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Work & Well-Being: Vocational Activity Trajectories in Young Adults with Autism

Spectrum Disorder

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Abstract

Young adults with autism spectrum disorder (ASD) experience limited social connectedness, difficulty living independently, and other poor outcomes at high rates. Vocational activities, including employment and post-secondary education, are associated with increased positive outcomes and subjective well-being in typical adults. This study identified vocational activity trajectory groups in adults with ASD, examined change in these trajectories from ages 18-28, and compared levels of parent- and self-report subjective well-being across trajectory groups. 151 adults with ASD were drawn from an ongoing longitudinal study. Data on psychosocial outcomes and vocational activities were compiled from parent-report demographic forms. Vocational activities were scored using the Vocational Index (VDI). There was no significant effect of age on the slope of vocational trajectories ($p = .787$). Participants in the Independent Activities group had significantly higher parent-report happiness factor scores than participants in the No Activities group ($F (3, 107) = 3.56$, $p = .017$) and significantly higher self-report happiness factor scores than participants in the Volunteer Activities group ($F (2, 35) = 6.46$, $p = .004$). The Independent Activities group was also significantly more likely to have at least one social contact ($X^2 (3, 118) = 10.54$, $p = .014$), however, there was no difference in trajectories groups in the likelihood of living independently ($X^2 (3, 120) = 1.71$, $p = .634$). The results of this study indicate vocational activities in young adults with ASD are stable across time. In the current sample, participation in independent vocational activities was associated with increased levels of subjective well-being.

Lay Summary

Participation in vocational activities is linked to increased well-being in typical adults, but young adults with autism spectrum disorder (ASD) are less likely to participate in vocational activities than typical young adults. This study characterized the vocational activities of 151 adults with ASD ages 18-28 and examined the relationship between vocational activities and well-being. Participation in vocational activities was associated with increased well-being.

Introduction

Employment is a major component of adult life. For typical adults, employment is predictive of success in other realms, including financial autonomy, independent living, and social connectedness (Blustein, 2008; Schulenberg et al., 2004). Conversely, unemployment is associated with increased likelihood of experiencing mental health concerns (Paul & Moser, 2009). Given the importance of employment to typical well-being, understanding trajectories of employment and related activities (i.e., post-secondary education and volunteer work, referred to throughout as vocational activities) could provide insight into supporting positive outcomes in adults with ASD.

Many—though not all—young adults with ASD experience poor outcomes, as defined by few vocational activities (Taylor et al., 2014; Beenstock et al., 2020), limited social connectedness (Liptak et al., 2011; Orsmond et al., 2013), and/or difficulty living independently (Bishop-Fitzpatrick et al., 2016; Shattuck et al., 2012). It is estimated between 50-60% of individuals with autism experience one or more poor outcomes in adulthood (Howlin & Magiati, 2017; Shattuck et al., 2012). There is some supposition that employment is key for adults with ASD to achieve positive adult outcomes. Vocational activities may provide a major social outlet in adulthood, strengthen the skills and resources necessary for independent living, and increase adults with ASD's feelings of competency and autonomy (Gal et al., 2015). Thus, adults with ASD who are unable to obtain or maintain employment may face additional hurdles in efforts to achieve positive outcomes (Lord et al., 2020).

While there have been some short-term retrospective studies and intervention trials evaluating employment programs (Burgess & Cimera, 2014; Wehman et al., 2019), overall, there is limited longitudinal data on the vocational activities of adults with ASD. A longitudinal

population cohort study of Israeli young adults with ASD found that ratings of adults' functional

and social competencies at age 18 were significant predictors of participation in higher

education, civic volunteering by age 30; functional competency ratings were also a significant

predictor of employment (Beenstock et al., 2020). In two 2014 studies, participation in more

independent vocational activities predicted reductions in autism symptom severity and

maladaptive behaviors over a five-year period (Taylor et al., 2014). Additional analyses of the

same sample found that on average, engagement in vocational activities significantly decreased

over a ten-year period (Taylor & Mailick, 2014). In short, this work suggests participation in

vocational activities is associated with improvements in ASD and psychiatric symptoms,

however, adults with ASD were less likely to take part in vocational activities as they aged.

These findings have yet to be independently replicated in other longitudinal samples of ASD.

Much of the literature on adult outcomes in ASD focuses on normative indicators of adult

well-being, including vocational activities. However, there are many ways to conceptualize

"good" outcomes, and normative indicators may not be suitable for all individuals on the autism

spectrum (Taylor, 2017). Thus, there has been a push for studies of ASD in adulthood to

incorporate measures capturing subjective well-being, in addition to examinations of normative

outcomes (Bal et al., 2018; Kirby et al., 2016; Lawson et al., 2020). Moreover, there have been

few attempts to systematically examine the relationship between subjective well-being and

vocational activities in adults with ASD (Goldfarb et al., 2021; McCauley et al., 2020). Though

the literature on typical adulthood has established a strong relationship between these two factors

(Schulenberg et al., 2004) it is unclear whether a similar relationship exists for adults with ASD.

There is some evidence that verbally-fluent adults with ASD may derive less satisfaction from

employment activities than typical adults (Black et al., 2019) and that participation in

employment may not be strongly linked to adults with ASD's positive well-being or levels of depression and anxiety (Hedley et al., 2019). Additionally, it cannot be assumed that adults with ASD who do not engage in vocational activities or engage only in volunteer or supported activities experience a lower quality of life than adults with ASD engaged in more normative vocational activities. Thus, the current study attempts to specifically investigate the relationship between vocational trajectories and subjective well-being in adults with ASD.

Study Aims

Our first aim was to characterize the sample's vocational activity trajectories over a ten-year period, from ages 18-28. We anticipated that controlling for IQ, participants would fall into one of three trajectory groups: a stable-low group that would consistently have little to no participation in vocational activities, a high-declining group that would consistently participate in independent vocational activities but would experience a downward trend in participation by age 28; and a mid-declining group that would inconsistently participate in independent vocational activities and/or consistently participate in supported vocational activities, but would experience a downward trend in participation by age 28.

Our second aim was to examine the slope of vocational activity trajectories across time. Based on the extant literature (Taylor et al., 2014), we hypothesized the slope of the stable-low trajectory group would not significantly change, but the slopes of the high-declining and mid-declining groups would significantly decline from ages 18-28.

Our third aim was to explore psychosocial factors related to inclusion in each of the vocational trajectory groups. We anticipated participants in the high trajectory group would have higher IQs, lower autism symptom severity, and higher adaptive functioning than participants in

the mid and low trajectory groups. However, we hypothesized that subjective well-being would not significantly differ by trajectory group.

Method

Participants

Consecutive referrals (N = 213) under 37 months old to clinics in North Carolina and Chicago were enrolled in a longitudinal study of ASD—192 individuals referred for autism and 21 referred for non-spectrum developmental delays. At age 9, 40 children from Michigan of similar age and diagnostic characteristics joined the study, resulting in 253 participants total. In-person assessments were completed at ages 2, 3, 5, 9, 18, 21, and 26. Detailed descriptions of this sample can be found in prior work (Anderson et al., 2014; Lord et al., 2006).

The current analyses include data from 151 participants from the longitudinal sample. To be included in this subset, participants had to have at least one instance of relevant data between ages 18-28. Participants excluded due to attrition and/or missing data were more likely to be African American than included participants $X^2(4, 253) = 18.34$, $p = .001$ and were more likely to have caregivers with less than a college degree $X^2(1, 253) = 7.35$, $p = .007$. Descriptive characteristics of the subsample and total sample are displayed in Table 1. Participants in this subset did not significantly differ from participants lost due to missing data or attrition by gender $X^2(1, 253) = .01$, $p = .91$, ethnicity = $X^2(1, 250) = .02$, $p = .86$, recruitment site $X^2(1, 253) = 5.46$, $p = .06$, ever/never having ASD $X^2(1, 253) = .85$, $p = .35$, Vineland Adaptive Behavior Scales (VABS) adaptive behavior composite (ABC) or domain scores $t(140) = 1.45$, $p = .14$, Autism Diagnostic Observation Schedule (ADOS) calibrated severity scores (CSS) in childhood $t(203) = .61$, $p = .53$ or adulthood $t(127) = .48$, $p = .62$, or adult full scale IQ $t(124) = 1.13$, $p = .73$.

Thirty-one of the participants in the current study have never been diagnosed with ASD, despite repeated diagnostic assessments. Individuals without ASD diagnoses were included in these analyses because repeated measurement has shown the ASD and non-ASD groups in this longitudinal sample share similarities across development (Lord et al., 2020). The inclusion of the non-ASD group also allows for comparison of the vocational outcomes of individuals with ASD and individuals with developmental delays other than ASD.

Measures

Autism Symptomatology

Calibrated severity scores (CSS) from the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2012) were used to measure autism symptomatology. Participants completed ADOS assessments during in-person visits at ages 2, 3, 5, 9, 18, 21, and 26.

IQ

The Mullen Scales of Early Learning were administered at age 2. Later cognitive assessments were chosen from a standard hierarchy including the Wechsler Intelligence Scale for Children (WISC; Wechsler, 2003), Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999), Differential Abilities Scale (DAS; Elliott, 2007), and Mullen Scales of Early Learning (MSEL; Mullen, 1995). Ratio IQs were calculated when raw scores fell outside deviation score ranges.

Adaptive Behavior

The Vineland Adaptive Behavior Scales (VABS; Sparrow et al., 2005) was used to assess participants' adaptive functioning. The VABS is a caregiver-interview assessment of adaptive behavior composed of three domains: communication, daily living skills, and socialization. The VABS produces an Adaptive Behavior Composite (ABC) standardized score and age

equivalence (AE) score, as well as domain-specific standardized and AE scores. The VABS was

administered as a caregiver interview during in-person visits and over the phone at age 14.

Participants' families competed the VABS at ages 2, 3, 5, 9, 14, 18, 21, and 26.

Vocational Activities

Data from parent-report demographic forms was used to determine participants'

vocational activities from ages 18-28. These data were coded using the Vocational Index (VDI)

developed by Taylor and Seltzer (2012). The VDI was specifically designed to measure

independence in vocational activities in adults with ASD, and was used to measure change in

vocational trajectories in a separate longitudinal sample of adults with ASD (Taylor and Mailick,

2014; Taylor et al., 2014). Scores on the VDI range from 1-9, with 1 indicating no participation

in employment or post-secondary education activities, and 9 indicating participation in post-

secondary education or competitive employment for 10 hours/week or more without supports.

The VDI also includes scores specifically for individuals in volunteer, sheltered workshop and

supported employment settings, making it a uniquely effective measure for understanding

vocational outcomes in ASD amongst individuals of varying language and IQ levels (see Taylor

& Seltzer, 2012 for a full description of VDI design and scoring).

For the current study, in an effort to distinguish adults with ASD who are able to obtain

and maintain independent competitive work, the VDI was modified to include a score of 10. This

modification was made in consultation with one of the authors of the VDI (J. L. Taylor, personal

communication, January 13th, 2021). A score of 10 was defined as participation in competitive

employment for 20 hours/week or more without supports.

Psychosocial Outcomes

Happiness Factor. Data from questionnaire forms on affect and happiness, specifically the positive total scores from the Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988), total scores from the Well-Being Questionnaire (WBQ; Ryff, 1989) and total scores from the Quality of Life Questionnaire (QLQ; Schalock & Keith, 1993) were used to create a composite measure of happiness in adulthood. This happiness composite was identified via exploratory factor analysis in prior analyses of this longitudinal sample (see McCauley et al., 2020). Happiness factor scores ranged from -1 to 1, with higher scores indicating greater reported levels of happiness. Both parent-report ($n = 110$) and self-report ($n = 37$) happiness scores were analyzed. This caregiver and self-report happiness factors were used to operationalize subjective well-being, and the terms are used interchangeably throughout.

Social Contact & Living Circumstances. During the age 25 in-person assessment visit, parents and participants capable of self-report were interviewed via an updated version of the Social Emotional Functioning Interview (SEF-S and SEF-I; Rutter et al., 1988). The SEF has been previously used in studies of adults with ASD (Howlin et al., 2000) and includes open-ended questions relevant to adult outcomes, including living status and the presence of friendships and acquaintances. Caregivers and participants also provided updated information on these topics via demographic questionnaires completed at ages 26 and 28. Participant social contact and independent living outcomes were coded as 1 or 0. For social contact, a score of 1 indicated at least one friend or acquaintance outside of their immediate family, and a score of 0 indicated no friends or acquaintances. For living circumstances, a score of 1 indicated the participant was living by themselves, with a partner, or with non-relative roommates. A score of 0 indicated the participant was living with their immediate family or in a supported residential setting.

Procedures

Questionnaires and direct testing, including the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2; Lord et al., 2012), IQ tests chosen from a standard hierarchy (Anderson et al., 2014) and parent and participant interviews conducted by trained research assistants were completed at participants' homes. During the ten-year data collection period highlighted in the current study, participants and their families were mailed study packets with questions on participants' current work and school activities at least once per year. However, there was variability in how often participants and their families completed questionnaire packets. The number of vocational activity data points from ages 18-28 per participant ranged from 1-9, with an average of 3.6 (Table S1).

Ethical approval for this research was obtained from the Institutional Review Boards at the various study sites (UCLA, University of Michigan, University of Chicago, and University of North Carolina, Chapel Hill). Parents and participants over 18 who were their own legal guardians gave written consent as required by the relevant institutional review board(s) prior to visits at all timepoints. Detailed descriptions of study procedures can be found in prior work (Anderson et al., 2014; Lord et al., 2006).

Data Analysis

To examine vocational activity trajectories, group-based trajectory modeling was performed using the traj plugin in Stata 16 (Jones & Nagin, 2007; 2013). Group based trajectory modeling estimates developmental trajectories via maximum likelihood estimation. The best fitting model (linear, quadratic, etc.) and number of trajectory groups were determined using Bayesian Information Criteria (BIC). Nine timepoints were used as independent variables to analyze the latent grouping of individuals in their vocational activity trajectories. Unconditional

2, 3, and 4 class models were compared using Bayesian Information Criterion (BIC) and the smallest group membership percentage (Table 2). After classes were determined, higher order effects were tested to establish whether cubic, quadratic, linear, or intercept modeling best explained variation over time. To aid in model selection, the average posterior probabilities were evaluated to determine adequate model fit (above 0.70; Nagin et al., 2018). One-way ANOVA and chi square analyses were then used to compare the composition of classes for measures of diagnosis (Ever or Never ASD), gender, race, caregiver education, ADOS CSS scores, adult and childhood IQ, VABS domain and ABC composite scores, and happiness quotient scores (Tables 3 & 4).

Multilevel modeling—using the lme4 package in R, version 4.0.2 (Bates et al., 2015; R Core Team, 2020) —was used to investigate rates of change in vocational trajectories. A multilevel modeling approach was selected to account for the non-independence introduced because of the nesting of participants across time points and to evaluate the potential influence of the inclusion of a random slope on trajectory estimates. The outcome, VDI scores, is categorical but because of the wide range of scores possible it met the necessary assumptions to be fit using a linear model. There were two models of interest, the first included fixed effects for age, trajectory group, race, caregiver education, adult IQ, adult ADOS CSS and the interaction between age and trajectory group. The next, more parsimonious, model excluded the non-significant interaction between age and trajectory group. Both models included a random subject level intercept. While more complex data structures were explored, the inclusion of random subject or trajectory group level slopes did not explain any additional variance in the model and so the simplest data structure (random intercept) was used.

Results

Vocational Activity Trajectories

A four-group model was determined to be the best fit (Table 2). The first trajectory group, No Activities, comprised 22.7% of the sample, the second group, Volunteer Activities, comprised 29.2% of the sample, the third group, Supported Activities, comprised 19.8% of the sample, and the fourth group, Independent Activities, comprised 28.3% of the sample. The slope of all four groups was linear (Figure 1). The No Activities trajectory was characterized by little or no participation in vocational activities, with an estimated mean VDI score of 1.05 (SE=0.27) at age 18 and 1.00 (SE=0.20) at age 28. The Volunteer Activities trajectory was characterized by participation in volunteer activities or sheltered employment for 10 hours a week or less. The estimated mean VDI score at age 18 was 2.66 (SE=-.25) and 2.59 (SE=0.19) at age 28. The Supported Activities trajectory was characterized by participation in supported (i.e. with the assistance of a job coach, 1:1 aid, or other regular support staff at the job site) community employment and/or sheltered employment for more than 10 hours per week. The estimated mean VDI score for this group at age 18 and age 28 were 6.76 (SE=0.25) and 6.70 (SE=0.20) respectively. Finally, the Independent Activities trajectory was characterized by participation in postsecondary, degree-seeking educational programs and/or independent community employment for more than 10 hours per week. The estimated mean VDI score was 9.41 (SE=0.23) at age 18 and 9.34 (SE=0.22) at age 28. There was little to no overlap in the VDI scores between trajectory groups across the ten-year period.

Rate of Change in Vocational Activity Trajectories from 18-28

Multilevel modeling was used to investigate whether the slopes of the four trajectory groups changed differentially over the ten-year study period. The interaction between age and trajectory group was non-significant, indicating no differences in slopes between the No-

Activities group and the other groups (all $p > .05$). This interaction was then dropped from the model. The effect of age was non-significant ($p = .787$) indicating, on average, VDI scores did not increase or decrease over time. To confirm the non-significant effect of age was not an artifact of the addition of a score of 10 to the VDI, a separate model was run using the original VDI scoring scheme (Taylor & Mailick, 2012). This model also found a non-significant effect of age ($p = .357$) nor were any of the group by age interaction terms significant (all $p > .05$). However, there was a significant effect of membership, indicating the average VDI score for the No Activities trajectory group was significantly lower than the VDI scores for the Volunteer Activities, Supported Activities, Independent Activities (all $p < .001$) groups (Table 5). None of the covariates significantly contributed to the model (Table 5).

Characteristics of Vocational Activity Trajectory Groups

One-way ANOVAs and chi-square analyses were used to examine differences in psychosocial characteristics. There was a significant difference in parent-report happiness factor scores between trajectory groups ($F(3, 107) = 3.56$, $p = .017$); the Independent trajectory group had significantly higher happiness factor scores than those in the No Activities group ($p = .017$). Similarly, there was a significant difference in self-report happiness factor scores between trajectory groups ($F(2, 35) = 6.46$, $p = .004$); the Independent trajectory group had a significantly higher happiness factor score than the Volunteer Activities group ($p = .006$). None of the other group differences in happiness factor scores were significant.

There was a significant difference in the likelihood of having at least one social contact by trajectory groups ($X^2(3, 118) = 10.54$, $p = .014$), but no significant differences in living circumstances by trajectory group ($X^2(3, 120) = 1.71$, $p = .634$). There were also no significant differences by gender ($p = .15$), race ($p = .18$), ethnicity ($p = .41$), caregiver education ($p = .91$),

or study recruitment site ($p = .15$; Table 3). However, there was a significant difference between groups by diagnostic status; individuals who had never been diagnosed with ASD were less likely to be in the No Activities trajectory group than participants with an ASD diagnosis (X^2 (3, 120) = 10.31, $p = .016$).

There were also significant differences between trajectory groups in childhood verbal (F (3, 119) = 7.34, $p < .001$) and nonverbal IQ (F (3, 119) = 8.25, $p < .001$) and adult verbal (F (3, 109) = 36.64, $p < .001$) and nonverbal IQ (F (3, 108) = 35.92, $p < .001$). The Independent Activities group had significantly higher verbal and nonverbal IQs in childhood than the Volunteer ($p = .017$ and $p < .001$, respectively) and No Activity groups ($p < .001$, $p = .001$, respectively) as well as higher verbal and nonverbal IQs in adulthood than the Volunteer (all $p < .001$) and No Activity groups (all $p < .001$). Additionally, the trajectory groups significantly differed on adult ADOS CSS scores (F (3, 99) = 7.05, $p < .001$); the Independent group had significantly lower ADOS CSS scores in adulthood than the Volunteer ($p < .001$) and No Activities groups ($p = .001$). Finally, the trajectory groups also had significantly different VABS ABC (F (3, 99) = 49.03, $p < .001$) and communication (F (3, 102) = 46.21, $p < .001$), daily living skills (F (3, 102) = 41.43, $p < .001$) and socialization (F (3, 100) = 41.05, $p < .001$) domain AE scores. The Independent group had significantly higher scores on VABS ABC AE scores than the Supported ($p < .001$), Volunteer ($p < .001$), and No Activity ($p < .001$) groups. The Independent Activities group also had significantly higher scores on VABS communication, daily living skills, and socialization AE scores than the Supported ($p < .001$), Volunteer ($p < .001$), or No Activity ($p < .001$) groups. Group contrast results are displayed in Table 4.

Discussion

The current study characterizes vocational activity trajectories in young adults with ASD and illustrates the relative importance of vocational activities to subjective well-being and quality of life outcomes. We identified four distinct trajectories: an Independent Activities trajectory characterized by participation in postsecondary, degree-seeking programs and/or independent community employment, a Supported Activities trajectory characterized by participation in supported and/or sheltered employment, a Volunteer Activities trajectory characterized by participation in volunteer activities or sheltered employment, and a No Activities trajectory characterized by no participation in vocational activities. Contrary to expectations, we found no significant change in the slope of vocational activity trajectories over time, suggesting this sample's engagement in vocational activities was stable. Additionally, we found the Independent Activities group had significantly higher parent-report happiness than the No Activities group and significantly higher self-report happiness than the Volunteer Activities group. Participants in the Independent Activities group were also more likely to have one or more social contacts than participants in the other trajectory groups, however, there were no significant differences in the likelihood of living independently by trajectory group.

The present findings offer a valuable comparison to those of the Taylor et al. (2014) paper. Though Taylor et al. (2014) found a significant negative effect of age on the slope of vocational activity trajectories, the VDI scores of over 80% of participants in their sample did not change at all or changed by only one point during the ten-year study period. Further, the largest decline in VDI scores in the Taylor et al. (2014) sample was seen in female participants. Unfortunately, the limited number of female participants in the current study ($n = 30$) prevented us from examining possible gender differences in detail. Notably, the addition of a score of 10 to the original VDI did not appear to drive the non-significant effect of age on the slope of

vocational trajectories seen in this sample. Several key factors could have contributed to this difference in the current results and the results of the Taylor et al. (2014) paper. First, the age range for this sample is relatively narrow. The age range for participants at the first time point of this study was 18-27 years (SD = 2.76). In contrast, the age range for participants at the first time point of the Taylor et al. (2014) study was 18-52 years (SD = 8.3). It is possible the significant negative effect of age on vocational trajectory slope found by Taylor et al. (2014) was driven predominately by older participants in their sample. In addition, participants in the current study are, on average, about ten years younger than participants in the Taylor et al. (2014) sample. The availability of and access to adult services for individuals with ASD has increased in the last several decades. It is possible participants in the current study utilized adult services at higher rates than individuals in the Taylor et al. (2014) study, and that this bolstered their ability to engage in vocational activities consistently in young adulthood.

The trajectories analysis showed vocational status at age 18 is a strong indicator of vocational outcomes across adulthood. These data may support prior findings indicating the importance of early and targeted services for employment success amongst transition-aged youth. Those adults who were engaged in supported or independent activities at age 18 sustained those activities, therefore, continued efforts to move more transition-aged youth towards these positive outcomes through early, and intensive, vocational programs appear warranted. Although it is promising those in the Independent Activities group maintained their employment, it should be noted that those in the Supported Activities, Volunteer and No Activities groups did not improve their vocational outcomes during early adulthood. Continued efforts to support young adults in transitioning towards more appropriate and independent vocational activities is warranted.

The number of adults with ASD seeking traditional Vocational Rehabilitation (VR) services has increased over time, though the benefits of accessing VR services across key outcomes, such as achieving competitive employment and wages, appear mixed (Burgess & Cimera, 2014). This indicates the intensity, type, or timing of employment supports may need adjustment. These services may begin too late; one study found states that initiate transition services at age 14, compared to those who start at age 16, had better employment outcomes on average and spent less on services for participants to achieve those outcomes (Cimera et al., 2013). More intensive and targeted approaches may also be needed. For example, there is evidence Project SEARCH for autism can improve the likelihood of employment in young adults (Wehman et al., 2013; Wehman et al., 2019). The mechanisms by which Project SEARCH leads to improved employment outcomes have not been systematically evaluated, however, the 9-month, 35-hour per week, program relies on personalized vocational training, targeted internships and transition supports, and traditional direct instruction of employment related tasks to prepare individuals for the job market (Wehman et al., 2019).

Although there were differences in IQ when contrasting the Independent, Volunteer and No Activities groups, on average, full-scale adult IQ was not a significant predictor of VDI scores. This is further evidence that IQ is not a direct corollary to positive adult outcomes (Alvares et al., 2019; Pickles et al., 2020). Intellectual disability does not preclude people from working. Conversely, average intellectual functioning is not a guarantee of obtaining and maintaining employment. Some specific risk factors for average cognitive ability individuals failing to obtain or maintain employment include gender, parental education, and maladaptive social skills (Taylor et al., 2015). Additional vocational supports are needed for all individuals on the autism spectrum, both with and without intellectual disability. Additionally, it is important

to consider, and develop targeted employment solutions for, individuals with additional risk factors (e.g. gender) that may compound difficulties obtaining and maintaining employment above and beyond having ASD.

Contrary to our hypothesis, the subjective well-being of participants in this sample significantly differed across vocational trajectory groups. Specifically, parent-report data indicated individuals in the Independent Activities group had higher happiness factor scores than individuals in the No Activities group. Self-report data indicated individuals in the Independent Activities group had higher happiness factor scores than those in the Volunteer Activities group. Due to the range of ability levels represented in this sample, self-report happiness factor scores were not available for any individuals in the No Activities group and were only available for a small portion of individuals in the Volunteer and Supported Activities groups. The finding that only participants with normative levels of vocational engagement and participants with no vocational engagement significantly differed in their parent-report happiness factor scores suggests that *any* participation in vocational activities may bolster the subjective well-being of adults with ASD. Notably, there was great variability in both the parent- and self-report happiness factor scores (Table 4). This seems to support prior findings (Hedley et al., 2019) suggesting that the relationship between vocational activities and subjective well-being in adults with ASD may be less direct than the relationship between these two factors seen in typical adults, though further work is needed to confirm this.

Participants in the Independent Activities group were significantly more likely to have at least one social contact; however, there was no difference in the likelihood of living independently across the vocational trajectory groups. Participants in the Independent Activities group are, on average, spending more time in employment or post-secondary education settings

than participants in the other trajectory groups. Thus, it seems likely these individuals would have increased opportunities to engage with members of their community and establish new social contacts. The null finding for the likelihood of living independently may be partially driven by the fact that even typical young adults are likely to live with their caregivers into their twenties. Data from the Pew Research Center indicates that as of February 2020, 47% of Americans aged 18-29 were living with a parent (Fry et al., 2020). In comparison, 57% of the current sample lived either with family or in a supported setting (i.e., group home). Work with older samples of adults with ASD is needed to determine if the relationship between vocational activities and the likelihood of living independently changes in middle and later adulthood.

Limitations

This sample, initially evaluated in the early 1990's and since followed longitudinally, comprises a unique and relatively small group of adults with ASD. These participants' families sought help very early in childhood during an era in which ASD services were much less available than they are today. Thus, the participants in this sample may be meaningfully different from individuals diagnosed later in development. Also, attrition has reduced the number of African American participants and participants with low caregiver education in this longitudinal cohort.

In addition, the participants without ASD were significantly more likely to participate in vocational activities than participants with ASD. This may suggest that ASD poses unique challenges to obtaining and maintaining vocational activities in adulthood beyond those experienced by individuals with other neurodevelopmental conditions. However, regardless of diagnostic category, adults with neurodevelopmental disorders encounter considerable difficulty

in young adulthood (Clarke et al., 2020; Lord et al., 2020). Future research should continue to compare the outcomes of adults with ASD and other developmental conditions.

Future Directions

The focus of the current manuscript was on the early adulthood period between 18 and 30 years old; more work is needed to determine whether the identified trajectories carry through to middle and late adulthood. This is especially important given there is evidence that the vocational trajectories of individuals older than 30 may decline over time (Taylor et al., 2014). Prospectively monitoring how factors like gender and types of interventions and supports received affect long-term trajectories remains important. The trends towards differences between trajectory groups seen in the current sample (i.e., non-significant but notable increases in the independent group and decreases in the supported group), indicate potentially meaningful variability amongst adults with ASD across these groups and so deserve attention in future work.

As increasing numbers of individuals with ASD pursue secondary education, variations in the demands of post-secondary education and vocational activities for individuals with ASD should be explored (Elias & White, 2018). Future work should examine the specific predictors and impacts of participation in post-secondary education, both independent of and in addition to vocational activities, whenever possible.

Further, there has been little work examining measures of subjective well-being of adults on the spectrum. The evaluation of the success of systems of support and vocational programs for adults on the spectrum is dependent on improving both objective and subjective markers of positive outcomes. Continued validation and evaluation of current measures of subjective well-being and the development of new measures is critical to accurately capture this important construct. This could include validating the factor structure of the happiness measure used in this

study (e.g. McCauley et al., 2020) through confirmatory factor analyses in independent samples, exploring ways to combine self-report and parent report measures of well-being, and further work identifying appropriate measures of subjective well-being in those adults without verbal language.

Conclusions

Vocational activities are a key component of normative adulthood and a predictor of subjective well-being in typical adults. However, the relationship between vocational activities and well-being in adults with ASD has not been previously examined. This study characterized trajectories of vocational activities and specifically investigated the relationship between vocational trajectories and subjective well-being in young adults with ASD and other neurodevelopmental disorders. We identified four distinct vocational activity trajectories. The slope of vocational activity trajectoires in all four groups was stable—in other words, participants' vocational activities did not significantly increase or decrease with age. Lastly, we found participants who engaged in independent vocational activities had higher parent- and self-reported ratings of subjective well-being and were more likely to have social contacts than participants who did not engage in vocational activites or engaged only in volunteer activities. However, there were no significant differences in the likelihood of living independetly by vocational trajectory group. Future studies should assess possible changes in vocational activity engagement in later adulthood, and identify earlier intervention targets to increase the likelihood that young adults with ASD obtain and maintain engagement in vocational activities.

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Figure 1. Vocational Activity Trajectories from Ages 18-28

Legend: The No Activities trajectory group, characterized by little or no participation in vocational activities, comprised 22.7% of the sample. The Volunteer Activities group, characterized by participation in volunteer activities or sheltered employment for 10 hours a week or less, comprised 29.2% of the sample, the Supported Activities group, characterized by participation in supported community employment and/or sheltered employment for more than 10 hours per week, comprised 19.8% of the sample. The Independent Activities group, characterized by participation in postsecondary, degree-seeking educational programs and/or independent community employment for more than 10 hours per week, comprised 28.3% of the sample. The slope of all four groups was linear.

Table 1. Descriptive Characteristics for the Current Subsample and Total Sample

		Current Subsample ($n = 151$)	Total Sample (N = 253)	
Participant Race	White	120	179	$X^2(4, 253) = 18.34, p = .001$
	Non-White	31	74	
Participant Gender	Male	121	203	$X^2(1, 253) = 0.01, p = .91$
	Female	30	50	
Caregiver Education	< Four-year degree	122	189	$X^2(1, 253) = 7.35, p = .007$
	≥ Four-year degree	29	64	
First Non-Verbal IQ[a]	M(SD)	71.14 (24.31)	69.65 (23.09)	$t(242) = 1.23, p = .21$
First Verbal IQ[a]	M(SD)	46.20 (29.52)	44.71 (28.63)	$t(242) = .40, p = .32$
Most Recent Non-Verbal IQ[b]	M(SD)	62.71 (40.28)	63.23 (40.40)	$t(125) = .39, p = .69$
Most Recent Verbal IQ[b]	M(SD)	63.76 (43.97)	63.54 (42.75)	$t(147) = .15, p = .88$
First ADOS CSS Score[a]	M(SD)	6.82 (2.89)	7.08 (2.96)	$t(203) = .61, p = .53$
Most Recent ADOS CSS Score[b]	M(SD)	5.35 (2.76)	5.70 (2.56)	$t(127) = .48, p = .62$

[a]First IQ and ADOS Calibrated Severity Scores (CSS) were collected at the first time point participants were seen as part of this study (M = 2.38 years, SD = 0.43). All participants were administered the Mullen Scales of Early Learning [30] at this time point.
[b]Most Recent IQ and ADOS CSS were collected at the most recent time point participants were seen as part of this study (M = 25.76 years, SD = 2.40). IQ assessments administered at this time were chosen from a standard hierarchy of assessments that varied with participants' level of ability (see Anderson et al., 2014 for a detailed description of this hierarchy).

Table 2. Vocational Activity Trajectory Model Selection

Model	BIC	Smallest Group %
2 Class Model	-778.77	46.0
3 Class Model	-765.03	24.1
4 Class Model	**-759.49**	**19.8**
5 Class Model	-763.55	6.6

Note: Final model selected in bold

Table 3. Descriptive & Psychosocial Characteristics by Vocational Trajectory Groups

		Total	No Activities		Volunteer Activities		Supported Activities		Independent Activities			
		N = 120	n = 29		n = 35		n = 22		n = 34			
		n(%)	ASD	Non-ASD	ASD	Non-ASD	ASD	Non-ASD	ASD	Non-ASD	X^2 (df,N)	p
			n = 29	n = 0	n = 30	n = 5	n = 15	n = 7	n = 27	n = 7		
Gender	Male	99 (82.5)	24	--	23	3	15	2	26	6	5.23(3,120)	0.15
	Female	21 (17.5)	5	--	7	2	0	5	1	1		
Ethnicity	Non-Hispanic/Latino	116 (96.7)	29	--	29	5	14	7	25	7	2.87(3,119)	0.41
	Hispanic/Latino	3 (2.5)	0	--	1	0	0	0	2	0		
Race	White	100 (83.3)	22	--	23	5	15	6	23	6	12.55(9,120)	0.18
	Non-White	20 (16.7)	7	--	7	0	0	1	4	1		
Recruitment Site	North Carolina	57 (47.5)	16	--	13	4	6	5	10	3	9.30(6,120)	0.15
	Illinois	47 (39.2)	12	--	15	0	5	0	14	1		
	Michigan	16 (13.3)	1	--	5	1	4	2	3	3		
Caregiver Education	< Four-year degree	20 (16.7)	5	--	4	3	2	1	3	2	0.52(3,120)	0.91
	≥ Four-year degree	100 (83.3)	24	--	26	2	13	6	24	5		
Social Contact	One or More	59 (50.0)	7	--	16	3	7	5	16	5	10.54(3,118)	**0.01**
	None	59 (50.0)	22	--	13	2	7	2	11	2		
Living Circumstances	Independent	51 (42.5)	10	--	13	1	5	5	14	3	1.71(3,120)	0.63
	Supported	69 (57.5)	19	--	17	4	10	2	13	4		

Table 4. Behavioral and Psychosocial Characteristics by Vocational Trajectory Groups

		No Activities		Volunteer Activities		Supported Activities		Independent Activities				
		n	m(SD)	n	m(SD)	n	m(SD)	n	m(SD)	F	df,N	p
Childhood IQ	Verbal	29	29.48(15.32)[a]	35	37.74(22.20)[a,b]	22	51.86(24.78)[b,c]	34	43.54(26.96)[c]	7.34	3,116	<.001
	Nonverbal	29	62.20(21.96)[a]	35	61.40(22.94)[a]	22	77.04(21.45)[a,b]	34	83.61(20.34)[b]	8.25	3,116	<.001
Adulthood IQ	Verbal	27	25.88(30.20)[a]	30	42.23(31.16)[a]	22	66.04(40.27)[b]	31	106.16(24.38)[c]	36.64	3,106	<.001
	Nonverbal	27	37.44(30.80)[a]	30	43.10(29.48)[a]	22	67.81(37.67)[b]	30	106.60(13.10)[c]	35.92	3,105	<.001
VABS Age Equivalence Score	ABC	24	4.27(2.57)[a]	29	7.08(3.43)[b]	20	10.70(5.05)[c]	27	15.68(3.16)[d]	49.03	3,96	<.001
	Com	26	3.96(2.80)[a]	30	6.59(3.98)[a]	20	10.61(5.66)[b]	27	16.05(3.50)[c]	46.21	3,99	<.001
	DLS	26	5.73(3.03)[a]	30	8.24(3.81)[a]	20	11.64(4.87)[b]	27	16.08(2.60)[c]	41.43	3,99	<.001
	Soc	25	2.64(2.38)[a]	29	6.01(3.64)[b]	20	9.83(5.44)[c]	27	14.92(4.98)[d]	41.05	3,97	<.001
ADOS CSS Score	Childhood	28	7.71(2.71)[a]	31	7.09(2.46)[a]	16	5.56(3.79)[a]	27	6.62(2.60)[a]	2.12	3,98	.102
	Adulthood	24	6.37(2.90)[a]	29	6.44(2.19)[a]	20	5.35(2.62)[a,b]	27	3.74(2.17)[b]	7.05	3,96	<.001
Happiness Quotient	Parent-report	25	-0.21(0.75)[a]	21	0.02(0.84)[a,b]	34	-0.12(0.73)[a,b]	28	0.43(0.76)[b]	3.56	3,107	.017
	Self-report	0	_—	5	-0.85(1.26)[a]	9	-0.24(0.65)[a,b]	24	0.36(0.65)[b]	6.46	2,35	.004

[a,b,c,d] For each characteristic, mean values without common superscripts are significantly different ($p < .05$).

Table 5. Multilevel Model of Rates of Change in Vocational Activity Trajectories from 18-28

VDI Score (N = 106)		Coefficient	SE	95% Confidence Interval	
Participant Age		.009	.03	-.05	.07
Trajectory Group	Volunteer Activities	1.45*	.27	.93	1.97
	Supported Activities	5.40*	.31	4.79	6.01
	Independent Activities	7.81*	.39	7.05	8.58
Race covariate		-.40	.23	-.86	.06
Adult IQ covariate		.50	.27	-.03	1.04
Caregiver Education covariate		.18	.25	-.31	.66
ADOS CSS covariate		-.002	.04	-.08	.08

Note. The reference group for trajectory group is No Activities, the reference group for Caregiver education is < a 4-year degree.
* $p < .05$