The Experiences of College Students on the Autism Spectrum: A Comparison to their Neurotypical Peers

This study describes the academic, social, and health experiences of college students on the autism spectrum as they compare to students with other disabilities and their non-disabled, neurotypical peers. Data were from an online survey of college students at 14 public institutions (N=3073). There were few significant differences between students on the spectrum and students with other disabilities. Both groups of students reported significantly worse outcomes than neurotypical students on academic performance, social relationships and bullying, and physical and mental health. The findings suggest that some of the challenges students on the spectrum face in college result from the stigma and social rejection associated with disability rather than from the unique characteristics of autism.

The Experiences of College Students on the Autism Spectrum: A Comparison to their Peers

Young adults with autism spectrum disorders (ASD) increasingly identify college graduation as a goal but graduate from college at lower rates than their neurotypical peers (Anderson, McDonald, Edsall, Smith, and Taylor 2016; Gotham et al. 2015; Liptak, Kennedy, and Dosa 2011; Sanford et al. 2011; Shattuck et al. 2012; Wehman et al. 2014a). Despite growing scholarly interest in the reasons why students on the spectrum struggle in college, the evidence base remains sparse (Gelbar, Smith, and Reichow 2014). To facilitate successful transitions to adulthood for this population of youth, we need more comprehensive information about the unique challenges they face during the college years.

Gaining a better understanding of this population takes on heightened importance in light of evidence that a college education is increasingly necessary to secure high-quality employment in the United States (Hout 2012; Julian 2011). Rates of employment for young adults on the spectrum are dramatically lower than those for young adults with other disabilities and nondisabled adults (Barneveld et al. 2014; Roux et al. 2013; Shattuck et al. 2012; Taylor and Seltzer 2011). For example, according to data from the National Longitudinal Transition Study-2 (Roux et al. 2013), only about one-half of young adults (53.4%) with an autism spectrum disorder had ever been employed after high school—a much lower percentage than observed for young adults with emotional disturbance (88.2%), learning disability (89.8%), and speech-language impairment (88.2%). Among those who were employed, young adults with an autism spectrum disorder also worked fewer hours, in a narrower range of jobs, and earned less than young adults with other disabilities. Although a college education does not ensure high-quality employment for young adults on the spectrum (Holwerda et al. 2012), it does increase the

probability (Hendrickson et al. 2013; see Walsh, Lydon, and Healy 2014 for a review). Moreover, employment facilitates independent living and also enhances quality of life, cognitive functioning, and well-being (Barneveld et al. 2014; Walsh et al. 2014).

Clinical and counseling researchers have identified a range of potential challenges for college students on the autism spectrum. These include trouble adjusting to new situations and larger class sizes, poor self-advocacy skills, poor executive function, comorbid depression and anxiety, and problems with social interactions, among others (e.g., Dente and Coles 2012; Dipeolu, Storlie, and Johnson 2014; Lawrence, Alleckson, and Bjorklund 2010; Longtin 2014; McKeon, Alpern, and Zager 2013; White, Ollendick, and Bray 2011). New forms of institutional support have been recommended, such as campus-based summer transition programming, single room housing, counseling services, universal design, social communication supports, peer mentors, and academic accommodations (Hendricks and Wehman 2009; Lawrence et al. 2010; Longtin 2014; Lucas and James 2018; Pinder-Amaker 2014; White et al. 2017; Zager and Alpern 2010). However, evidence regarding the prevalence and efficacy of these supports is limited (Volkmar, Reichow, and McPartland 2014; see Gelbar et al. 2014 for a review).

Within this burgeoning literature, relatively few studies have collected information from college students themselves. Evidence about the college experiences of students on the autism spectrum comes from two primary sources: (1) the National Longitudinal Transition Study (NLTS-2) and (2) smaller, non-representative surveys and interview studies of adults on the autism spectrum. The NLTS-2 provides a nationally-representative sample of youth who received special education services, recruited initially when the youth were in middle or high school (e.g., Newman et al. 2011; Sanford et al. 2011). Data from the NLTS-2 confirm that youth on the autism spectrum have higher rates of non-participation in employment, vocational

education, or college than young adults with other disabilities (Shattuck et al. 2012). Specifically, 35% of young adults on the autism spectrum were defined as “not participating” compared to young adults with mental retardation (25.6%), speech and language impairment (7.4%) and learning disabilities (3.0%).. Youth on the spectrum are less likely to enroll in college than youth with other intellectual disabilities, and students on the spectrum who do enroll college enroll disproportionately in community colleges rather than 4-year institutions (Wei et al. 2014).

Two key limitations of the NLTS-2 justify additional research on this topic: (1) all of the respondents to that survey had some type of disability, leaving open the question of how students with autism differ from their non-disabled peers, and (2) the survey includes limited information on students’ perceptions of the college experience. The NLTS-2 research team has addressed the first limitation through comparisons with other national data on comparably-aged youth (e.g., with the National Longitudinal Surveys of Youth; Sanford et al. 2011) but those comparisons are restricted to outcomes that are measured consistently across studies.

First-hand accounts of college students on the spectrum complement the NLTS-2 by incorporating a broader range of college experiences. However, few such studies have been conducted and are, for the most part, based on small, non-representative samples. In their review of relevant research, Gelbar and colleagues (2014) identified only 20 studies of college students on the autism spectrum, of which the majority were case studies. Students in these studies reported receiving a range of institutional accommodations including extra time on exams, separate exam locations, alternatives to group projects, as well as non-academic supports including peer mentorship programs and cognitive behavioral therapy. They also reported high levels of anxiety, loneliness, depression, and peer rejection. Subsequent studies confirm that students on the spectrum are often able to maintain strong academic records despite having

trouble focusing on lectures and using time effectively (Gelbar, Schefcyk, and Reichow 2015). These studies also highlight the need for better transition planning (Anderson and Butt 2017) and identify strategies that students on the spectrum can adopt to be successful in college (e.g., disclosing to school staff when accommodations are needed but only disclosing to peers when circumstances require it; Anderson and Butt 2017; Cox et al. 2017). However, because those studies use non-representative samples, we cannot be sure whether the results generalize.

Surveys of college students have the potential to address both sets of limitations by incorporating a broad range of measures, representative samples, and comparison samples of neurotypical peers. More recent studies have taken important steps in this direction. White and colleagues (2011) conducted a survey of college students at a single institution, identified students on the spectrum, and compared outcomes based on autism status. Of the 667 survey participants, only 13 scored above the clinical threshold for autism based on the Autism Spectrum Quotient (AQ; Baron-Cohen, Wheelwright, Skinner, Martin, and Clubley 2001). Relative to a random comparison group of students with low AQ scores, those who had high AQ scores had higher levels of social anxiety and verbal (but not physical) aggression (e.g., getting into arguments), and lower satisfaction with college and with life.

Because it can be difficult to identify a large sample of students on the spectrum through a random survey, Trevisan and Birmingham (2015) administered the Broad Autism Phenotype Questionnaire (Hurley, Losh, Parlier, Reznick, and Piven 2007) to a sample of 135 college students at Simon Fraser University. The 18 students who scored above the threshold for broad autism phenotype reported significantly lower levels of academic and social adjustment, and marginally lower levels of personal-emotional adjustment, than a matched sample of students who scored below the threshold. Continuous measures of autism symptoms and behaviors,

especially pragmatic language difficulties, were also negatively associated with adjustment in the full sample.

Most recently, Jackson and colleagues (2018) presented results from a national, online survey of college students with an autism diagnosis (N=56). Their respondents reported satisfaction with their academic and social lives but also high rates of depression (35.7%), social anxiety (33.9%), loneliness (75%), and past-year suicidal ideation (53.6%). Similarly, in an online survey of college students on the spectrum in Australia, students on the spectrum reported high levels of depression (47.8%), anxiety (65.2%), sleep problems, loneliness, and sensory challenges, and low levels of services utilization (Anderson, Carter, and Stephenson 2018). Although neither study included a comparison group, other national studies of college-youth provide a basis for comparison. The 2008 National College Health Assessment reported that more than one in three undergraduates reported depression that interfered with daily functioning (American College Health Association 2008). According to the Healthy Minds Study, which included random samples of college students at 26 colleges and universities, 17% of college students screened positive for depression and 10% for anxiety (Hunt and Eisenberg 2010). A separate study of 26,000 college students in 2006 found that 6% reported past-year suicidal ideation (Drum et al. 2009). Even allowing for variation in measurement across studies, these studies suggest much higher rates of mental health problems among students on the spectrum as compared to their neurotypical peers.

The current study is part of a larger project concerned with the association of autism with academic, social, and health outcomes in college populations. The project staff collected data from college students at 14 institutions through an online survey. The project staff also conducted in-depth interviews with a subsample of survey respondents on the spectrum and their

parents, and completed telephone interviews with disability services coordinators from the participating campuses. This research uses only data from the survey.

The study's aim is to compare the experiences of college students on the autism spectrum to students with other disabilities and to their non-disabled, neurotypical peers. We incorporate comparisons to students with other disabilities in order to identify experiences that are unique to students on the spectrum and those that are common to students with a range of disabilities. The study includes a broad range of outcomes in order to look beyond graduation rates and satisfaction to consider other indicators of adjustment. In particular, several key predictors of academic success—including academic engagement, social integration, and peer relationships—are frequently referenced as critical challenges for students on the spectrum (e.g., Anderson and Butt 2017; Cox et al. 2017; Dente and Coles 2012) but infrequently measured in representative samples. These outcomes are important in their own right but also as they affect distal outcomes such as graduation (Astin 1999; Tinto 1998).

The study accounts for demographic and student characteristics that may differ by autism/disability status and that are associated with the outcomes—something that most previous studies have been unable to do. If students on the spectrum or students with disabilities differ from their non-disabled, neurotypical peers in age, socioeconomic status, full-time/part-time student status, or other characteristics, any observed differences in outcomes based on autism/disability status could reflect differences in these characteristics. By controlling for a wide range of demographic and student characteristics, this study bolsters confidence that any observed differences in outcomes are not attributable to confounding. Supplementary analyses consider whether the associations of autism and other disabilities with outcomes vary based on enrollment in 2-year v. 4-year institutions based on prior evidence regarding the differences in

student experiences across institution types (Zapata-Geitl et al. 2016) and the disproportionate enrollment of students on the spectrum in the former (Powers et al. 2008; Taylor, Henninger, and Mailick 2015; Wei et al. 2014).

METHODS

Procedure

An online survey was fielded over an eight-week period in spring of 2017. The survey was programmed in Qualtrics and implemented by the Center for Survey Research at Indiana University. After receiving the survey link, participants reviewed the informed consent document and consented to participate before beginning the survey. Participants answered a series of questions related to their college experiences, including prior educational background, motivations for attending college, academic challenges, course-taking and classroom behaviors, feelings of belonging, social relationships, and health. Participants who reported any of a series of conditions (autism, sensory or mobility impairments, learning disabilities, a mental health disorder) answered an additional question series on disability accommodations. Participants who reported a diagnosis of autism also answered questions on disclosure and autism identity. The median length of time for survey completion was about 20 minutes.

Participants

All public 2-year and 4-year post-secondary institutions in Indiana were invited to participate in the study (N=26).[1] In all, 14 institutions participated including six of eleven regions of the statewide community college system. Participating institutions vary in their selectivity and size, with total undergraduate student populations ranging from approximately 3,000 to 30,000. Each participating institution was asked to contribute two samples of students: (1) all students who were currently registered for disability accommodations based on autism (the “registered”

sample) and (2) a probability sample of currently-enrolled, degree-seeking undergraduate students (the "general sample"). All participating institutions agreed to provide a registered sample. Ten institutions also provided a general sample. The general samples allowed us to capture students who had been diagnosed on the autism spectrum but who were not registered for accommodations, and to compare students on the spectrum to their neurotypical peers.

The two samples were recruited using different procedures. With one exception, institutions sent recruitment emails to registered students on our behalf. Each email included an anonymized link to the survey. The Center for Survey Research sent invitations directly to students in the general sample with personalized messages and personalized survey links. The initial invitation was followed by two reminder messages, sent roughly 7-10 days later. In the early stages of the survey, participants in the general sample were offered a $5 gift card and entry into a drawing for $500 to complete the survey; participants in the registered sample were offered a $10 gift card and the same drawing entry. In order to increase response rates, the respondent incentives were increased to $10 and $20, respectively, at the second and third invitations. Informed consent was obtained from all individual participants included in the study.

In total, 3216 students completed the survey, of whom 78 were in the registered sample. An additional 22 students from the general sample reported an autism diagnosis, yielding a total sample of 100 students on the autism spectrum. Using AAPOR's Response Rate 1 (the "minimum response rate,"[2] American Association for Public Opinion Research 2016), the response rate for the general sample was about 14%, with response rates for individual institutions ranging from 6.32% to 25.45%. The response rate for the registered sample was about 15%, with response rates for individual institutions ranging from 1.10% to 31.71%. The overall cooperation rate was roughly 87%, meaning that 87% of the students who opened the

recruitment email and clicked on the survey link went on to complete the survey.

Measures

Autism/Disability Status

For purposes of the analysis, participants were categorized into one of three mutually exclusive groups: on the spectrum; disabled; non-disabled, neurotypical. Participants were defined as "on the spectrum" if they were in the registered sample or if they reported having ever received a diagnosis of an autism spectrum disorder. Participants were defined as having a disability if they were not "on the spectrum" but did report having ever received any of the following classes of diagnoses: a sensory impairment (vision or hearing), a mobility impairment, a learning disability (e.g., ADHD, dyslexia), a mental health disorder, or a disability of impairment not listed. All other participants were defined as "neurotypical, non-disabled." For the sake of concision, the label "neurotypical" is used for the latter group. All analyses were re-run using two alternative definitions of "on the spectrum": (1) member of the registered sample whether or not reported a diagnosis; or (2) reported an autism spectrum diagnosis whether or not a member of the registered sample. Conclusions did not change.

Outcomes

The analysis considers three sets of outcomes: academic, social, and health. Most measures were drawn from existing studies of college life, including the National Survey of Student Engagement (NSSE; Kuh 2008) and the National Longitudinal Study of Adolescent to Adult Health (Add Health; Harris and Udry 2018). All items were self-reported.

The academic domain covers academic success, challenges, and engagement. All items in this domain were drawn from the NSSE and have demonstrated reliability and validity (National Survey of Student Engagement nd.). The measures of academic success include self-reported

grade point average (GPA), and whether the participant had failed a course or taken a remedial course at their current institution. We analyzed each outcome separately. The measure of academic challenges was based on a 7-question series on specific challenges (e.g., difficulty learning course material or difficulty managing time; on a 1 to 4 scale from “not at all” to “very” difficult). We calculated the average value across the items. The measures for college engagement incorporated indicators of academic engagement (3 binary items; e.g., “asked questions during class or contributed to course discussions in other ways,”), collaborative learning (2 binary items; e.g., “explained course material to one or more students”), and student-faculty interaction (4 binary items; e.g., “talked about career plans with a faculty member,” “worked with a faculty member on activities other than coursework”). Sums were calculated for each engagement area. Given the importance of internship experience to job market entry (Nunley et al. 2017), we also asked students “which of the following you have done or plan to do prior to graduation,” one option for which was “participate in an internship, co-op, field experience, student teaching, or clinical placement.” Students who reported doing that now or having done that in the past were coded 1, with those who reported planning to do that or not planning to do that coded 0.

The social domain encompasses feelings of belonging on campus as well as the quantity and quality of social relationships. Feelings of belonging were measured with two items (rated from 1=strongly disagree to 4=strongly agree): “I see myself as part of the campus community” and “I feel valued at this institution,” drawn from the Wabash National Study of Liberal Arts Education Student Experiences Survey (Blaich and Wise 2011), averaged for purposes of the analysis. The quality of social relationships was measured in two different ways. The first measure was the average value of a 4-item scale (also rated from 1 to 4) including items such as

"The student friendships I have developed at this institution have been personally satisfying," also from the Wabash study (Blaich and Wise 2011). The second measure was a binary variable based on respondent reports of whether they have a confidant—"anyone they can really open up to about your most private feelings without having to hold them back"—or a steady romantic relationship with someone at their institution, based on an item from the National Comorbidity Survey (Kessler et al. 2004). The latter was asked only of participants not currently married or living with someone in a marriage-like relationship.

In addition to these standard indicators of social relationships, two additional measures were developed for this study: bullying and feelings of difference. Elementary, middle school, and high school students with disabilities report being bullied at higher rates than their nondisabled peers (Blake, Lund, Zhou, Kwok, and Benz 2012). We wondered whether bullying would continue in college settings. Bullying was measured by three separate questions asking whether participants had ever been "physically bullied" or "verbally bullied" by other students at their current institution or whether other students had "ever told lies or nasty rumors about you, or deliberately excluded you from social groups or activities" (Schafer et al. 2004). To measure feelings of difference, participants were asked "do you often feel that you are different from other students at your institution?" Responses were coded as 1 for yes, and 0 for no.

The health domain covered physical and mental health. Participants rated their "overall physical health" and "overall mental health" on separate 5-point scales from "poor" to "excellent." Self-ratings of physical and mental health predict future morbidity and mortality, independent of objective health (Idler and Benyamin 1997; McAlpine, McCreedy, and Alang 2018). To assess depression, the survey included a subset of items from the Center for Epidemiologic Studies-Depression Scale (Radloff 1977) that have been shown to be racially-

invariant (Perreira, Deeb-Sossa, Harris, and Bollen 2005) and, to assess generalized anxiety, the Mini-SPIN (Connor, Kobak, Churchill, Katzelnick, and Davidson 2001). Mean item values were computed for respondents who reported at least half of the items in each scale. Participants also reported how often they feel sleep deprived (4-point scale from "never" to "often") and how often, in a typical week, they "have 5 or more drinks in one setting" (5-point scale from 0 times to 5 or more times). We treat the latter as a rough indicator of binge drinking.[3]

Demographic and Student Characteristics

Students responded to questions about several demographic characteristics, including their current age (calculated from birthdate), race/ethnicity (Asian, Black or African American, Hispanic or Latino, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, White, Other), gender identity (man, woman, intersex, transgender, other), sexual identity (heterosexual/straight, gay, lesbian, bisexual, queer, asexual, questioning or unsure, other), marital status (married, separated, divorced, widowed, never married), and parents' highest level of education (coded here as dichotomy: less than a BA, or BA or higher). Small racial/ethnic categories were combined into the "other" category; participants with multiple racial identities were coded as such. For gender identity, the intersex, transgender, and other categories were combined. For sexual identity, queer, asexual, and questioning were combined with the "other" category. Students also reported their domestic/international student status, year in school, and full-time/part-time student status.

Analyses

Upon initial review of the data, 11 duplicate cases were discovered in the registered sample. The cases were judged duplicates based on a combination of respondents' IP addresses and responses to select questions, beginning with birthdate. In these cases, we retained either the response with

the least missing data, the response that was completed first, or, if unable to select based on these criteria, a randomly-selected duplicate. Several variables had missing values with the largest number of missing values being for the items for social relationships and demographics: sets of questions that appeared relatively late in the survey. Our analyses were restricted to respondents who had valid values on all control variables and on autism/disability status (N=3073). To preserve as many cases as possible, separate listwise deletion samples were used for each dependent variable (N=2915 to 3072).

Analyses of variance were used to compare means/proportions on the dependent variables for students on the spectrum (N=95) to those for students with other disabilities (N=804) and their non-disabled, neurotypical peers (N=2174). Bonferroni tests were used for the significance of differences among pairs of groups. Regression models for those differences were then estimated, adding controls for age, race/ethnicity, gender identity, sexual identity, marital status, parents' highest level of education, domestic/international status, year in school, and full-time/part-time student status. The controls adjust for the possibility that autism and disability are associated with outcomes because they are also associated with other student characteristics. Logistic regression models were used for binary outcomes and OLS regression models for all other outcomes. Robust standard errors were estimated to take into account the clustering of students within institutions. Because not all institutions agreed to participate, estimates may not be representative of students at all Indiana public colleges and universities.

RESULTS

Bivariate Associations

The three groups of students differed significantly on several demographic characteristics (Table 1). Students with disabilities were older than neurotypical students, who were also older than

students on the spectrum [F (2, 3070)=10.27, p=.00]. Neurotypical students were more likely to belong to racial/ethnic minority groups than either of the other two groups of students. Parents of students on the spectrum were more likely to have Bachelors degrees or higher than parents of the other groups of students [F (2,3070)=5.45, p=.00]. Consistent with more general diagnostic patterns (Newschaffer et al. 2007), students on the spectrum were much more likely to be male; students with disabilities were less likely than neurotypical students to be male [F (2,3070)=20.91, p=.00]. Although rates of intersex and transgender identities were low in all groups, they were significantly higher for students on the spectrum [F (2,3070)=30.35, p=.00] (deVries et al. 2010). Students with disabilities and students on the spectrum also had higher rates of nonheterosexual identities, including gay/lesbian, bisexual, and other (e.g., asexual). Perhaps not surprisingly, students on the spectrum were less likely than other students to be married [F (2,3070)=4.07, p=.02].

<Table 1 about here>

Students on the spectrum also differed in their statuses as students. They were less likely than neurotypical students to be international students, as were students with disabilities [F (2,3070)=19.64, p=.00] and also less likely to be enrolled full-time [F (2,3070)=7.20, p=.00]. Students with disabilities were significantly more likely to be enrolled in 2-year institutions than neurotypical students [F (2,3070)=4.09, p=.02].

Group differences in outcomes extended into every domain, although were larger and more consistent for social and health outcomes than for academic outcomes. Compared to students with disabilities and students on the spectrum, neurotypical students had higher GPAs [F (2,2911)=14.11, p=.00], were less likely to have failed a course [F (2,3053)=10.93, p=.00] or taken a remedial course [F (2,3053)=14.24, p=.00], and reported fewer academic challenges [F

(2,3067)=20.12, p=.00]. Students on the spectrum engaged in less collaborative learning than neurotypical students [F (2,3065)=3.99, p=.02] but did not differ from other students in levels of academic engagement [F (2,3065) = 1.40, p=.25] or student-faculty interaction [F (2,2995)=0.72, p=.49]. Students on the spectrum were significantly less likely to participate in internships, field placements, and other career-oriented academic experiences than students with other disabilities and neurotypical students [F (2,3064)=4.18, p=.01}.

Students with disabilities reported the lowest levels of belonging, significantly different from neurotypical students [F (2,3057)=8.74, p=.00]. Students with disabilities reported lower quality social relationships than neurotypical students [F (2,3057)=10.04, p=.00]. Students on the spectrum were also significantly less likely than the other two groups of students to report having a confidant or being involved in a romantic relationship [F (2,3061)=13.73, p=.00].

Rates of physical and verbal bullying were higher for students with disabilities than for neurotypical students [F (2,3067)=3.21, p=.040; F (2,3066)=13.22, p=.00, respectively]. Students on the spectrum reported the highest rates of having been the subject of lies, rumors, or other forms of social exclusion although their rates were not significantly different from students with disabilities [F (2,3066)=13.09), p=.00]. Students on the spectrum and students with disabilities were more likely than neurotypical students to report feeling different from other students [F (2,3060)=23.72, p=.00], with students on the spectrum being most likely to report feeling different.

Students on the spectrum and students with disabilities reported poorer health than neurotypical students on most indicators. Their health disadvantage extended to self-reported physical health [F (2,3070)=39.59, p=.00], self-reported mental health [F (2,3068)=132.97), p=.00], depression [F (2,3065)=87.08, p=.00], and anxiety [F (2,3059)=16.69, p=.00]. The two

exceptions were for sleep deprivation and binge drinking. Students with disabilities reported more frequent sleep deprivation than neurotypical students and students on the spectrum [F (2,3069)=10.28, p=.00]. Binge drinking was more common among disabled and neurotypical students than among students on the spectrum [F (2,3065)=4.03, p=.02].

Incorporating Controls

The comparisons to this point do not take into account demographic differences among the three groups of students; nor did they adjust for the clustered sample. Tables 2-4 present the coefficients from regression models predicting academic, social, and health outcomes, respectively. The models include dummy variables for disability status and autism status (the non-disabled, neurotypical category omitted) with controls for demographic characteristics (age, race, gender, sexual identity, marital status, parental education) and indicators of student status (international, full-time, year in school). All models were estimated with robust standard errors that accounted for the clustering of students within institutions.

<Table 2 about here>

For the most part, the associations of autism and disability with the outcomes were unchanged by the addition of controls or the adjusted standard errors. In two cases, previously significant associations became nonsignificant: rates of course failure were no longer significantly higher for students on the spectrum and rates of collaborative learning were no longer significantly lower. In three cases, previously non-significant associations became significant: in the model with controls, students with disabilities reported significantly lower levels of academic engagement than neurotypical students and had significantly higher levels of contact with faculty, and students on the spectrum reported higher levels of verbal bullying. Otherwise, the sign or significance of the associations did not change when controls were added

to the model. These models confirm that, with few exceptions, the associations of autism and other disabilities with college experiences are independent of students' other characteristics.

<Tables 3-4 about here>

We extended our analysis by estimating the associations of autism and disability with outcomes for students in 2- and 4-year institutions separately. Table 5 presents the coefficients for autism and other disabilities from these models; for the sake of concision, coefficients for control variables are not presented.

For the most part, although the significance levels of the coefficients sometimes differ, the signs of the associations are consistent across institution types. For example, the coefficients for GPA are negative for students on the autism spectrum and for students with disabilities in both 2- and 4-year institutions but only the coefficient for students with other disabilities in 4-year institutions is significant. Similarly, students with other disabilities report lower levels of academic engagement regardless of the type of institution they attend but the difference is only significant for students who attend 2-year institutions.

<Table 5 about here>

There are four noteworthy differences in student experiences across institution types, two in the academic domain and two in the social domain. In the academic domain, students on the spectrum who attend 4-year institutions report *higher* levels of engagement than neurotypical students whereas students on the spectrum who attend 2-year institutions report (nonsignificantly) lower levels of engagement. In contrast, students on the spectrum who attend 4-year institutions report *lower* participation in collaborative learning than neurotypical students whereas collaborative learning does not differ for students at 2-year institutions.

In the social domain, students on the spectrum who attend 4-year institutions report higher levels of verbal bullying compared to neurotypical students but the same is not true for students who attend 2-year institutions. At the same time, and surprisingly, students on the spectrum who attend 2-year institutions report higher levels of belonging than their neurotypical peers. With these exceptions, the differences in the experiences of students on the spectrum and with other disabilities relative to those of neurotypical students were comparable across institution types.

DISCUSSION

This study described the experiences of college students on the autism spectrum as they compared to students with other disabilities and their non-disabled, neurotypical peers. Results indicate that students on the spectrum and students with other disabilities differ from neurotypical students in academic, social, and health outcomes. Most of the differences remain significant in the context of comprehensive controls for demographic characteristics and indicators of student status, lending confidence that the observed differences are attributable to students' autism or disability status rather than to confounding variables.

In the academic domain, the most pronounced differences are in measures of academic performance and career-oriented academic opportunities. Students on the spectrum and students with other disabilities both report significantly lower GPAs, higher rates of remedial coursework and course failure, and higher levels of academic challenges than neurotypical students. This is true even though, for the most part, students on the spectrum and students with other disabilities report similar levels of academic engagement: asking questions, preparing for class, and attending class. They are also equally or more likely to have contact with faculty: discussing careers, working together or activities, and working on research. In short, students on the

spectrum are not less engaged with their academic work than other students. Nevertheless, their equal levels of engagement do not translate into equal achievement.

The relatively poor academic performance of students on the spectrum could be attributable to characteristic limitations of autism, such as poor executive function (Longtin 2014; McKeon et al. 2013). However, it could also reflect the structure and expectations of college courses. In many disciplines, courses assign heavy reading loads. Children with autism demonstrate poor reading comprehension relative to neurotypical children (Nation, Clarke, Wright, and Williams 2006); even high-functioning adults with autism have poorer narrative comprehension than neurotypical adults (Mason et al. 2008). Similarly, in some disciplines, written essays and papers are used to assess student learning. Owing to poor executive functioning and compromised perspective taking, students on the spectrum may struggle with written work (Fleury et al. 2014). Group work has also become more central to college courses (National Survey of Student Engagement 2017) which may prove challenging for some students on the spectrum (Roberts 2010). Offering more flexible curricula that incorporate other learning modalities, such as visual learning, could facilitate college success for young adults on the spectrum (Tsatsanis 2004).

Two areas of engagement for which students on the spectrum differ significantly from other students are collaborative learning and career-oriented academic experiences. Students on the spectrum are less likely to participate in collaborative learning—explaining material to other students or asking other students for help—if they attend 4-year institutions. Consistent with the general social skills deficits that accompany autism (Liptak et al. 2011), engaging effectively with fellow students stands out as uniquely challenging for students on the spectrum. Students on the spectrum are also less likely to participate in self-directed career-oriented activities such as

internships and field experiences. Prior research demonstrates that post-secondary education programs that provide intensive skills training and internship placements for high school students on the spectrum are associated with higher rates of employment, and higher quality employment, (Moore and Schelling 2015; Wehman et al. 2014b). Our research highlights the potential value of incorporating some elements of those programs into college career services. More generally, students on the spectrum would benefit from flexible and targeted career assistance that does not rely as extensively on traditional, self-directed career preparation opportunities.

Students on the spectrum and students with disabilities also differ from other students in social outcomes. Both report lower quality social relationships and higher levels of bullying victimization than neurotypical students. These results suggest that the social challenges students on the spectrum face are not solely a result of the interactional deficits associated with autism but also reflect the more general social rejection associated with stigmatized conditions (Link and Phelan 2001). Although many college students struggle to become integrated into the complex social environment of postsecondary institutions, the struggle appears to be especially profound for marginalized students: racial and ethnic minority students, and—as we see here—students on the autism spectrum and with other disabilities (Ancis, Sedlacek, and Mohr 2000; Hewitt 2011; Hurtado and Carter 1997). Our survey did not ask about other forms of victimization, such as sexual assault, which has been reported at higher rates by adults on the autism spectrum (e.g., Brown-Lavoie, Viecili, and Weiss 2014). Recent research indicates that over 23% of undergraduate female college students experience rape or sexual assault during their time at college (Cantor et al. 2017). These high overall rates of sexual assault suggest an area of special risk for students on the spectrum.

Interestingly, and inconsistent with expectation, students on the spectrum report higher levels of belonging than neurotypical students, although only if they attend 2-year institutions. To the extent that feelings of belonging facilitate retention, this finding implies some advantage to students on the spectrum in attending 2-year institutions (Tinto 2006). We wondered whether the relatively high belonging reported by students on the spectrum at 2-year institutions might reflect unusually low levels of belonging overall among students at 2-year institutions. That does not appear to be the case. In supplemental analyses, we confirmed that students on the spectrum who attend 2-year institutions report higher levels of belonging than students on the spectrum who attend 4-year institutions ($\overline{X}$=3.06 v. $\overline{X}$=2.87, respectively) whereas levels of belonging for neurotypical students are similar across institution types ($\overline{X}$=2.88 at 2-year institutions and $\overline{X}$ =2.99 at 4-year institutions).

With the data available to us, we cannot determine why students on the spectrum report higher levels of belonging at 2-year institutions. Students on the spectrum may find the vocational/career orientation of 2-year institutions a better match to their educational goals than the more abstract educational orientation of 4-year liberal arts institutions. In addition, because 2-year institutions typically do not offer on-campus housing or campus-oriented social activities, students on the spectrum may experience less pressure to engage in social life at 2-year institutions. More generally, students on the spectrum may feel less intimidated by the academic culture at 2-year institutions given the predominance of nontraditional (older, enrolled part-time, living with family) and disadvantaged (low-income, poor high school performance) students (Deil-Amen 2015). More research is needed on the how the structural and cultural characteristics of different institution types align with the unique needs and interests of students on the spectrum.

Despite the higher levels of belonging reported by students on the spectrum at 2-year institutions, they—and students on the spectrum and with disabilities at both institution types—reported lower quality social relationships and/or were less likely to have a confidant, and were more likely to have experienced bullying from other students. Addressing the social challenges that students on the spectrum experience will require institutions to adopt a multi-pronged approach, some of which are directed to students on the spectrum and some of which are directed to the broader student population (Barnhill 2016). With respect to the former, social skills and communication training programs (Lorenc et al. 2018; Weiss and Rohland 2015), peer mentoring programs (Andreon and Durocher 2007; Hart, Grigal, & Weir 2010; Longtin 2014), and tailored social activities (Ashbaugh et al. 2017; Wheeler 2005) can help students on the spectrum adjust to the social expectations of college campuses and offer a respite from socially challenging environments. At the same time, anti-stigma campaigns that educate the general student population about autism and disabilities may reduce the need for autism-specific programming inasmuch as anti-stigma campaigns increase knowledge about autism and reduce the desire for social distance (Gillespie-Lynch et al. 2015; Matthews, Ly, and Goldberg 2015). Given the growing number of students on the spectrum enrolling in college (VanBergeijk, Klin, and Volkmar 2008), the need for such programs is intensifying.

Overall, students on the spectrum and students with other disabilities report poorer physical and mental health than neurotypical students. Some of the differences in health likely reflect the specific nature of their disabling conditions. For example, given the mental health comorbidities associated with autism (Rosenberg, Kauffman, Law, and Law 2011), it is not surprising to find that students on the spectrum report higher levels of depressed mood and anxiety than neurotypical students. Moreover, people with disabilities experience significant

health disparities in general population samples (Henderson 2001; Reichard, Stolzle, and Fox 2011). Yet, inasmuch as self-rated physical and mental health represent more global assessments of well-being (Idler and Benyamini 1997; McAlpine et al. 2018), the poor health our respondents reported warrants further attention. Institutions should consider targeted interventions and expanded mental health services to improve the well-being of students with disabilities.

Students on the spectrum report better health than other students on two outcomes: they are less likely than all other students to binge drink and they have lower levels of sleep deprivation than students with disabilities. The result for binge drinking is consistent with other findings that young adults with autism are less likely than other young adults to binge drink (De Alwis et al. 2014). The result for sleep deprivation is inconsistent with prior evidence that sleep problems are common among children and adolescents with autism (Richdale and Schreck 2009). Both patterns could reflect any of several processes: a selection effect (i.e., students on the spectrum who binge drink or who have sleep problems may be less likely to attend college), the unusually high levels of heavy drinking and sleep deprivation among college students (Buboltz Jr., Brown, and Soper 2010), or the active efforts of students on the spectrum to maintain healthy lifestyles. With respect to the latter, people with autism experience heightened risk for seizure disorders (Volkmar and Nelson 1990)—a risk that is exacerbated by alcohol use and sleep deprivation (Bråthen et al. 2003; Palma, Urrestarazu, and Iriarte 2013).

This study design allows us to compare students on the spectrum to students with other disabilities so as to identify challenges unique to autism. Somewhat surprisingly, few outcomes differ between these two groups. In addition to the health outcomes mentioned above, students on the spectrum are more likely than students with other disabilities to feel different from students at their institution, but both groups are more likely than neurotypical students to feel that

way. Students on the spectrum stand out from the other groups in their low likelihood of having a confidant or romantic relationship but do not differ from students with other disabilities in the overall quality of social relationships. Aside from a predictable disadvantage in some (but not all) social areas, college students on the spectrum and students with other disabilities experience many common challenges in social and academic life.

These challenges warrant attention in their own right but also because they increase the risk of suicide. Young adults who experience depression and anxiety, social isolation, bullying, who are gay, lesbian, or transgender, and who have non-binary gender identities are more likely than other young adults to attempt suicide, and the risk of suicide increases with the number of risk factors (Centers for Disease Control 2011). The relatively high prevalence of these characteristics among college students on the spectrum helps explain their high risk of suicidal ideation and suicide attempts (Jackson et al. 2018; Richa et al. 2014). College staff who work with students regularly—in residence halls, counseling centers, and student health centers—may not be aware of this heightened risk and would benefit from specialized training in this area.

We encourage future research that extends our study, with special attention to some of its limitations. The sample for this study only includes students enrolled in public postsecondary institutions, most of which are large. Students on the spectrum may have very different experiences at smaller colleges or at private institutions that feature smaller class sizes and more personalized attention (VanBergeijk, Klin, and Volkmar 2008). Moreover, because the participating institutions self-selected, they may not be representative of all public institutions in Indiana. The sample was also limited by the relatively low response rates, which were somewhat lower than those typical of online surveys (although students generally respond at lower rates than older adults; Kaplowitz, Lupi, Couper, and Thorp 2012). Low response rates may, although

do not necessarily, introduce bias into the sample (Fosnacht et al. 2017). If the determinants of participation differ by autism/disability status, the observed differences in outcomes may reflect participation bias.

Another potential limitation is that autism diagnoses were not confirmed by clinicians. Postsecondary institutions typically require that students present medical documentation for their condition before they can register for disability accommodations but we do not have independent confirmation of the diagnosis. The measure of other disabilities relied entirely on student self-reports.

Despite these limitations, this study provides new information about the experiences of college students on the autism spectrum. The academic, social, and health disadvantages these students face place them at high risk of college dropout and later challenges when moving into adult life. Longitudinal studies that track student progress through and after college would permit a more precise evaluation of which disadvantages are most predictive of degree attainment and difficulties in adulthood.

FOOTNOTES

1. This number counts regional campuses as separate institutions.

2. The minimum response rate is defined as (# complete surveys)/(# complete surveys + # partial surveys + # refusals + # break-offs + # non-contacts).

3. The National Institute of Alcohol Abuse and Alcoholism (n.d.) defines binge drinking as "a pattern of drinking that brings blood alcohol concentration (BAC) levels to 0.08g/dL" and notes that "(t)his typically occurs after 4 drinks for women and 5 drinks for men—in about 2 hours." The annual National Survey on Drug Use and Health defines binge drinking as "5 or more alcoholic drinks for males or 4 or more alcoholic drinks for females on the same occasion…on at least 1 day in the past month." The question we used in our survey comes from the Wabash National Study of Liberal Arts Education Student Experiences Survey (Blaich and Wise 2011) and is intended as a rough indicator of binge drinking behavior. Because all respondents received the same survey, the question about binge drinking did not differentiate by sex.

COMPLIANCE WITH ETHICAL STANDARDS

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

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