and a sixth wave collected in 2010. At each time point, data were collected from the primary caregiver, who was usually the mother, via in-home interviews that typically lasted 2–3 h and via self-administered questionnaires.

The present analyses made use of the fourth and sixth waves of data (referred to as Time 4 and Time 6). Time 4 was chosen as the starting point for the bidirectional analyses because it maximized the number of individuals with ASD who had exited high school and thus had vocational independence data (vocational independence was only coded after high school exit). More specifically, only 40.5 % of the larger sample had exited high school at Time 1

of the study, however that percentage increased to 64.3 % by Time 4. We chose Time 6 (the last time point currently available) as the end point for our analyses because we wanted a larger measurement interval for detecting change in our variables of interest. Specifically, there was an average of 3.81 years between Time 4 and Time 5, but this interval increased to 5.46 years (range of 4.44–6.66 years) between Time 4 and Time 6.

We included all families whose son or daughter with ASD had exited high school before Time 4, and who had vocational or educational data at both Time 4 and Time 6. Of a possible 158 sample members who met this criteria, participants were included in the final analyses if they had either Time 4 or Time 6 data on each of the behavioral variables (autism symptoms, maladaptive behaviors, and activities of daily living). Using this approach, we ensured that a maximum of one data point was missing for each participant for each of the cross-lagged models. Five potential participants were excluded from the analyses because of missing behavioral data at both Time 4 and Time 6, resulting in a final sample of 153 adults with ASD. Of the 153 participants, 128 (83.7 %) had no missing data, 18 (11.8 %) had missing data on one of the six behavioral measures, and 7 (4.6 %) were missing data on two of the six behavioral measures (although there was never a case in which the two missing values were in the same model). Further information about the method for addressing missing data is presented in the data analysis section.

The adults with ASD included in this analysis averaged 30.2 years of age ($SD = 9.1$) at Time 4 (the first time point of this study), with a range from 19.0 to 53.3 years. Approximately three-fourths (73.2 %) were male. The adults with ASD exhibited tremendous heterogeneity in intellectual functioning, with IQ scores ranging from 35 to 142. Approximately 18 % of the adults had IQ scores of 100 or above, suggesting average or above average intellectual functioning. Using well-accepted IQ and adaptive behavior criteria (American Association on Intellectual and Developmental Disabilities 2010), 69.3 % had a comorbid intellectual disability. Just over three-fourths of adults in this sample (75.2 %) were verbal, as indicated by daily functional use of at least three-word phrases. Nearly one-half (46.4 %) of the adults were living with the responding parent at Time 4, with 33.1 % living in a community residence, 9.3 % living in a semi-independent living arrangement, 4.6 % living in a public or private institution or a foster home, 3.3 % living independently, and 3.3 % in another arrangement.

Approximately two-thirds (64.1 %) of the adults with ASD had been diagnosed with a comorbid psychiatric disorder by Time 4; the most common disorders were anxiety disorder (37.3 %), attention deficit disorder (33.3 %), obsessive compulsive disorder (32.7 %), and major depressive disorder (26.8 %). The majority of adults with ASD (81.9 %) were taking at least one prescription medication, and 28.9 % were taking 4 or more medications (range from 0 to 12). Approximately 60 % (60.8 %) were taking at least one psychotropic medication (7.2 % were taking 3 or more psychotropic medication; range from 0 to 5), and just under two-thirds (64.5 %) were taking a non-psychotropic medication, with 15.7 % taking 3 or more non-psychotropic medications (range from 0 to 8).

The parent sample was composed of 150 mothers and 3 fathers. At Time 4, the participating parent in this subsample ranged from 41.6 to 86.2 years of age ($M = 59.4$, $SD = 10.2$).

Approximately one-half (52.9 %) had attained a post-secondary degree (Associate's or Bachelor's degree), with 30.7 % of parents earning a post-bachelor's degree. Two-thirds of parents were married at Time 4 (69.1 %) and 94.1 % were Caucasian. In 68.6 % of married couple families, at least one parent was employed full-time. Among parents who were not married, approximately one-third (34.0 %) were employed full-time (these rates of employment are not surprising given the average age of parents in this sample).

The median household income was between $50,000 and $60,000 in 2003 (at Time 4), which is consistent with the median income for all family households in the United States in 2003 ($53,991; DeNavas-Walt et al. 2004). Nearly 30 % of families (29.5 %) had annual household incomes below $30,000, and 41.1 % had annual household incomes of $70,000 or above. Thus, there was considerable variability in the socioeconomic status of this sample. Using definitions from the 2010 U.S. Census, 62.3 % of families lived either in Urbanized Areas (50,000 or more residents; 26.5 % of families), or in smaller cities within the major metropolitan areas of Milwaukee, Wisconsin, Madison, Wisconsin, and Boston, Massachusetts (35.8 % of families). The remaining families lived in Urban Clusters (between 2,500 and 50,000 residents; 28.5 % of families), and in rural areas (fewer than 2,500 residents; 9.3 % of families).

Between Time 4 and Time 6, there were 9 cases in which the primary respondent changed because the mother died or was no longer able to participate due to health problems. In these cases, primary study participation was assumed by the father (n = 2) or a sibling (n = 7).

### Measures

**Outcome Variable: Vocational Independence**—The Vocational Index (Taylor and Seltzer 2012) was used to categorize the vocational and post-secondary educational activities of the adults with ASD at Time 4 and Time 6. A full description of the development of the Vocational Index, including detailed coding rules, complete category descriptions, and information about reliability can be found in Taylor and Seltzer (2012). This index is composed of nine ordered, mutually-exclusive categories, ranked on a scale from 1 to 9; ordering of categories reflects the independence necessary to achieve a vocational/educational activity, as well as whether the adult participated in activities for more than a minimal amount of time (i.e., more than 10 h a week). Vocational Index scores are as follows: 1 = no vocational/educational activities; 2 = volunteering or non-degree seeking education only; 3 = sheltered vocational setting (e.g., sheltered workshop or adult day center) for 10 h a week or less; 4 = sheltered vocational setting greater than 10 h a week; 5 = sheltered vocational setting and employment in the community; 6 = supported employment in the community for 10 h a week or less; 7 = supported employment in the community for greater than 10 h a week; 8 = degree-seeking educational program or employment in the community without supports for a total of 10 h a week or less; 9 = degree-seeking educational program or employment in the community without supports greater than 10 h a week. The distribution of Vocational Index scores for the larger sample is presented in Taylor and Seltzer (2012).

## Behavioral Indices

**Autism Symptoms:** We measured current autism symptoms at both time points using the ADI-R (Lord et al. 1994). Thirty-three items from the diagnostic algorithm appropriate for adolescents and adults were administered in interviews with parents. Ratings of current functioning were made at each time of measurement by interviewers who had participated in an approved ADI-R training program. Inter-rater agreement between the interviewers and two supervising psychologists experienced in the diagnosis of autism and in the use of the ADI-R averaged 89 % at Time 1, and the average Kappa was .81. Past research has demonstrated the test–retest reliability, diagnostic validity, convergent validity, and specificity and sensitivity of the items used in the ADI-R diagnostic algorithm (Hill et al. 2001; Lord et al. 1997). Each ADI-R item was scored on the following scale: 0 = *no abnormality*, 1 = *possible abnormality*, 2 = *definite autistic-type abnormality*, 3 = *severe autistic-type abnormality*.

We recoded each ADI-R item to reflect either no impairment (coded 0, corresponding to an ADI-R code of 0) or some degree of impairment (coded 1, corresponding to an ADI-R code of 1, 2, or 3). This coding strategy has been used previously (Fecteau et al. 2003; Lounds et al. 2007; Seltzer et al. 2003; Shattuck et al. 2007; Taylor and Seltzer 2010) and allowed us to capture the qualitative difference between having and not having a given autism symptom.

In the present analyses we used an overall autism symptoms score, consisting of items related to restricted repetitive behaviors and interests, reciprocal social interaction impairments, and non-verbal communication impairments (verbal communication impairment items were not included in our overall score as some of the participants were non-verbal). The overall score was created by summing the number of items on which an individual was symptomatic, with higher scores indicating more autism symptoms (possible range of 0–23).

**Maladaptive Behaviors:** Parents completed the Behavior Problems subscale of the Scales of Independent Behaviors-Revised (SIB-R; Bruininks et al. 1996) at both times of measurement. This subscale measures maladaptive behaviors, grouped in three domains (Bruininks et al. 1996): internalized behaviors (hurtful to self, unusual or repetitive habits, withdrawal or inattentive behavior), externalized behaviors (hurtful to others, destructive to property, disruptive behavior), and asocial behaviors (socially offensive behavior, uncooperative behavior). Parents who indicated that their son or daughter displayed a given behavior problem during the past 6 months then rated the frequency (1 = *less than once a month* to 5 = *1 or more times/hour*) and the severity (1 = *not serious* to 5 = *extremely serious*) of the behavior. Standardized algorithms (Bruininks et al. 1996) translate the frequency and severity ratings into subscale scores (internalizing, externalizing, and asocial) and an overall maladaptive behaviors score. The overall maladaptive behaviors score was used in the present analyses. Higher scores indicate more severe maladaptive behaviors. Reliability and validity of this measure have been established by Bruininks et al. (1996).

**Independence in Activities of Daily Living:** Independence in activities of daily living was measured using the Waisman Activities of Daily Living Scale (W-ADL; Maenner et al. 2013). Parent respondents rated their son or daughter's level of independence on 17 items covering the domains of personal care, housekeeping, and meal-related activities. Items encompass a wide range of skills that are critical for independent living. Examples of basic tasks included in the W-ADL are toileting, dressing, or drinking from a cup; more intermediate tasks include making the bed or preparing simple foods (e.g., making a sandwich); examples of tasks with the highest degree of difficulty are doing laundry, preparing a complete meal, or managing daily finances. Each item was rated on a 3-point scale of independence—0 (does not perform the task at all), 1 (performs the task with help), or 2 (performs the task independently)—and items were summed. Scores from the W-ADL have a correlation of .82 with scores from the Daily Living Skills subdomain of the Vineland Screener (Sparrow et al. 1993), and high levels of reliability and validity have been established (Maenner et al. 2013). Higher scores indicate greater independence (possible range = 0–34).

**Sex and Age:** At the start of the study, the sex (0 = *male*, 1 = *female*) and age of the adult with ASD were recorded.

### Data Analysis

A cross-lagged panel analysis was employed to examine the bidirectional effects of vocational independence and behaviors (autism symptoms, maladaptive behaviors, and activities of daily living) for adults with ASD. Mplus Version 5.21 (Muthen and Muthen 2009) was used to test 3 two-wave, cross-lagged models. The cross-lagged design allowed for tests of both stability effects and cross-lagged effects. This type of model is ideal for separating out the direction of effects between two variables measured longitudinally, while also accounting for the important component of developmental continuity over time (Robins and Rutter 1990). For each variable, the Time 4 value (e.g., autism symptoms) was predicted by the Time 6 value (e.g., autism symptoms) as well as the cross-lagged variable (e.g., Vocational Index). All variables measured at the same time point were allowed to correlate, resulting in a fully saturated model. Depending on which lagged effect is greater (e.g., Time 4 Vocational Index predicting Time 6 behavior *or* Time 4 behavior predicting Time 6 Vocational Index), inferences can be made about the direction of effects between variables. A conceptual model is presented in Fig. 1.

For each of the three cross-lagged models, we controlled for age and sex of the adult with ASD. Our earlier work (Taylor and Mailick 2013) found that females had lower scores on vocational independence, and thus we felt it was important to remove variance that could be accounted for by sex. Furthermore, given the relatively wide age range of the sample (19–53 years), and the significant relations between age of the person with ASD and behavioral indices (Shattuck et al. 2007), we also decided to control for variance that could be attributed to age in the cross-lagged models. Alternatively, we chose not to control for whether the person with ASD had a comorbid intellectual disability, for both conceptual and pragmatic reasons. Conceptually, we were interested in examining the relations between vocational independence and behavioral measures across the full range of functioning of

adults with ASD, instead of removing variance in range of functioning. Pragmatically, the correlations between intellectual disability and the behavioral variables of interest were quite high (e.g., correlations between intellectual disability and Time 6 activities of daily living and autism symptoms were −.66 and .51, respectively), suggesting substantial overlap. Thus, controlling for intellectual disability status would make it difficult if not impossible to examine our research questions of interest.

We used a Full Information Maximum Likelihood (FIML) estimation approach to account for missing data in all models. Mplus, like most structural equation modeling software packages, has an option for FIML estimation, which computes the likelihood function for each case utilizing all data available for that case (Bollen and Curran 2006). FIML is a highly recommended approach as it retains all possible cases and treats missing data as random variables that do not influence the likelihood function (as if not sampled) rather than substituting values or deleting cases (Schafer and Graham 2002).

## Results

### Descriptive Analyses

Table 1 presents descriptive information about the Time 4 and Time 6 study variables. At both time points, around 50 % of adults with ASD were spending time in sheltered vocational settings, with only 20 % functioning independently in the community (in competitive jobs without support or in post-secondary degree-seeking educational programs). The ranges and standard deviations of the behavioral variables provide evidence for the significant heterogeneity of functioning in this sample. Although the mean autism symptoms score fell at nearly the midpoint of the scale, the one standard deviation interval included approximately 9 symptoms (out of a possible 23). Further, the range of functioning in this sample spanned the entire possible range of the autism symptoms measure (it is important to note that it is possible for some participants to have very mild current autism symptoms scores, as autism diagnoses were based on early childhood behaviors when symptoms tend to be more severe, as is standard). The majority of participants had maladaptive behaviors scores in the normal range, although a substantial minority experienced borderline behavior problems.

Scores on independence in activities of daily living ranged from a 4 (i.e., able to perform only 4 of the 17 tasks with some help, or 2 tasks independently) to 34 (i.e., able to perform all tasks independently). The one standard deviation interval encompassed 16 points on the 34-point scale. Only 4 % of adults received the highest possible score, meaning that they could perform all of the necessary activities of daily living without help. The remaining 96 % of the sample required some assistance in carrying out the tasks critical to independent living. Just under 40 % of adults had a W-ADL score of 17 or below, which is the midpoint of the scale and the equivalent of being able to perform each of the tasks with some help (although a person could also reach this score by performing fewer of the tasks independently). Thus, although substantial heterogeneity was observed in the study variables, the vast majority of adults with ASD demonstrated significant impairment.

## Bivariate Relations

Bivariate relations between the study variables are presented in Table 2. Vocational independence at both time points was significantly correlated with all of the behavioral variables, with the strongest correlations between vocational independence and activities of daily living. Maladaptive behaviors showed the weakest correlations with vocational independence as well as with the other behavioral variables (although all correlations were statistically significant). The age of the adult with ASD was related to all variables except activities of daily living, and sex showed small but significant relations with vocational independence at Time 4 and activities of daily living at Time 6 (with females having lower scores on both of those measures).

## Bidirectional Effects

Table 3 shows the bidirectional effects of vocational independence and behaviors (autism symptoms, maladaptive behaviors, and activities of daily living) of the adults with ASD. The coefficients for autism symptoms are found in Model 1, followed by the coefficients for maladaptive behaviors and activities of daily living in Models 2 and 3, respectively.

**Stability Effects—**Significant stability coefficients were observed for behaviors of the adults with ASD. The highest rate of stability in behaviors was found for activities of daily living, with a stability coefficient of .83 (see Table 3, Model 3). High rates of stability, however, were also found for autism symptoms and maladaptive behaviors, with coefficients of .67 and .64, respectively, all $p$ values <.001. Across the three models, stability effects for vocational independence were somewhat lower, although still statistically significant, ranging from .51 to .56, with $p$ values <.001. Thus, behavioral measures demonstrated high levels of stability in the 5.5 years between Time 4 and Time 6, with somewhat lower but still significant stability in vocational independence over this time.

**Cross-Lagged Effects—**Next we examined the cross-lagged effects of vocational independence and behaviors of the adults with ASD. Significant cross-lagged effects were observed for earlier (i.e., Time 4) measures of vocational independence with all three indicators of later (i.e., Time 6) behaviors. Specifically, greater vocational independence at Time 4 was significantly related to subsequent reductions in autism symptoms (B = −.12, SE = .06) and maladaptive behaviors (B = −.14, SE = .07), and subsequent improvements in activities of daily living (B = .12, SE = .04).

Although significant bivariate correlations were observed between earlier (Time 4) behaviors and later (Time 6) vocational independence (see Table 1), after accounting for the stability effects and both directions of cross-lagged effects, improvements in behaviors were not significantly related to subsequent improvements in vocational independence. The one exception to this pattern was activities of daily living. That is, there was a marginally significant association between higher levels of activities of daily living and subsequent improvements in vocational independence (B = .13, SE = .08). However, the overall pattern of direction of effects was for greater independence in vocational placements leading to more subsequent improvement in autism symptoms, maladaptive behaviors, and daily living skills over the 5.5-year period.

**Control Variables—**In each of the models, the relations between control variables (sex and age), vocational independence, and behaviors of the adult with ASD were examined. Consistent with our previous work using a different subsample from the larger longitudinal project (Taylor and Mailick 2013), females had lower vocational independence scores relative to males (B = −.18, SE = .08). Sex was not significantly related, however, to any of the indices of behavioral functioning (autism symptoms, maladaptive behaviors, or activities of daily living). The age of the adult with ASD was significantly related to vocational independence and to two of the behavioral measures. Specifically, adults with ASD who were older at the start of the study had lower vocational index scores (B = −.21, SE = .08), more autism symptoms (B = .22, SE = .08), and fewer maladaptive behaviors (B = −.19, SE = .08).

### Follow-Up Analyses

Although our method of handling missing data is appropriate and well-accepted, we wanted to be sure that the conclusions drawn from our analyses were consistent with what would be found in models that had no missing data. Therefore, we reran the cross-lag models with only the participants who had complete data for each model, thereby allowing the sample size to differ across models (*n*s = 153, 142, and 132 for models that included autism symptoms, activities of daily living, and maladaptive behaviors, respectively). The pattern of findings was identical to what was observed when missing data was allowed in the models; that is, the pathways from earlier vocational independence to later behavioral indices were statistically significant in all models (all *p*s < .05), whereas the pathways from earlier behavioral indices to later vocational independence were at the trend level or non-significant.

We also wanted to ensure that our findings were not unduly influenced by the 9 cases in which the respondent changed between Time 4 and Time 6 (i.e., respondent changed from the mother to either the father or a sibling); thus, we reran our cross-lagged models removing those cases. The pattern of findings with this slightly smaller subsample (n = 144) was identical to the pattern of findings for the sample that included cases in which the respondent changed (*n* = 153).

Finally, because our scale of maladaptive behaviors can be broken down into three clinically-meaningful subscales, we ran the cross-lag models with each individual maladaptive behavior subscale: internalized behaviors (hurtful to self, unusual or repetitive habits, withdrawal or inattentive behavior); externalized behaviors (hurtful to others, destructive to property, disruptive behavior); and asocial behaviors (socially offensive behavior, uncooperative behavior). The pattern of results found with each subscale was consistent with that of the overall maladaptive behaviors score (stronger relations between earlier vocational independence and later change in behaviors than the reverse). Of the subscales, the strongest effects were found for vocational independence predicting later internalized behaviors (full results for all sets of follow-up analyses are available from the first author).

## Discussion

Results from this study provide clear evidence that adults with ASD who are in vocational placements with a greater degree of independence have greater reductions in autism symptoms and maladaptive behaviors over a subsequent 5.5-year period, as well as acquisition of greater independence in functional activities of daily living. Although the links between vocational activities and autism symptoms, maladaptive behaviors, and activities of daily living at a single point in time have been reported (Eaves and Ho 2008; Farley et al. 2009; Howlin et al. 2004; Taylor and Seltzer 2011), to our knowledge this is the first study to attempt to separate out the directionality of these relations.

Although our earlier work (Taylor and Mailick 2013) examined only the direction of effects from behavioral phenotype of ASD to vocational activities, in this study we examined bidirectional effects. By taking stability in both behaviors and vocational activities into account, while simultaneously examining both directions of effects, a specific picture emerged: The degree of independence in vocational activities was uniquely related to subsequent change in autism symptoms, maladaptive behaviors, and activities of daily living.

Our findings suggest that the common perspective in disability research—namely, considering vocational outcomes as a function of behavioral indices—may not accurately capture the dynamics of this relationship. Instead, the relations between vocational activities and behavioral development for adults with ASD likely function in much the same way as for adults without disabilities. Multiple meta-analyses and reviews report the pervasive detrimental effects of job loss and unemployment on the mental health and life satisfaction of typically developing adults (Dooley and Catalano 1980; McKee-Ryan et al. 2005; Murphy and Athanasou 1999; Paul and Moser 2009). However, among those who are currently working, underemployment has a similarly negative influence on adult development. Underemployment is most typically manifested as involuntary part-time work, low-income work, or mismatch between the person's skills and the requirements of the job (Feldman 1996; Friedland and Price 2003). Although less well-researched than the effects of unemployment, underemployment is associated with higher levels of depressive symptoms and lower positive self-concept, as well as a host of other negative developmental outcomes (Feldman 1996; Feldman and Turnley 1995; Friedland and Price 2003). Furthermore, there has been some suggestion that the negative implications of underemployment for mental health are just as severe as the effects of unemployment (for a review, see Feldman 1996).

Underemployment is a common phenomenon among adults with ASD. Studies have found that around 50 % of adults with ASD primarily spend their days in segregated work or day activity settings, with little contact with their communities (Taylor and Seltzer 2012). A small minority of these adults are employed in the community without supports (Ballaban-Gil et al. 1996; Eaves and Ho 2008; Howlin et al. 2004), and those that do have community employment tend to have menial jobs that do not provide a living wage (Eaves and Ho 2008; Howlin et al. 2004; Taylor and Seltzer 2012). Estimates of the number of adults without any vocational or educational activities at a given point in time vary tremendously, with some studies finding that under 20 % have no daytime activities (Cederlund et al. 2008; Farley et

al. 2009) and other studies finding that 50–75 % of adults with ASD have no formal activities (Ballaban-Gil et al. 1996; Eaves and Ho 2008). Our analyses suggest that these high levels of underemployment and unemployment among individuals with ASD negatively impact their subsequent adult development, just as it does among adults without disabilities.

Although this study may be the first to suggest that more independent vocational activities lead to improved behavioral development among adults with ASD, it is consistent with a number of other longitudinal studies suggesting that the environment of individuals with disabilities, including those with ASD, is an important determinant of their subsequent behaviors. For example, the family environment has been shown to have this effect, with greater parental warmth, less parental criticism, and better family adaptability predictive of subsequent improvements in autism symptoms and maladaptive behaviors for adolescents and adults with ASD (Baker et al. 2011; Greenberg et al. 2006; Smith et al. 2008). Similarly, for adolescents and adults with Down syndrome, more stimulating home environments and fewer maternal depression symptoms are associated with fewer ensuing behavior problems and better subsequent daily living skills, social competency, and language (Esbensen et al. 2013; Shepperdson 1995). Among children and adolescents with intellectual/developmental disabilities, multiple aspects of the home environment have been found to pervasively influence subsequent child development, whereas child developmental indices such as behavior problems have much more targeted influences on specific aspects of the home environment (Mink and Nihira 1986, 1987; Nihira et al. 1983, 1985). Our findings suggest that, just as the home environment is an important influence on child and adult development, so too is the vocational or work environment for adults with ASD.

Because autism spectrum disorders are lifelong neurobiological disorders, our finding that greater vocational independence leads to subsequent improvements in maladaptive behaviors, activities of daily living, and even the core features of autism in adulthood is important. Just as in typically developing adults (Baltes et al. 1980), development is life-long for adults with ASD, with the possibility for growth and improvement throughout adulthood. The autism field has typically focused on interventions in early childhood and early environmental experiences (Dawson 2008; Dawson et al. 2010; Harris and Handleman 2000), which are no doubt of critical importance. But these findings, as well as our earlier research (Baker et al. 2011; Greenberg et al. 2006; Smith et al. 2008) suggest that the environment continues to have direct effects on the phenotypic expression of ASD throughout adulthood, and thus should be considered and further studied.

It should be noted that although longitudinal data and analytic techniques such as cross-lagged panel analysis provide suggestive evidence about the direction of effects, there are limits to the causal inferences that can be drawn. Our data suggests that maximizing the independence of a person with ASD's vocational activities might lead to subsequent reductions in autism symptoms, maladaptive behaviors, and improvement in practical daily living skills. However, given our correlational design, it is impossible to rule out the possibility that other variables might be influencing the observed relationships in a causal way. Some evidence, however, for the causal role of vocational activities in behavioral development has been provided in an intervention study conducted by Garcia-Villamisar et

al. (2000, 2002), who found that adults with ASD who were assigned to a supported work program in the community had autism symptoms and quality of life scores that improved relative to adults who were assigned to a segregated work program (i.e., sheltered workshop). Unfortunately these authors did not use random assignment. In order to provide stronger evidence for the causal role of vocational activities in adult development, future research should use randomized controlled trials to test the effects of vocational interventions on behavioral change among adults with ASD.

As with any study, there are limitations that are worth noting. This is not a nationally-representative sample, and findings from this study may not generalize to other samples with different clinical characteristics, racial/ethnic distributions, or from states that provide varying amounts of government-funded services. Further, this sample of adolescents and adults ranged from 19 to 53 years of age at the start of this study. Although this wide age range can be considered a strength, many of the adults were diagnosed with an ASD before the DSM-IV widened the autism diagnostic criteria. Further, many of this older cohort may not have benefitted from the explosion in early intervention services available to families of young children with ASD today. Thus, it is unclear to what extent findings from this cohort will generalize to subsequent cohorts of adults with different diagnostic criteria and more early intervention services. Finally, the Vocational Index used to categorize vocational activities captures change in type of vocational activities, but not instability within type. For example, change from one sheltered workshop to another would not be captured by this measure, and this type of change is common among adults with ASD (Taylor and Seltzer 2012). Future research might consider whether instability (vs. stability) in vocational activities, regardless of type of activity, is also related to less optimal pathways of behavioral development.

These limitations are offset by a number of strengths. The racial/ethnic diversity of the sample was limited; however, there was considerable diversity in socioeconomic status and in the rural–urban distribution of the participants. Although there are limits to its generalizability, our sample was relatively large and recruited from the community, making our findings more generalizable than many other studies of individuals with ASD. This is the first longitudinal study to examine bidirectional relationships between vocational/educational activities and behavioral development for adults with ASD. By examining change over a 5.5-year period, our study was able to reveal novel and important information about the directionality of the relations between vocational activities and behavioral development—information that is impossible to derive from cross-sectional studies or studies that focus on vocational activities as outcome only. Although further intervention research is clearly needed, our results provide preliminary evidence for a possible therapeutic role of work in the development of adults with ASD. Finally, this study adds to our conceptual understanding of the role of work for individuals with developmental disabilities. Similar to what is observed for typically developing adults, vocational activities may serve as a mechanism for providing cognitive and social stimulation, structuring the day, and enhancing well-being, adult development, and quality of life for individuals with ASD.

## Acknowledgments

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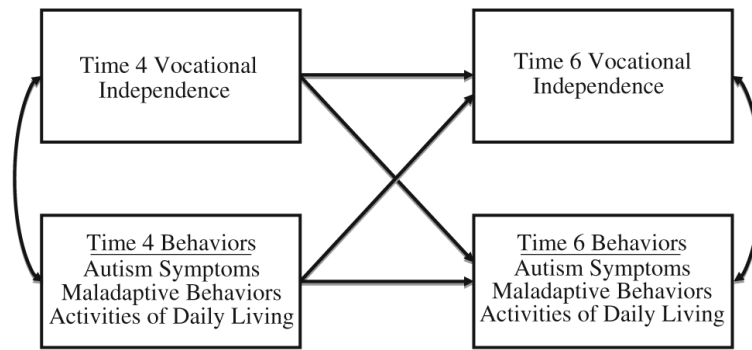Woodman, AC.; Mailick, MR.; Greenberg, JS. Trajectories of psychopathology among adults with autism. (under review)

**Fig. 1.**
Conceptual model of the relationship between vocational independence and behaviors

**Table 1**

Descriptive information about study variables

| | |
|---|---|
| *Time 4* | |
| Vocational activities (% in each type of activity) | |
|     No activities or volunteering only | 13.1 |
|     Sheltered setting only | 39.9 |
|     Sheltered setting and community employment | 11.8 |
|     Supported employment (no sheltered setting) | 13.7 |
|     Competitive employment or post-secondary degree-seeking education | 21.6 |
| Autism symptoms (n = 153) | |
|     Mean (SD) | 13.88 (4.12) |
|     Range | 1–21 |
| Maladaptive behaviors (n = 151) | |
|     Mean (SD) | 110.36 (9.48) |
|     Range | 100–153 |
|     % with scores in serious or very serious range | 4.0 |
|     % with scores in marginal or moderate range | 32.5 |
|     % with scores in normal range | 63.6 |
| Activities of daily living (n = 152) | |
|     Mean (SD) | 21.06 (7.97) |
|     Range | 4–34 |
| *Time 6* | |
| Vocational activities (% in each type of activity) | |
|     No activities or volunteering only | 19.0 |
|     Sheltered setting only | 41.2 |
|     Sheltered setting and community employment | 9.8 |
|     Supported employment (no sheltered setting) | 11.8 |
|     Competitive employment or post-secondary degree-seeking education | 18.3 |
| Autism symptoms (n = 153) | |
|     Mean (SD) | 13.78 (4.55) |
|     Range | 1–23 |
| Maladaptive behaviors (n = 134) | |
|     Mean (SD) | 109.54 (9.24) |
|     Range | 100–137 |
|     % with scores in serious or very serious range | 3.7 |
|     % with scores in marginal or moderate range | 28.4 |
|     % with scores in normal range | 67.9 |
| Activities of daily living (n = 143) | |
|     Mean (SD) | 20.57 (8.24) |
|     Range | 4–34 |

**Table 2**

Pearson correlations among study variables by time

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Time 4 | | | | | | | | | | |
| 1. Vocational independence | — | | | | | | | | | |
| 2. Autism symptoms | −.36* | — | | | | | | | | |
| 3. Maladaptive behaviors | −.19* | .33* | — | | | | | | | |
| 4. Activities of daily living | .54* | −.47* | −.31* | — | | | | | | |
| Time 6 | | | | | | | | | | |
| 5. Vocational independence | .59* | −.31* | −.17* | .41* | — | | | | | |
| 6. Autism symptoms | −.37* | .73* | .20* | −.53* | −.27** | — | | | | |
| 7. Maladaptive behaviors | −.27** | .31* | .68* | −.41* | −.34* | .36* | — | | | |
| 8. Activities of daily living | .60* | −.52* | −.32* | .90* | .47* | −.61* | −.45** | — | | |
| Covariates | | | | | | | | | | |
| 9. Age | −.21** | .23** | −.20* | −.13 | −.18* | .25** | −.09 | −.15 | — | |
| 10. Sex (daughter) | −.18* | .06 | .06 | −.12 | −.14 | .03 | .14 | −.20* | .13 | — |

***
$p < .001$;

**
$p < .01$;

*
$p < .05$

**Table 3**

Unstandardized path coefficients and standard errors for two-wave cross-lagged models for autism symptoms, maladaptive behaviors, and activities of daily living

| Model | Behavior | | |
|---|---|---|---|
| | **Model 1: autism symptoms** | **Model 2: maladaptive behaviors** | **Model 3: activities of daily living** |
| Stability effects | | | |
| T4 vocational independence to T6 vocational independence | .54 (.06)*** | .56 (.06)*** | .51 (.07)*** |
| T4 behavior to T6 behavior | .67 (.05)*** | .64 (.05)*** | .83 (.03)*** |
| Cross-lagged effects | | | |
| T4 vocational independence to T6 behavior | −.12 (.06)* | −.14 (.07)* | .12 (.04)** |
| T4 behavior to T6 vocational independence | −.10 (.07) | −.07 (.07) | .13 (.08)† |
| Control variables | | | |
| Sex to T4 vocational independence | −.18 (.08)* | −.18 (.08)* | −.18 (.08)* |
| Sex to T4 behavior | .06 (.08) | .06 (.08) | −.12 (.08) |
| Age to T4 vocational independence | −.21 (.08)** | −.21 (.08)** | −.21 (.08)** |
| Age to T4 behavior | .22 (.08)** | −.19 (.08)* | −.13 (.08) |

***
$p < .001$;

**
$p < .01$;

*
$p < .05$;

†
$p < .10$