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College as a developmental context for emerging adulthood in autism: A systematic review of what we know and where we go from here

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Abstract

Autistic individuals often struggle to successfully navigate emerging adulthood (EA). College is an increasingly common context in which individuals learn and hone the necessary skills for adulthood. The goal of this paper is to systematically review and assess the existing research on college as a context of EA development in autistic individuals, particularly in terms of underdressing whether and how this context might be critically different for those who are typically developing or developing with other disabilities. Our findings indicate that ASD college students report feeling prepared academically, but exhibit weaknesses in daily living and social skills. Interventions largely focus on social skills, and rarely evaluate outcomes relevant to college success or longer-term emerging adulthood independence. We conclude with hypotheses and recommendations for future work that are essential for understanding and supporting ASD students as they navigate potentially unique challenges in college and their transition to independence during EA.

Keywords

Autism Spectrum Disorder; social communication; daily living skills; Academic skills; Intervention; emerging adulthood

Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental disability involving difficulty with social interactions and the presence of restricted and/or repetitive behaviors. Approximately 1 in every 59 children in the United States is diagnosed with an ASD (Baio et al., 2018). Although ASD is often diagnosed in childhood, it is a life-long disability that presents different challenges across developmental stages. One developmental transition that is especially difficult for those with ASD, even compared to individuals with other disabilities, is that from adolescence through emerging adulthood (Ebensen et al., 2010).

Emerging adulthood (EA) is defined by age (18–25 years) and is a distinct developmental stage of semi-autonomy that is characterized by increased self-exploration and instability

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(Arnett, 2000; Arnett, 2007; Arnett, 2014; Arnett et al., 2014). In fact, it may be the most heterogeneous period of development, with large individual differences in housing, family, and job status, which reflect key developmental tasks of EA (Arnett, 2000; Arnett, 2007; Arnett, 2014; Arnett et al., 2014). During EA, young adults work to become autonomous from parents financially, acquire independent living status, and explore romantic partnerships as they begin to build their own families. Critically, the success with which typically developing (TD) individuals accomplish these developmental tasks in EA predicts long term outcomes in adulthood (Arnett, 2007; Hill et al., 2011; Hawkins et al., 2012; Krahn et al., 2015).

Every year, there are an estimated 50,000 autistic[1] individuals transitioning through EA in the United States alone (Roux et al., 2015). There is mounting evidence that autistic individuals struggle to accomplish the social developmental tasks of EA. For example, autistic emerging adults struggle with financial independence as evidenced by the finding that less than half of them have ever held a paying job (Shattuck et al., 2012; Taylor, Henninger & Mailick, 2015; Taylor & Seltzer, 2011). They also struggle with independent living; they are less likely than their TD peers to live independently (Anderson, Liang & Lord, 2014a; Anderson et al., 2014b; Billstedt, Gillberg & Gillberg, 2005; Howlin et al., 2004). Also, although autistic emerging adults desire romantic partnerships (Strunz et al., 2016) and other social connections (Han, Tomarken & Gotham, 2019), these relationships are difficult for them to initiate and navigate (Howlin & Moss, 2012; Marriage, Wolverton & Marriage, 2009; Stokes, Newton & Kaur, 2007).

College as a Developmental Context for EA

College is an increasingly common context in which individuals navigate emerging adulthood (Bureau of Labor Statistics, 2019). For example, among American youth in 2018, 69% of high school graduates attended colleges or universities (Bureau of Labor Statistics, 2019). This is important because the college experience optimizes both academic and peer competence, which are both related to success accomplishing developmental tasks of emerging adulthood among TD individuals (Bureau of Labor Statistics, 2019; Tropey, 2018; Trostel, 2015). For example, in terms of financial independence and independent living, college graduates are less likely to utilize public and housing assistance programs; they are also more likely to volunteer in the community and make charitable donations (Ma, Pender & Welch, 2019; Trostel, 2015). In terms of personal relationships, college graduates are more likely to be in lasting marriages (Parker & Stepler, 2017; Trostel, 2015), to spend time with their children in educational activities (Ma et al., 2019; Trostel, 2015), and report being happy overall in their life (Trostel, 2015).

Success in the college environment requires that individuals adapt to new social roles (e.g., becoming a roommate), develop new social support systems, and adjust to new social norms. Thus, success in college for TD students is influenced by academic and organizational abilities as well as social skills, including social support, self-regulation, and the ability to adapt to new surroundings (Swenson, Nordstrom & Hiester, 2008; Zarrett & Eccles,

[1]Although the American Psychological Association recommends person-first language, we are using identity-first language on the basis of recommendations from autism disability advocates (Brown, 2011) and recent literature (Gernsbacher, 2018; Bury et al., 2020)

2006). Therefore, as with TD individuals, college may provide important developmental opportunities for autistic individuals to support the transition to emerging adulthood. In fact, many autistic individuals do attend postsecondary educational programs (approximately 73%); however, there is a larger attrition rate among autistic students (~ 62%) compared to students in the general population (~48%) (Newman et al., 2011). Also, when ASD students are in college, they are more likely to think about taking time off and withdrawing from college than do TD students (Gurbuz, Hanley & Riby, 2019).

However, ASD students with college education fair better than ASD adults with no post-secondary education, even though ASD adults are likely to be unemployed or underemployed more generally (Hurlbutt & Chalmers, 2004). ASD students with postsecondary education are employed at higher rates, work longer hours, and have higher wages compared to their ASD peers without postsecondary education (Migliore et al., 2012); all of which increase their ability to become financially independent. These findings indicate that it is important to understand the potentially unique challenges for ASD students as they pursue college as a context for development in emerging adulthood.

Current Study

The goal of this paper is to review and assess the existing research on college as a context of development for emerging adulthood in ASD. Here, we provide a narrative review of the literature investigating how ASD students function and develop in the college environment. Our goal is to understand the relative strengths and challenges that contribute to the disproportionate levels of attrition rates for ASD students. A longer-term goal is that this work can inform the design of interventions that will target skills and behaviors that are particularly challenging for ASD students to improve developmental outcomes and matriculation rates.

There are several existing papers that review some aspects of this literature (Anderson, Stephenson & Carter, 2017; Kuder & Accardo, 2018; Nuske et al., 2019). Importantly, the scope of each of these reviews is fairly circumscribed focusing on either intervention or skill assessment studies (Kuder & Accardo, 2018; Nuske et al., 2019), which limits opportunities for assessing whether and to what extent findings from each of these domains influence one another. Although Anderson and colleagues (2017) integrated these literatures in their summary review of the ASD college student literature, more than 28 studies have been added to this literature since the publication of this article. Critically, none of these existing review articles inform the ASD college student literature with findings from the non-ASD college student literature to understand whether the challenges that ASD students face are unique to ASD or not. Given these gaps in the existing reviews, there is a need for a more comprehensive and integrated assessment of this literature.

We begin with a brief overview of the empirical work investigating the academic, organizational, and social skills that develop among TD college students, enabling them to succeed in college and progress toward the developmental tasks of emerging adulthood. Next, we review the existing literature comparing ASD to TD college students in the development of these skills to determine the extent to which we understand the challenges that ASD students encounter. Third, we review the existing intervention studies that have

been designed specifically to support ASD college students. Finally, based on the findings from this narrative review, we provide recommendations about the most pressing questions that still need to be addressed empirically to understand the nature of the challenges for ASD college students in their developmental transition through emerging adulthood, particularly in the college context.

Typically Developing Students in the College Environment

Students bring skills with them and develop new skills in the college environment, both of which are associated with positive long-term outcomes. For example, performance in high school, as assessed by completion of coursework (Warburton, Bugarin & Nunez, 2001) and grade point average (GPA; Geiser & Santelices, 2007), is associated with strong performance in college. In addition, family support is critical to success in the college environment. Students who report greater emotional support from their families, particularly during their freshman year, are more likely to have a GPA of 3.0 or greater, accumulate substantial credits over their first year, and continue their education into the second year of college (Roksa & Kinsley, 2019). Also, students whose family emphasizes the importance of college are more likely to report being committed to the goal of college graduation (Strom & Savage, 2014).

Once students enter college, self-motivated behaviors, including daily living skills and social skills, also contribute to college success. For example, students' time management skills can have a large impact on their college performance and persistence (Britton & Tesser, 1991; Misra & McKean 2000). Management of health behaviors, like sleep duration (Okano et al., 2019; Trockel, Barnes & Egget, 2000) and healthy eating behaviors (Peltzer & Pengpid, 2015; Phillips, 2005), are positively related to college outcomes. Building social connections in college is positively related to academic persistence. For example, students who report making more new friends also report achieving more personal and academic goals (Skahill, 2002). Similarly, students who report establishing positive relationships with faculty (Kelly et al., 2012) and peers (Hu, 2011) report being more persistent towards their goal of graduating.

In sum, positive developmental outcomes in college among TD students are related to strong academic abilities, family support, daily living skills, management of healthy habits, and social connections with both peers and faculty. Next, we use these findings from the TD college student literature as we review the current literature investigating ASD college students' experiences to evaluate whether and how these same factors influence developmental outcomes for ASD college students. Our prediction is that the social communication deficits of ASD will lead to a disproportionate difficulty with the critical self-motivated and social skills that are essential to this developmental transition, particularly in the college context.

Methods

Study Search and Selection Criteria

We used several sources for identifying relevant articles. First, in the Fall of 2019 and again in the Summer of 2020, we conducted a literature search in the PsychINFO, PubMed, ERIC, and Google Scholar databases. The diagnostic criteria, and thus nomenclature, of autism has changed considerably over the last 20 years. Therefore, we included study search terms that would capture the full range of terminology used to classify individuals on the autism spectrum (particularly by the multiple versions of the DSM). The search terms included: (autism OR autistic OR Asperger's) AND (college OR university OR undergraduate). Second, we conducted a "manual reference search" by screening the reference lists of several recent review papers for studies that met full inclusion criteria (Anderson et al., 2017; Kuder and Accardo, 2018; Nuske et al., 2019).

Inclusion and Exclusion Criteria

We employed the following inclusion criteria: articles must (1) include an ASD group in emerging adulthood (ages 18–25 years) attending or having attended college, and (2) report first-hand or stakeholder (i.e. parent) accounts or behavior of ASD college student experiences. Studies were included as long as ASD groups were characterized as having a diagnosis of autism, ASD, Asperger syndrome, autistic disorder, or pervasive developmental disorder – not otherwise specified (PDD-NOS). Intervention studies were included if they included pre- and post-intervention assessments. Studies were excluded if they were not (1) not published in English, (2) available in full-text, (3) peer-reviewed.

Study Selection

The full study search, identification, and selection process is shown in Figure 1. We applied our inclusion criteria in two steps. First, we screened the titles and abstracts of all articles returned from the initial database literature searches. Since this was the first level of screening, we emphasized overinclusion to maximize yield. For example, abstracts were only rejected on the basis of exclusion criteria (i.e., not published in English, not ASD group). After this first set of articles was pared down, we assessed the remaining articles for inclusion by evaluating each full text article for inclusion criteria. The full set of studies are reported in Table 1 and Table 2.

Results

In total we included 62 studies of ASD college students. The full process of study identification, screening, and selection is documented in Figure 1. The majority of these studies (49 studies; Table 1) evaluated academic, functional independence, or social skills of ASD college students. A smaller portion of this literature (13 studies; Table 2) assessed interventions designed for ASD college students. The sample sizes, participant demographics, study characteristics, and outcome measures of each study are reported in Tables 1–2. In the vast majority of studies, data were collected from ASD college students directly; however, a small number of studies also acquired responses from parents of ASD college students. Approximately 20% of the studies compared findings between the ASD

students and another group of college students. A minority of the studies empirically confirmed the ASD diagnosis. In total, these studies include 4,211 ASD individuals, 188,894 TD college students, and 9,214 students from other disability groups.

Investigation of ASD College Student Skills

Academic Skills—The existing literature indicates that ASD college students mostly feel prepared academically. ASD college students self-report that they have an intense interest in their subject of study, they are receiving good grades, and they have the academic skills to succeed in college (Accardo et al., 2019a; Anderson, Carter & Stephenson, 2020; Anderson, Carter & Stephenson, 2018; Gelbar, Shefcyk & Reichow, 2015; Gurbuz et al., 2019; Jackson et al., 2018; Sturm & Kasari, 2019). For example, Gelbar and colleagues (2015) found that 80% of the ASD students they interviewed reported having GPAs above 3.0 and that they agreed with the statement, “I have the academic skills to succeed in college.” Gurbuz and colleagues (2019) found no differences in the percentage of ASD and TD students who reported that they were receiving good grades (ASD = 65%; TD = 68%), enjoying academic work (ASD = 64%; T = 68%), or had the academic skills to succeed (ASD = 71%; TD = 78%). ASD students and their significant others also describe their special interests as a strength in course work, driving them to study and putting them ahead of their classmates in course knowledge (Casement, Carpio de los Pinos & Forrester-Jones, 2017; Harn et al., 2020; Ward & Webster, 2018; Anderson et al., 2020b). Finally, there is evidence that, under some contexts, ASD students perform as well academically as do non-ASD students (Richardson, 2017).

However, there is also evidence that ASD students may have more difficulty focusing attention in the college environment than do their TD peers. For example, ASD students report having difficulty concentrating when studying and when following lectures, and determining the “gist” of course information from the details (Gelbar et al., 2015; Jansen et al., 2017; Anderson et al., 2020b). As one ASD student reported, “…because I have to work so hard to get to that level of understanding, that creates a lot of anxiety, and because there’s anxiety it’s harder for me to process the content…” (Anderson et al., 2020b). ASD students also report finding some related academic accommodations such as note-takers helpful (Accardo, Kuder & Woodruff, 2019b). Tops and colleagues (2017) provide empirical support for this anecdotal evidence. They developed a Thinking-Aloud Protocol (TAPs), where ASD and TD college students were asked to complete academic tasks while articulating their thought processes aloud. After each task they were given a short quiz to measure learning. Although there were no group differences in performance, the ASD students reread the material more frequently and had more difficulty ignoring irrelevant information and identifying the main ideas in the materials. Further, Cage and colleagues found that ASD students who dropped out of college were more likely to report negative academic experiences (2020a). These results suggest that ASD college students may have to work harder to manage attentional control to achieve similar levels of performance in the college environment as their TD peers, and that those who struggle with this may be more likely to drop out of college before graduation.

Based on this small number of findings, it appears that ASD college students largely feel prepared and skilled to complete academic coursework, which is evident in their positive self-reports about academic work and strong performance in the classroom. However, there is also evidence indicating that ASD college students work harder to achieve this level of performance than do their TD peers, which may be related to managing attention. It will be essential to determine whether these issues are specific to ASD college students or are general academic issues that are shared by many students with disabilities.

Skills for Functional Independence—Part of the critical developmental transition that is required in emerging adulthood involves becoming functionally independent from caregivers. This is particularly relevant for residential college students. Functional independence is indicated by the acquisition of financial independence through occupational work, high-quality friendships, and independent living (see Howlin et al., 2004). Such independence is supported by the development of multiple kinds of adaptive behaviors including, daily living skills (DLS), social, and communication skills.

Importantly, cognitive and functional adaptive skills can be quite discrepant in ASD (Howlin et al., 2004). Therefore, it may be that the acquisition of functional adaptive behaviors in emerging adulthood is especially difficult for ASD emerging adults, particularly in the college context. This idea is supported by the finding that ASD college students report equally high levels of distress across academic, daily living, and socialization domains (Lei et al., 2020b). Several studies have investigated the status of skills for functional independence in ASD college students using survey and interview measures.

Daily living skills (DLS) are skills that support maintenance of personal hygiene, meal preparation, money, and time management (Bal et al., 2015). DLS contribute to one's well-being and are important to living independently and obtaining employment (Bal et al., 2015). Two studies find that ASD college students report lower levels of functional adaptive behaviors, including DLS, than do their non-ASD peers (Cullen, 2015; Zukerman et al., 2019). Parents of ASD emerging adults also recognize this gap in DLS (Elias & White, 2018; Van Hees, Roeyers & De Mol, 2018) and that indicate that their adult children would likely benefit from independent living training (Elias & White, 2018).

The most consistent findings regarding difficulties with DLS among ASD college students center around time management and organizational skills (Anderson et al., 2018; Anderson et al., 2020a; Cage & Howes, 2020b; Cai & Richdale, 2016; Dymond, Meadan & Pickens, 2017; Gelbar et al., 2015; Van Hees, Moyson & Roeyers, 2015; Ward & Webster, 2018; White et al., 2016a). Time management skills include the abilities to effectively and efficiently organize time to accomplish well-defined goals and to flexibly alter such plans in response to changing demands on one's time. The ability to adhere to college class schedules, which vary by day and hour, and coursework deadlines, particularly during intense exam weeks, places strong demands on time management skills. Further, parents report needing to significantly support and guide important college decisions for their ASD students, such as course registration and financial aid (Pena & Kocur, 2013). The symptomatic preference for routine in ASD (Banda & Grimmett, 2008) makes the flexibility required for good time management difficult for ASD students (Cai & Richdale, 2016; Van

Hees et al., 2015). For example, in one study a student reported, “Yesterday a lesson was cancelled. I became so upset by the loss of structure that I could not do anything else for the rest of the day” (Van Hees et al., 2015). Indeed, nearly all the ASD students interviewed in this same study reported difficulty managing variability in routines. In a similar study, a majority of ASD students (67%) reported difficulty managing their time effectively (Gelbar et al., 2015). Anderson and colleagues (2018) reported that 75% of the ASD students they interviewed reported concerns about the lack of structure in the college environment, which may contribute to the time management difficulties.

ASD students report that the struggle to structure and manage time leads them to become overwhelmed and physically ill. For example, one ASD student reported, “It was hard to get used to routines at first, and I was sick a lot” (Gelbar et al., 2015). One study reported that ASD college students reported the highest levels of stress due to trying to balance coursework, self-care, and personal responsibilities (LeGary, 2017). In a larger sample, the vast majority of ASD students (~87%) reported concerns about time management and were fatigued, overwhelmed, and wanted help with DLS (Van Hees et al., 2015). Parents of ASD college students also report helping their adult children organize their daily schedule (Alverson, Lindstrom & Hirano, 2015; Cullen, 2015). Recall that among TD college students, time management skills are related to examination performance (Trueman & Hartley, 1996) and predict GPA better than SAT scores (Britton & Tesser, 1991). This link has yet to be established in the ASD literature. We propose that the observed and self-reported challenges with time management likely impact college success and performance for ASD college students as well.

DLS also include skills for maintaining good health. Poor physical hygiene impacts health outcomes and is also related to worse academic outcomes. For example, among TD college students, class attendance is negative associated with rates of physical illness (White et al., 2003; White et al., 2005), which is likely associated with worse hygiene behavior. ASD college students reported being in worse physical health compared to TD students and to those with other disabilities (McLeod, Meanwell & Hawbaker, 2019; McLeod, Hawbaker & Meanwell, 2020). Based on these findings, one could infer that ASD students may be missing more classes than are other students due to physical illness. Also, sleep hygiene, which is related to both the quantity and quality of sleep, is positively associated with academic performance among TD college students (Gomes et al., 2011; Wong et al., 2013). Recent findings indicate sleep disturbances in ASD adolescents and young adults (Goldman et al., 2017). Although, one report suggested that ASD college students are less likely to self-report being sleep deprived compared to their non-ASD peers (McLeod et al., 2020), another survey found that 79% of ASD college students reported their quality of sleep as a moderate or large concern (Anderson et al., 2020a). Therefore, both physical and sleep hygiene may contribute to relatively poorer overall health and wellbeing among ASD students in ways that interfere with success in the college environment (Croen et al., 2015). These issues may be particularly difficult for ASD college students to address given the strategies they report using to manage academic before daily living stressors, like choosing to eat uncooked pasta/rice to save time (Knott & Taylor, 2014; Van Hees et al., 2015).

Social skills.—Navigating social interactions and relationships is a core challenge for ASD individuals, which may be amplified in a college setting. In self-report studies, some ASD college students report a desire for friendships and social relationships, but difficulty attaining them, while others convey no desire/need to meet people (Accardo et al., 2019a; Casement et al., 2017; Cullen, 2015; Dymond et al., 2017; Gurbuz et al., 2019; Harn et al., 2020; McLeod et al., 2019; Van Hees et al., 2015; Vincent et al., 2017; Ward & Webster, 2018).

Social connection is critical to the success of TD college students. For example, peer support during college is protective and is related to increased school adjustment and belonging (Buote et al., 2007; Swenson et al., 2008), which increases positive self-perceptions (Pittman & Richmond, 2008) and motivation/engagement in college academics (Zumbrunn et al., 2014). Importantly, loss of such connection, as indicated by the feelings of loneliness, negatively impacts mental health (Zawadzki, Graham & Gerin, 2013), physical health (Pressman et al., 2005), and academic persistence (Alkan, 2014; Nicpon et al., 2006) among TD college students.

Unfortunately, interview studies have revealed that ASD college students report high loneliness and low confidence in their social skills at college (Anderson et al., 2018; Gelbar et al., 2015; Jackson et al., 2018; White et al., 2016a). Gelbar and colleagues (2015) reported that only 41% of ASD college students believe that they have the social skills necessary for college. Additional studies show that ~60% of ASD college students report being concerned about loneliness (Anderson et al., 2018), and 75% report feeling left out, isolated or lacking in companionship (Jackson et al., 2018). More disturbingly, over 74% of the students surveyed by Jackson and colleagues (2018) reported experiencing some form of suicidal behavior in their lifetime (including ideation, planning and attempts), which was inversely associated with the frequency and severity of their autism behaviors (as measured by the Autism Quotient), the number of friends they reported, and their overall sense of connectedness. Further, ASD emerging adults who dropped out of college reported less organizational and social identification during their college years compared to those who graduated (Cage et al., 2020a). Given the influence of these social factors on the performance of TD college students, it is reasonable to predict that they provide difficult barriers for ASD college students.

More recent studies that included important control groups and very large samples have confirmed and extend these findings. Compared to both TD college students and those with ADHD, ASD students report being less confident in their interpersonal skills (Sturm and Kasari, 2019). Another study reported that although both ADHD and ASD students report difficulty with social, emotional, and academic aspects of college, ASD students report more negative peer interactions (Bolourian, Zeedyk & Blacher, 2018). A large study of ASD and TD students, as well as those with “other disabilities”, found that ASD students are less likely to report having a confidant or a romantic partner (McLeod et al., 2019). Finally, a large survey of college students found that students with disabilities, including ASD, were twice as likely as their TD peers to report unwanted sexual contact (Brown et al., 2017).

Lei and colleagues report several findings comparing ASD and TD students using survey responses. In the first study, the researchers reported that ASD students reported more worries about social aspects of college life, smaller social networks, and more distress (Lei et al., 2020a). In a longitudinal study, Lei and colleagues surveyed TD and ASD students three times over the course of their first year in college (2020b). Although high levels of social anxiety for both TD and ASD students were associated with higher rates of perceived social distress, the ASD students also reported distress in the domains of daily living and academic skills and did not feel attached to their school community.

Together, these studies suggest that ASD college students have difficulties in social interactions and relationships that are potentially unique and disproportionately impact their experiences in the college environment. The distinctive structure of the college environment may contribute to these difficulties.

Distinctive Structure of the College Environment

Overwhelming sensory experiences.—Collegiate learning and social interactions often occur in bright, loud, environments with lots of people. For example, libraries, classrooms and even dorm rooms are often lit with fluorescent lighting. Classes range from as few as a handful of people to hundreds of people. Routines vary in new ways, making daily organization and travel a difficult issue to navigate. Overall, college environments are reported to be busy, loud, and unpredictable, which is aversive to ASD students (Beardon, Martin & Woolsey, 2009; Gurbuz et al., 2019; Knott & Taylor, 2014; Lambe et al., 2019; Lizotte, 2018; Madriaga, 2010; Thompson et al., 2018; Van Hees et al., 2015; Vincent et al., 2017). As a result, ASD students report that they feel isolated on campus (Gelbar et al, 2015). For example, ASD college students report that they avoid areas of campus specifically because of noise and crowding, which limits their opportunities for social interaction (Madriaga, 2010; Anderson et al, 2020b; Colclough, 2018). ASD students also attribute sensory overload to reduce their academic performance and drive to interact in social settings (Gurbuz et al. 2019).

Collegiate social structure.—In adolescence, social interactions are largely accessed and supported via programs such as classes, clubs, sports teams, and support groups that scaffold social interactions. This structure helps some ASD students form social bonds, particularly with peers (Alverson et al., 2015). During adolescence, family is also a major source of social support, particularly for autistic students, many of whom describe their family as a major source of support, socialization, and structure (Anderson & Butt, 2017; Bailey et al., 2020; Cai & Richdale, 2016; Cullen, 2015; Lambe et al., 2019; LeGary, 2017; Mitchell & Beresford, 2014).

In contrast, much of the socialization in college and young adulthood is self-motivated and self-structured. This kind of socialization requires more social competence and confidence, which is likely to be challenging for ASD students. Indeed, in one study 29% of ASD students reported feeling socially ‘lost’ on campus (Gelbar et al., 2015). Similarly, a major theme identified by Bailey and colleagues’ regarding difficulties for ASD college students is navigating the new social expectations in college (2020). One student reported, “The

most difficult thing about this social transition has been getting up the courage to introduce myself." This anecdotal evidence is supported by empirical evidence suggesting that ASD students desire to form social relationships and they report needing more structure and clarity about how/where to meet people (Cullen, 2015). Similarly, another study reported that ~77% of ASD students reported that they have difficulty introducing themselves to others and ~65% mentioned difficulty navigating social activities (Gurbuz et al., 2019).

Some ASD students report that they feel more accepted by and enjoy being around their college peers more than their high school peers (Anderson et al., 2018). The ASD students who are more successful forming new social relationships in the college environment appear to do so by joining structured programs, like school clubs, using social media to find people with common interests (Anderson et al., 2018; Bolourian et al., 2018; Cullen, 2015; Drake, 2014), or finding a job (Madriaga, 2010).

Disability disclosure.—While disability disclosure is not unique to the college environment, emerging adulthood may be the first time that ASD individuals have to make their own decision about disclosing their disability status. While some students with ASD report that disclosure helps with understanding and acceptance by peers, others fear judgment (Frost, Bailey & Ingersoll, 2019). Many students delay disability disclosure, even to university faculty and offices (i.e. disability services), until there is a negative event that requires help (i.e. an adverse mental health event; Cai & Richdale, 2016; Pena & Kocur, 2013; Zeedyk, Bolourian & Blacher, 2019). In one study, 50% of ASD students felt uncomfortable disclosing their diagnosis and 26% reported experiencing some form of disability discrimination on campus (Gelbar et al., 2015). ASD college students report feeling the need to "suppress their autism" due to fear of or lived experiences with discrimination (Casement et al., 2017; Cox et al., 2017; Frost et al., 2019; McLeod et al., 2019; Van Hees et al., 2015; Wiorkowski, 2015) and that this masking of symptoms makes social interactions exhausting, challenging, and less rewarding (Cage & Howes, 2020b; Anderson et al., 2020b). As a result, some ASD students report that they prioritize academic performance over the formation of social relationships (Bailey et al., 2020; Wiorkowski, 2015).

Summary of Literature Investigating ASD College Student Skills

Our review of the literature indicates that there are three categories of skills that researchers have focused on assessing in ASD college students and that correlate with the skills indicated as important in the TD literature; namely, academic, functional independence, and social skills. Skills in each of these domains are related to college performance and/or matriculation rates in typically developing students. Objective measures of academic performance and self-report measures of confidence indicate that ASD students are well prepared academically for college. However, there is also evidence that they work much harder to maintain this level of performance than do typically developing students, which may reduce resources for coping with bigger challenges.

ASD college students (and their parents) report that developing skills for functional independence (e.g., time management, health hygiene, sleep hygiene) is problematic.

Among typically developing college students, mastery of these skills is related to success in the college environment, both academically and socially. Therefore, supporting the development of these skills appears to be an ideal target for intervention for these students.

Finally, the literature overwhelmingly identifies social skills to be particularly difficult for ASD college students, which is consistent with the core features of the disability. ASD college students report feeling isolated and lonely; they are not engaging in social relationships to the same extent that their peers are; and, they have low confidence in their social skills, which causes worry and distress. It may be that the inherent organization of social interactions in college environments (loud, noisy, bright, crowded) makes it even more difficult for ASD students to navigate social relationships. This is particularly concerning because peer companionship increases feelings of school belonging and positive adjustment (Swenson et al., 2008) and is related to future job attainment and job retention among typically developing students (DePape & Lindsay, 2016; Hurlbutt & Chalmers, 2004; Taylor & Seltzer, 2011). Therefore, developing interventions that target improving skills to initiate and navigate social relationships among ASD college students appears to be critical.

In the following section, we review the existing intervention studies designed for ASD college students. In so doing, we will focus on understanding whether and how successfully these intervention studies target the skills that are identified to be the focused challenges for ASD college students, particularly the functional independence and social skills.

Interventions for ASD College Students

The Americans with Disabilities Act requires that colleges and universities offer appropriate support services to students with disabilities, including those with autism. The primary accommodations for those who self-disclose their autism status and seek support are provided for all students with disabilities, like increased time to complete tests and alternative testing sites (Anderson et al., 2018; Anderson & Butt, 2017; Pena & Kocur, 2013; Zeedyk et al., 2019). Although these accommodations may be helpful for ASD students (Lizotte, 2018), they are not necessarily specific to the needs of ASD students. As a result, researchers are increasingly evaluating whether interventions designed to support ASD college students, more specifically, are effective.

In our review of this literature, we specifically focused on empirical studies that included effectiveness measures across time (i.e., prior to and following the intervention). There are several studies in the literature that describe intervention programs, which included some qualitative assessment, but that did not meet our inclusion criteria (Ames et al., 2016; Lei et al., 2020c; Retherford & Schreiber, 2015; Roberts & Birmingham, 2017; Shmulsky, Gobbo & Donahue, 2015; Thompson et al., 2018). These studies are informative for the design and evaluation of future empirical intervention studies with measures of effectiveness.

Here, we review the intervention studies designed for ASD college studies that do include effectiveness measures. As in our review of the of the literature evaluating challenges (i.e., deficient skills) that ASD students encounter in the college environment, we organize this section according to skills that are targeted for intervention. In so doing, we discovered that most of the intervention studies simultaneously target multiple domains of skills, making

it difficult to assess which aspects of the intervention have led to improved outcomes. Nevertheless, we have discussed these interventions with each targeted domain of skills separately so as to facilitate connections between these two literatures.

Academic Skills.—There are only two intervention studies that included academic skills in their training (Hillier et al., 2018; Schindler et al., 2015). Hillier and colleagues (2018) designed and tested the Connections program for ASD college students. In Connections, small groups of ASD student participants met with a single faculty or counseling staff member each week for seven weeks. The group sessions involved a focused discussion around common challenges observed in ASD students and goal setting. One week of this intervention was dedicated to discussing academic skills, including study skills, communicating with professors, and accessing university resources. The researchers measured the effectiveness of Connections using student report surveys assessing changes in self-esteem and loneliness, qualitative analysis of structured focus group interviews, and matriculation rates. Analyses of the focus group responses revealed that participants reported having more confidence in their academic skills and better knowledge of university resources following the intervention. Quantitatively, 41 of the 52 participants successfully graduated or retained their student status by the time of publication, which is a higher matriculation rate than has been reported previously for ASD students (Newman et al., 2011).

Schindler and colleagues (2015) designed an individualized, peer-mentored intervention for freshmen ASD college students with the goal of facilitating the transition into post-secondary schooling. Following an extensive assessment of relevant skills (e.g., study and writing skills), students and peer mentors worked together to develop both long- and short-term goals to improve problem areas for each participant. Participants and mentors met regularly to assess progress over the course of the entire first year of college. Effectiveness of the intervention was assessed quantitatively using a standardized, semi-structured interview that identified and rated performance on self-identified problem areas. Seven ASD college students completed the intervention. The researchers reported performance improvements in the self-identified problem areas and 6 of the 7 participants who completed the program continued to matriculation.

Together these findings indicate that including a focus on improving academic skills may enhance the academic performance of ASD college students. However, it is important to remember that the academic skills training within these interventions was embedded in a much broader intervention that was designed to improve skills across multiple domains, making it difficult to ascertain how much influence the academic skills training had on these improvements.

Daily Living Skills.—Despite the consistent findings that ASD college students have difficulty with daily living skills that are essential for achieving functional independence as emerging adults, the existing literature is minimally focused on these skills as targets for intervention. When daily living skills are included in the intervention training, they are not a focus of the intervention (Capriola-Hall et al., 2020 & White et al., 2019; Hillier et al., 2018; Lucas & James, 2018; Rando, Huber & Oswald, 2016; Schindler et al., 2015;

Weiss & Rohland, 2015; White et al., 2016b). The Connections intervention described above dedicated a week of training to discussing and improving time management skills (Hillier et al., 2018). Focus group interviews with the ASD students revealed that improvements in time management skills were a common theme. In another intervention designed specifically to help ASD college students transition into the college environment, time management skills were one of five core competencies of focus for training (e.g. time management & organization, resiliency, technology use; Rando et al., 2016). In this year-long, peer-mentored intervention, individualized training plans were developed for the ASD student participants following initial assessment. The retention rate of the participants by the end of the academic year was higher than that of the overall university's first year retention rate for the same period. The number of faculty concerns was also reduced compared to pre-intervention.

In addition to time management skills, a few studies mentioned incorporating other aspects of daily living skills training into their intervention programs. For instance, Weiss and Rohland (2015) evaluated the success of the Communication Coaching Program, wherein ASD students attended weekly meetings with a team of mentors. Disability counselors helped students learn management skills and peer mentors helped them develop more customized DLS, like navigating public transportation. A qualitative analysis of weekly progress reports suggested that participants improved their abilities to plan academic and social activities, and set and achieve goals.

Together, these findings hint at the notion that including daily living skills training, such as work on time management skills, in intervention strategies for ASD college students is beneficial and can improve college retention rates. Again, it is critical to note that each of these interventions incorporated DLS skills in a much broader intervention strategy that was designed to improve skills across multiple domains, making it difficult to ascertain how much influence the time management skills training had on these improvements.

Social Skills.—Given the nature of the social communication deficits in ASD, it is not surprising that the majority of intervention studies for ASD college students focus on improving social skills. Most of these interventions were designed to have mentors scaffold skills during the training. The mentors vary from peers (Ashbaugh, Koegel & Koegel, 2017), to graduate students (Capriola-Hall et al., 2020; Pugliese & White, 2014; Schindler et al., 2015), to psychologists or staff from disability services (Furuhashi, 2017; Lucas & James, 2018), or include a whole team (Hotez et al., 2018; Koegel et al., 2013; Rando et al., 2016; Weiss & Rohland, 2015). For example, the study assessing the Connections intervention described above was administered by faculty and/or counseling center mentors. Multiple weeks of the intervention focused on improving social skills, including learning to work in groups, meeting people on campus, dating, and friendships. As mentioned before, the contribution of any one of these components to the effectiveness of this program is difficult to evaluate because it was embedded in a multi-faceted program.

Many of these social skills interventions target improvements in social communication (Ashbaugh et al., 2017; Capriola-Hall et al., 2020; White et al., 2019; Lucas & James, 2018; Rando et al., 2016; Schindler et al., 2015; Weiss & Rohland, 2015). For instance,

the Communication Coaching Program described above was largely focused on training social communication skills (Weiss & Rohland, 2015). The qualitative analysis of weekly progress reports suggested that participants improved skills in perspective taking, managing conversations, and reading non-verbal cues, as well as a growing confidence in their conversational skills.

Some interventions also provide structured social activities so that ASD students could observe and practice learned skills (Ashbaugh et al., 2017; Koegel et al., 2013; Capriola-Hall et al., 2020 & White et al., 2019; White et al., 2016b). Ashbaugh and colleagues (2017) developed and tested a social skills intervention for ASD college students that was mediated by peer mentors who modeled social behavior in real social settings. The outcome measures included the number of self-reported peer interactions and attended social events. Only three students participated in the intervention, two of whom reported increased social interactions following the intervention.

One of the most comprehensive social skills interventions that has been empirically tested is the Stepped Transition in Education Program for Students (STEPS; White et al., 2019; Capriola-Hall et al., 2020). STEPS is a developmentally sensitive, multi-component intervention designed specifically for ASD students to improve the postsecondary school experience (White et al., 2019). The program is customized to individual participants, delivered via individual sessions with a mentor, and includes community-based social outings. In the first empirical evaluation of the effectiveness of STEPS, an ASD STEPS treatment group was compared to an ASD treatment as usual group over the course of a semester in a randomized clinical trial. Effectiveness was assessed using a self-report measure designed to measure student adaptation to college across multiple domains. There was low attrition, indicating good program feasibility, and modest findings of improved adaptation to college (White et al., 2019). Participants also reported fewer depressive symptoms following STEPS compared to the control group (Capriola-Hall et al., 2020). Together, these findings suggest that interventions that are designed specifically for ASD college students and provide opportunities to practice learned skills in live collegiate social settings may improve mental health outcomes for ASD students, which could certainly have indirect effects on college performance and success. There is less strong evidence that this program has a direct impact on developing social skills for ASD college students.

Finally, there is limited understanding about whether interventions targeting social skills need to be administered by mentors or can be delivered in more scalable ways, like in the form of a computer-based intervention. One study compared the feasibility of a mentor-based, highly individualized social skills training intervention with a computer-based training program to improve recognition of emotion facial expressions and social interaction skills (White et al., 2016b). The study was not powered to evaluate effectiveness of either intervention strategy. It was merely designed to assess the relative feasibility of each approach. The duration of each intervention was approximately 10–14 weeks, the length of an academic semester. The researchers reported that both intervention approaches were feasible to implement in parallel with academic work during a college semester with ASD students. These findings indicate that interventions targeting social skills for ASD college students are feasible and could be implemented in multiple forms.

Other Skills.—A number of studies targeted skills for intervention that have not been specifically identified as problematic behaviors for ASD college students in the existing literature. For example, improved self-advocacy is often part of multi-component intervention strategies (Capriola-Hall et al., 2020; Hotez et al., 2018; Rando et al., 2016). Researchers argue that improving self-advocacy supports the ability to disclose disability status, which enables access to support services and may indirectly improve social skills by reducing anxiety and reliance on support personnel (i.e., parents, mentors). Unfortunately, outcome measures of these interventions do not assess improvements in self-advocacy behaviors, or disability disclosure status.

Several studies that used the STEPS program targeted the construct of self-determination for improving college success among ASD students (White et al., 2017, 2019; Capriola-Hall et al., 2020). In the context of the STEPS program, self-determination is operationalized as the ability to identify and achieve one's own set goals (White et al., 2017). Importantly, none of these studies reported treatment-related improvements in self-determination among the ASD college students.

Researchers also target emotion regulation behaviors within multi-component intervention strategies (Furuhashi, 2017; Hotez et al., 2018; White et al., 2016b). Difficulty with emotion regulation is widely reported in ASD (see Mazefsky & White, 2015), and targeting improvements in emotion regulation skills could lead to reduced internalizing symptoms (White et al., 2016b). One intervention program specifically focused on improving emotion understanding and emotion regulation in ASD college students in a group therapy context (Furuhashi, 2017). The researchers reported an improvement in self-reported state-anxiety, depression, and self-esteem among ASD students. Although these results suggest that targeting emotion perception and regulation skills could improve mental health outcomes for ASD students, there are no findings to indicate whether or how targeting these skills specifically improves college performance or success.

In sum, our review of this literature indicates that the majority of interventions designed for ASD college students are multi-component, largely focus on social skills, and are delivered using a mentorship model. This literature provides some promising initial findings. However, there are also some critical methodological and conceptual limitations that must be addressed in future work to move the field forward and understand whether and how targeted interventions can facilitate college retention, success, and matriculation rates among ASD students.

Going Forward

A strength of the existing work is that it provides a foundation of preliminary findings upon which to build future work. Importantly, this systematic narrative review has also identified some critical gaps in this literature. In this section, we identify these gaps and articulate several recommendations for identifying critical skills that are especially challenging for ASD students to develop in college and that could be essential targets for future intervention studies to help ASD students adapt to and succeed in the college environment. We identify several methodological and conceptual limitations in the current literature that will need

to be addressed in future work. To facilitate this effort, we provide recommendations to address these limitations in the hope that they will be useful to researchers identifying and addressing these most pressing challenges for ASD college students.

Recommendation 1: Targeted approaches that integrate findings from the intervention and skills literatures will be most effective.

A finding from this narrative review is that there is minimal integration of findings between the skills and intervention literatures. For example, although there are converging findings indicating that daily living skills (DLS) necessary for wellness and self-organization are deficient and likely interfere with adaptation to college, interventions for ASD college students rarely focus on improving (DLS). Similarly, findings indicate that ASD students are academically prepared for college, but that they appear to be exhausted by the challenges of accommodating to the sensory demands of the learning environment. However, current interventions designed to improve academic skills tend to focus on study skills and accessing resources. Further, social connectedness is a strong predictor of college adaptation and success among TD students (Alkan, 2014; Nicpon et al., 2006; Zawadzki et al., 2013) and ASD students report feeling socially isolated and lonely. However, very few of the social skills interventions for ASD college students target strategies for improving social connectedness. Finally, several intervention programs target behaviors that have not been evaluated for deficiencies in the skills literature. For example, a number of intervention programs target self-advocacy skills among ASD college students. However, there is little empirical work exploring whether and to what extent self-advocacy skills are weak among ASD students and whether such shortcomings specifically interfere with college success.

Going forward, we recommend that there be a much more integrated approach to studying challenging skills and targeted interventions for ASD students. For example, we suggest that researchers developing intervention strategies look to this skills literature to identify targets for intervention. We recommend that DLS, including time management, organizational skills, flexibility around routines, sleep and physical health hygiene, and social connectedness are particularly important candidates for future interventions designed for ASD college students. Also, researchers working to identify skills of strength and weakness for ASD students can look to the intervention literature to assess whether there is ongoing developmental change in these skills, particularly in control groups. This could inform the skills literature in important ways, particularly in terms of thinking about when particular skills are needed and how they develop among college students.

Another finding from this narrative review is that most existing interventions designed for ASD college students are designed as holistic, multi-component programs that are evaluated for effectiveness with measures that are not related to college adaption or success. This approach makes it difficult to identify which aspects of the intervention contribute to changes in behavior and whether the interventions are relevant for helping ASD students adapt to and/or succeed in the college environment specifically. Going forward, we recommend that future intervention studies be designed using a more *experimental therapeutics* approach to developing and evaluating psychosocial interventions. This approach is borrowed from experimental medicine and has been adapted for the

development of novel psychosocial interventions for mental disorders (see Heckler et al., 2020; Sheeran, Klein & Rothman, 2017). In the experimental therapeutics approach, the design of an intervention starts with identifying a "target." A target is a factor that can be modified, resulting in improved symptoms, behavior, functional outcomes, or even lower risk. An appropriate target is a factor that has been empirically associated with a clinical symptom or functional deficit or is hypothesized to impact the psychological pathway through which a clinical or functional benefit would occur. Critical to this approach is the measurement of the target and change in the target over time as well as the ability of the intervention to modulate the target. Because so much of the intervention work for ASD college students is not designed to reduce ASD symptoms per se, but instead to help ASD students adapt to and succeed in the college environment, it is essential that the outcome measures of interventions actually reflect this goal. For example, college success can be operationally measured in terms of class attendance, grades, and matriculation rates, which has been addressed in several existing studies. However, adaptation to college life is not often measured. We suggest that researchers consider using (or adapting) measures such as the Student Adaptation to College Questionnaire (SACQ; Baker & Siryk, 1984; Baker & Siryk, 1989). The SACQ consists of 67 items comprising four subscales of academic adjustment, social adjustment, emotional/personal adjustment, and institutional attachment. This measure has good reliability for all subscales and has been used extensively in the TD college literature (i.e., Buote et al., 2007; Swenson et al., 2008).

An example of this approach is to consider the development of an intervention for ASD college students that targets the improvement of DLS. There is existing empirical evidence that poor physical health and sleep are associated with reduced functional adaptation to college life, increased missed classes, and reduced grades. Therefore, these DLS are appropriate targets because they are associated with functional outcomes (i.e., college adaption and success) and altering them could potentially lower risk (i.e., withdrawal or dropout) in the college environment. Next, we would identify (or develop) assessments of the target behaviors (i.e., physical health, sleep hygiene) as well as of the functional outcomes (i.e., adaptation to college, class attendance, grades) and level of risk (intention to or actual withdrawal from school). The intervention would be designed with the specific goal of improving the target behaviors over a designated period of time that was informed by prior work. Evaluating the effectiveness of the intervention would require implementing appropriate control conditions and having sufficient power to estimate differences over time.

There are important considerations regarding decisions about control conditions and/or groups. A critical finding from this review is that very few of the existing intervention studies test sufficiently large samples to evaluate effects or employ control groups for comparison (See Table 2). This is one of the largest limitations of the current literature. The two intervention studies that did design a control condition included ASD college students in both the experimental and control conditions. This is an important strategy to control for factors related to ongoing development in the ASD students (regardless of the intervention effects), test-retest effects on the outcome measures, and feasibility issues of the intervention. It can also be useful for comparing intervention strategies, as in the experimental intervention under investigation versus a standard care group (i.e., ongoing

access to resources through disability center) or versus a sham intervention that controls for all of the structural components of the intervention (e.g., interactions with mentors).

However, comparing two ASD groups limits the ability to assess whether and to what extent the students benefit from the intervention approach compared to typically developing (TD) students. In other words, without including TD students as a comparison group, there is no way to assess the potential gains and relative skills of ASD students with respect to their primary peers. Importantly, many of the skills identified as weaknesses in ASD college students are also continuing to develop among TD college students. Therefore, it is important to understand whether ASD students are within the same distribution or are qualitatively different in skills than are their primary peers.

Another important approach is to include students with a different disability (e.g., ADHD) in a control group. This approach would help determine the extent to which identified challenges are due to having a disability in the college environment versus the specific challenges associated with ASD. For example, there are consistent findings of executive dysfunction in both autism and ADHD (Antshel & Russo, 2019; Lai et al., 2017; Craig et al., 2016). EF skills are implicated in academic performance at multiple levels, including college for typically developing students (Knouse et al., 2014). Therefore, it would be valuable to understanding whether deficiencies in EF skills among ASD college students interfere with college success (performance, adjustment) and if so, whether those difficulties are specific to ASD, or whether they impact a wider group of students. We recommend that future research use comparison groups thoughtfully to help hone our mechanistic understanding of how and why ASD students succeed or not in college. Importantly, clinical trial specialists are particularly helpful in making recommendations about these important factors of intervention design. We recommend that researchers designing psychosocial interventions to improve outcomes for ASD college students collaborate with clinical trial specialists even in the early design phase of their study.

Recommendation 2: Study Challenges for ASD Students as Cascading Effects

Building on existing findings from both the skills and intervention literatures reviewed here, we propose that there is a cascade of challenges for ASD college students. We suggest that poor social communication skills interfere with the ability to build new social relationships, particularly peer and romantic relationships, that are so important for success in the college environment. The lack of parental scaffolding to help build these new peer relationships in the college environment is likely to isolate ASD students even more. As a result, this difficulty forming a new social network at college jeopardizes the development of a sense of belonging (i.e., integration into the college community), which contributes to poor academic outcomes and higher drop-out rates for ASD students. Note that this hypothesis is focused on the early years of the college experience and on difficulty developing the skills necessary for building social networks that will sustain students throughout their college experience.

Although parts of this hypothesis have been articulated in the existing literature (STEPS; White et al., 2019; Capriola-Hall et al., 2020), the studies have not been designed to test the proposed directionality of the relations among these factors (i.e., social communication skills – peer relationships – sense of belonging – academic outcomes).

Testing these hypotheses will require a series of experiments that are longitudinal in nature and evaluate potential differences in the way new social networks are built and emerge over time for autistic college students and those who are typically developing. It also involves understanding whether and how social communication skills, in particular, limit the formation of new social relationships for autistic students. This could involve very basic deficits in social communication like difficulty understanding turn taking in social conversations, to more complicated deficits in understanding emerging adult-specific pragmatic uses of language, and ultimately understanding how to initiate a conversation with a social partner.

Going forward, testing this hypothesis requires that researchers leverage every tool available to empirically validate the ASD diagnosis of the study participants. ASD is a heterogenous diagnosis because of its spectrum nature. Therefore, reducing potential unrelated heterogeneity in the sample is critical for interpreting results. A finding from this review is that the majority of existing studies only required a self-reported community diagnosis of ASD (see Tables 1–2). ASD is a complicated disorder to diagnose because there are no diagnostic biomarkers. In research, the gold standard diagnostic tools involve extensive behavioral interviews with either the participant (Autism Diagnostic Observation Schedule, ADOS-2; Lord et al., 2012) or an informant (Autism Diagnostic Interview-Revised, ADI-R; Rutter et al., 2003). Importantly, training to conduct these interviews and become reliable in scoring the results is extensive and expensive. For projects that do not have the ability to employ these practices, we recommend that a community diagnosis is confirmed using a combination of other measures with established ASD cut-offs, including the Autism-Spectrum Quotient (AQ; Baron-Cohen et al., 2001), the Social Responsiveness Scale, 2nd edition (Constantino & Gruber, 2012) and the Broader Autism Phenotype Questionnaire (Hurley et al., 2007), which can all be completed as a self-report or an informant-based measure.

Second, testing this hypothesis requires valid and reliable measures of social communication skills, social network organization, sense of belonging in the college environment, and academic outcomes for ASD adults. A finding from this narrative review is that many existing studies employed outcome measures of self-report by ASD college students. Previous findings indicate that autistic individuals have limited insight into their own social skills and symptoms (Hill, Berthoz & Frith, 2004), which leads to concerns about the validity of self-report symptom measures, especially if they are not used in conjunction with performance- or informant-based measures. There are several measures of social communication skills that are not self-repot, including the Social Communication Questionnaire (SCQ: Berument et al., 1999; Rutter, Le Couteur & Lord, 2003). The SCQ is a caregiver rated screening measure that assesses behavioral impairments in reciprocal social interaction, communication, and repetitive and restricted or stereotyped behaviors. The SCQ has good internal consistency, particularly for social interaction, and is negatively associated with measures of adaptive behaviors in ASD adults (Brooks & Benson, 2013), providing support for its external validity. The SCQ could conceivably be completed by a parent and/or a school counselor who has the opportunity to observe a change in behavior over time. A performance-based measure of social interactions that is appropriate for use with autistic adults is the Contextual Assessment of Social Skills (Ratto et al., 2011).

The social relationships and networks of autistic students can also be measured in more quantitative ways. For example, the Social Network and Perceived Social Support (SNaPSS) is a new online tool that was recently validated to assess the structure (i.e., size) and functional perceived social support (in terms of frequency and quality) of social networks in autistic adults making a transition to college (Lei et al., 2019). It was also validated for typically developing adults, which makes the measure especially useful for understanding critical differences in how social networks are organized and change in the college environment. Finally, as described previously, the Student Adaptation to College Questionnaire (SACQ; Baker & Siryk, 1984; Baker & Siryk, 1989) can be used to measure college adjustment.

In sum, we expect that this line of work could help address critical questions about the primacy of deficient skills in ASD college students and how they contribute to college adjustment and/or success; intervention strategies for modifying these skills; and ultimately, an understanding about how successful college experiences relate to long-term functional outcomes for ASD adults, particularly in terms of accomplishing the social developmental tasks of emerging adulthood (i.e., attaining employment, social success, financial and living independence).

Recommendation 3: Understanding challenges regarding the physical environments of colleges will support ASD students.

Our review also revealed that ASD college students report difficulties functioning in the physical structure and organization of the college environment. Importantly, we found that neither intervention studies nor disability centers appear to be developing strategies to help ASD students address these challenges. Therefore, we suggest that the physical environment of a school can influence the relative adaptation and/or success of ASD students.

The physical environments of colleges can vary enormously in ways that have not been considered in the existing literature. For example, colleges vary in residential status and size, which influences how students adjust to the college environment. Although most research investigating college student adjustment largely focuses on the experiences of residential students, approximately 75% of all college students in the United State do not live in university-owned housing on campus, but commute from local and surrounding areas (Newbold et al., 2011). There are important differences about the college experience to consider for residential and commuter students that impact academic success and sense of belonging for typically developing students (Melendez, 2019). This is especially important to consider regarding ASD college students because the vast majority of ASD students who go on to college start at a 2-year public community college (Brown & Cooms, 2019).

We predict that the residential status will also influence the success with which ASD students adapt to the college environment. For example, ASD students who commute to college and continue to live at home with their family may benefit from familiarity in their daily routine of living at home and continued social support from family in ways that residential students do not. On the other hand, being a commuter student could contribute to social isolation as ASD students struggle to develop a sense of belonging within the college

community. We suggest that the residential status of students be evaluated and investigated in future studies of ASD college students.

The size and structure of the school may also influence the success with which ASD students adapt to college. Large universities are more likely to have well-funded disability resource centers, research opportunities evaluating intervention strategies for ASD college students, and a wider range of potential peer groups. At the same time, these large schools may be overcrowded, loud, bright and noisy, making it particularly challenging for ASD students to function in them. In contrast, smaller schools may offer more opportunities for faculty and peer mentorship but may not be as well positioned to support ASD students. Further, community colleges may offer more support in a smaller environment, but may lack the academic resources and opportunities of the 4-year universities. Going forward, we recommend that the organization of schools be considered in terms of assessing ASD student adaptation to and success in college.

Limitations

There are some limitations to the current review. First, this manuscript includes a narrative review, not an empirical meta-analysis of effects in the literature. This limitation is a reflection of the largely qualitative nature of the majority of existing studies in this literature. Our hope is that our synthesis of the findings and recommendations for future work will motivate a quantitative meta-analysis in the future.

We chose to focus this narrative review on published, peer-reviewed work. We appreciate that there may be ongoing, unpublished work that is relevant and informative to this review and that excluding this research may lead to a bias in reporting. We balanced this consideration with our understanding that this literature is only just emerging. As a result, we are unable to empirically estimate systematic differences in findings between published and unpublished findings using a sensitivity analysis, which would be an important step were we to include both kinds of studies. Therefore, as a first step, we have decided to only include published, peer-reviewed studies in this narrative review.

We also recognize that there may be college-relevant skills for ASD college students that have not been explored in this paper. For example, ASD adolescents and young adults are prescribed more psychotropic medications compared with similarly functioning individuals without ASD (Esler et al., 2019). It is possible that the effects of these medications and/or their daily management could lead to disproportionate difficulties during emerging adulthood for ASD college students. However, there is no research to date to evaluate this possibility. Again, this is an unfortunately limitation of the existing literature that we hope will be mitigated by the inspiration of researchers reading this work and investigating questions in the domain going forward.

Conclusions

College is becoming an increasingly common and important context for development during emerging adulthood (Bureau of Labor Statistics, 2019). While an increasing number of students attending college are autistic, these students have higher attrition rates and are more likely to consider leaving school before they matriculate. This is especially problematic

because success in the academic, social and emotional skill gained in college is associated with long-term developmental outcomes in adulthood for TD individuals. Therefore, autistic students who struggle in college are losing out on learning opportunities that will likely snowball into longer-term difficulties adjusting to independent life in adulthood. This is an unfortunate waste of talent and opportunity and leads to a disproportionate burden on caretakers and society. As a result, it is critical that the field use the best practices to design studies to investigate the strengths and weaknesses that autistic students bring to the college environment and intervene in targeted ways that will optimize their learning and developmental experiences so that they can adapt and succeed in the college environment. We expect that this work will ultimately have relevance for understanding how ASD emerging adults can be supported to accomplish developmental tasks of emerging adulthood, which will improve functional outcomes, including acquiring and maintaining employment, engaging in social relationships, and living independently. In turn, this can lead to improved mental health, life satisfaction, and relative independence, which improves the quality of life for individuals with ASD and their caregivers.

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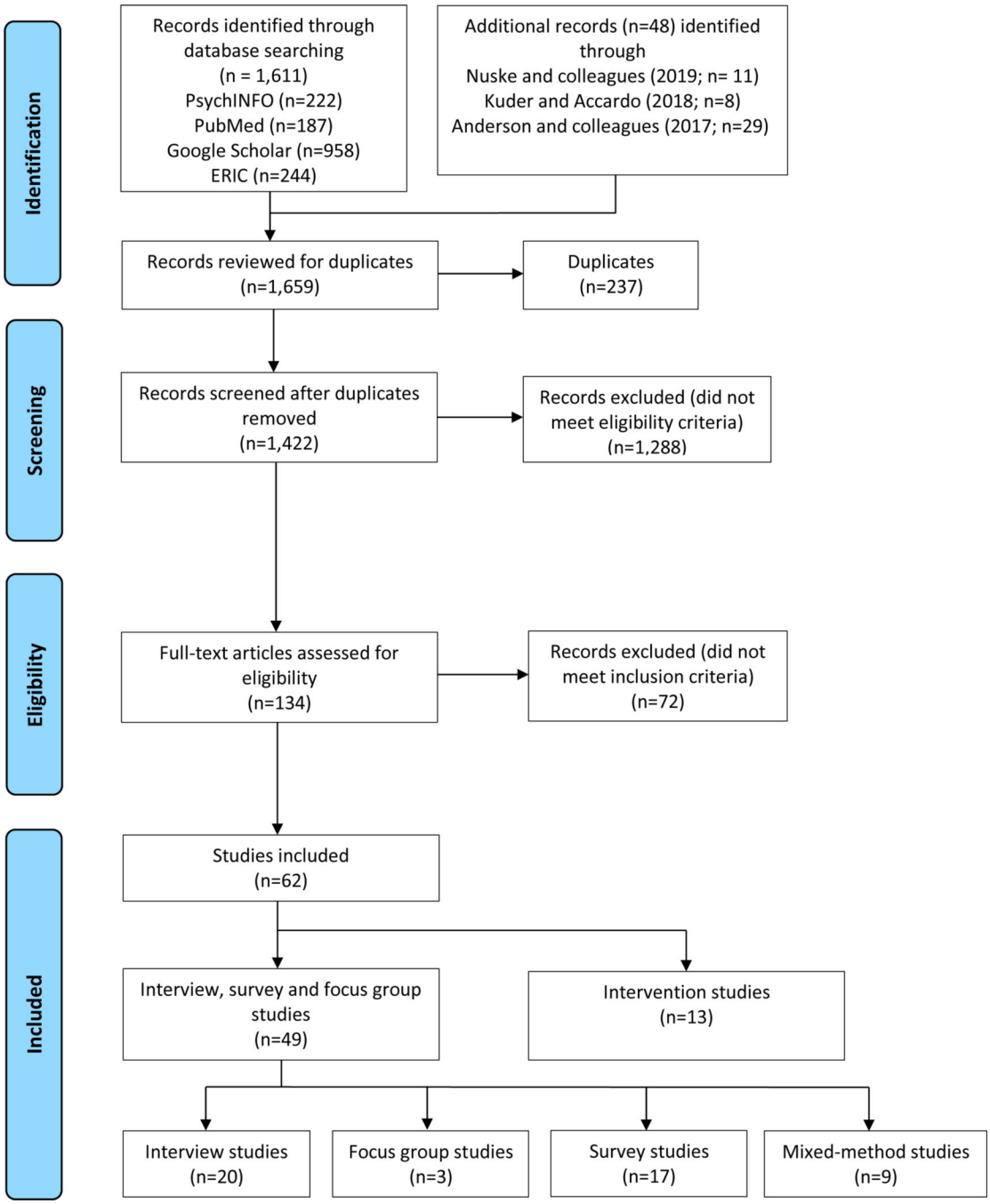

Figure 1.
Prisma flow chart of study selection process.

Table 1.

Demographic information and design features of studies investigating skill strengths and weaknesses in ASD college students.

Paper	Skills	Participant Group	Diagnosis Method*	Study Design	N	% male	Age Range (yrs)
Accardo et al., 2019a	Academic & Social	ASD college students	Community	Surveys	48	86	nr
				Interviews	nr	nr	nr
Accardo et al., 2019b	Academic	ASD college students	Community	Surveys	23	87	18–25
				Interviews	3	nr	nr
Alverson, et al. 2015	Social & Daily Living	ASD college students	Community	Interviews	5	100	19–22
		Parents		Interviews	nr	nr	nr
		Service Providers		Interviews	nr	nr	nr
Anderson & Butt, 2017	Social	ASD young adults	Community	Interviews	7	78	nr
		Parents		Interviews	18	nr	nr
Anderson et al., 2020a	Academic & Daily Living	ASD college students	Community	Surveys	102	41	18–25+
Anderson et al., 2020b	Academic & Social	ASD college students	Community	Interviews	11	18	18–70+
		Significant people to student		Interviews	6	nr	Nr
Anderson et al., 2018	Academic & Daily Living & Social	ASD college students	Community	Surveys	48	48	17–24+
Bailey et al., 2020	Social	ASD college students	Community; Confirmed with AQ	Surveys	42	28	nr
				Interviews	20	14	nr
Beardon, et al. 2009	Social	ASD college students	Community; 21 Self-diagnosed	Surveys	135	nr	nr
Bolourian, et al., 2018	Social	ASD college students	Community	Interviews	13	62	17–27
		ADHD college students	Community	Interviews	18	28	18–39
Brown et al., 2017	Social	ASD college students	Community	Surveys	158	59	nr
		Other disability college students		Surveys	7,018	nr	nr
		Non-disabled, TD college students		Surveys	27,703	nr	nr
Cage et al., 2020a	Academic & Social	ASD college students	Community	Surveys	230	31	nr
Cage & Howes, 2020b	Social & Daily Living	ASD college drop-outs	Community	Interviews	14	50	21–54
Cai & Richdale, 2016	Social & Daily Living	ASD college students	Community; Confirmed with AQ & SCQ	Focus Groups	23	70	17–59
		Family members		Focus Groups	15	nr	nr

Paper	Skills	Participant Group	Diagnosis Method*	Study Design	N	% male	Age Range (yrs)
Casement et al., 2017	Academic & Social	ASD college students	Community	Interviews	9	89	nr
Colclough, 2018	Social	ASD college students	Community	Interviews	5	80	19–36
Cox et al., 2017	Social	ASD college students	Community	Interviews	9	78	18–50+
Cullen, 2015	Social & Daily Living	ASD college students	Community	Surveys Interviews & Focus Groups	24	58	18–29
Drake, 2014	Social	ASD college students	Community	Interviews	5	20	nr
Dymond et al., 2017	Social & Daily Living	Parents		Interviews	nr	nr	nr
		University Personnel		Interviews	nr	nr	nr
Elias & White, 2018	Daily Living	Parents (ASD)		Surveys	52	77	16–25
		Parents (ADHD)		Surveys	47	68	16–25
Frost et al., 2019	Social	ASD college students	Community	Interviews	20	70	18–48
Gelbar, et al., 2015	Academic & Social & Daily Living	ASD college students	Community	Surveys	35	49	18–33
Gurbuz et al., 2019	Academic & Social	ASD college students	Community	Surveys	26	53	nr
		Non-ASD college students		Surveys	158	33	nr
Harn et al., 2020	Academic & Social	ASD college students	Community	Interviews	7	86	19–24
Jackson et al., 2018	Academic & Social	ASD individuals	Community; Confirmed with AQ-10	Surveys	56	46	18–57
Jansen et al., 2017	Academic	ASD college students	Community	Surveys	43	63	nr
		Non-ASD college students		Surveys	43	63	nr
		Student counselors		Surveys	30	17	nr
Knott & Taylor, 2014	Social & Daily Living	ASD college students	Community	Focus Groups	4	100	nr
		College Staff		Focus Groups	9	nr	nr
Lambe et al., 2019	Social	ASD students	Community; Confirmed with DSM5 criteria, parent report and RAADS-R	Focus Groups	25	80	16–21
LeGary, 2017	Social & Daily Living	ASD students	Community	Surveys & Interviews	10	90	nr
Lei et al., 2020a	Social	ASD college students	Community; Confirmed with AQ-28	Surveys	28	50	18–19
		Non-ASD college students		Surveys	28	54	18–19
Lei et al., 2020b	Social	ASD college students	Community	Surveys	21	52	18–19
		Non-ASD college students		Surveys	182	20	17–19
Lizotte, 2018	Social	ASD college students	Community	Interviews	6	83	26–37

Paper	Skills	Participant Group	Diagnosis Method*	Study Design	N	% male	Age Range (yrs)
Madriaga, 2010	Social	ASD college students	Community	Interviews	8	63	18–30
McLeod et al., 2020	Daily Living	ASD college students	Community	Surveys	89	62.92	nr
		Non-ASD college students		Surveys	2627	35.60	nr
McLeod et al., 2019	Social & Daily Living	ASD college students	Community	Surveys	95	61	nr
		Non-ASD, disabled		Surveys	804	29	nr
		Non-disabled, TD		Surveys	2174	36	nr
Mitchell & Beresford, 2014	Social	ASD students	Community	Interviews	18	78	15–25
Peña & Kocur, 2013	Social & Daily Living	Parents		Interviews	18	nr	nr
Richardson, 2017	Academic	ASD college students	Community	Surveys	209	73	nr
		ASD + other disabilities			343	59	nr
		TD college students			154,837	41	nr
Sturm & Kasari, 2019	Academic & Social	ASD college students	Community	Surveys	1258	70	nr
		ASD + ADHD	Community	Surveys	486	72	nr
		ASD + LD	Community	Surveys	267	65	nr
		ASD + ADHD + LD	Community	Surveys	200	67	nr
		ADHD college students	Community	Surveys	1024	70	nr
		TD college students		Surveys	1037	70	nr
Tops et al., 2017	Academic	ASD college students	Community	Study 1. Surveys	26	77	18–22
				Study 2. Thinking aloud protocol	12	92	18.3–22.8
		Non-ASD college students		Study 1. Surveys	53	40	17.9–21.1
				Study 2. Thinking aloud protocol	12	67	17.9–23.5
Van Hees et al., 2018	Daily Living	ASD individuals	Community	Interviews	34	74	nr
		Parents		Interviews	60	43	nr
Van Hees, et al., 2015	Social & Daily Living	ASD college students	Community; Confirmed with DSM-4-TR	Interviews	23	74	18–25
Vincent et al., 2017	Social	ASD college students	Community	Written responses	7	nr	nr
Ward & Webster, 2018	Academic & Social & Daily Living	ASD college students	Community; Confirmed with AQ	Interviews	4	50	20–35
		Significant people to student		Interviews	3	nr	nr
White et al., 2016a	Social & Daily Living	ASD college students	Community	Surveys & Focus Groups	10	70	nr
		Parents		Survey (parent report)	32	nr	nr

Paper	Skills	Participant Group	Diagnosis Method*	Study Design	N	% male	Age Range (yrs)
		School personnel		Surveys & Focus Groups	40	nr	nr
Wiorkowski, 2015	Social	ASD college students	Community	Interviews	12	58	23–56
Zeedyk et al., 2019	Social	ASD college students	Community	Interviews	13	62	17–27
		College faculty		Interviews	18	67	30–70
				Surveys (teacher-report)	132	50	nr
Zukerman et al., 2019	Daily Living	ASD college students	Community; Confirmed with AQ	Surveys	55	93	18–34
		Non-ASD college students		Surveys	40	83	20–36

+Some surveys gave participants choices for age range, with upper age ranges indicating over a certain age without specifics (i.e. 50 and over)

ASD: Autism Spectrum Disorder

ADHD: Attention-Deficit/Hyperactivity Disorder

LD: Learning Disability

TD: Typically Developing

DSM: Diagnostic and Statistical Manual of Mental Disorders

AQ: Autism Spectrum Quotient

SCQ: Social Communication Questionnaire

ADOS: Autism Diagnostic Observation Schedule

RAADS-R: Ritvo Autism/Asperger Diagnostic Scale Revised

nr: not reported

Table 2.

Demographic information and design features of intervention studies for ASD college students.

Paper	Participant Group	Diagnosis Method*	Study Design	N	% male	Age Range (yrs)
Ashbaugh et al., 2017	ASD college students	Community; Confirmed with DSM-4 TR or DSM-5	Social Planning & Peer Mentor	3	33	19–24
Capriola-Hall et al., 2020 *	ASD college students	Community; confirmed with ADOS-2	Mentorship Program	16 treatment	68.75	16–25
			Transition as Usual	16 control	81.25	16–25
Furuhashi, 2017	ASD college students	Community	Group Therapy	15	73	19–24
Hillier et al., 2018	ASD college students	Community	Support Groups	52	98	18–28
Hotez et al., 2018	ASD college students	Community	Transition Program	10	80	17–22
Koegel et al., 2013	ASD college students	Community; confirmed with DSM-5	Social Planning & Mentorship Program	3	100	21–23
Lucas & James, 2018	ASD college students	Community	Mentorship Program	8	75	nr
	MHC college students	Community	Mentorship Program	7	14	nr
Pugliese & White, 2014	ASD college students	Community; Confirmed with ADOS	Group Therapy	5	100	18–23
Rando et al., 2016	ASD college students	Community	Mentorship Program	12	80	nr
Schindler et al., 2015	ASD college students	Community	Mentorship Program	11	64	18–20
Weiss & Rohland, 2015	ASD college students	Community	Coaching Program	23	65	nr
White et al., 2019 *	ASD college students	Community; confirmed with ADOS-2	Mentorship Program	17 treatment	70.6	16–25
			Transition as Usual	18 control	72.2	16–25
White et al., 2016	ASD college students	Community; Confirmed with ADOS	Psychosocial Intervention	4 CLS	nr	18–22
			Computer Task Intervention	4 BCI	nr	19–23

ASD: Autism Spectrum Disorder

MHC: Mental health conditions

DSM: Diagnostic and Statistical Manual of Mental Disorders

SCQ: Social Communication Questionnaire

ADOS: Autism Diagnostic Observation Schedule

CLS: College and Living Success program

BCI: Brain-Computer Interface program

nr: not reported

*same sample used