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A Review of Executive Functioning and Social Communication Supports for Neurodiverse College Students

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Research Question:

What post-secondary support programs are being implemented to help neurodivergent students (specifically those with ADHD, ASD, dyslexia, dyscalculia, and/or learning disabilities) with social communication and executive functioning as they relate to academic performance and/or research assistantships?

Abstract:

Purpose: The purpose of this investigation was to conduct a Literature review (LR) of publications concerned with academics and/or research related support programs for neurodivergent post-secondary students who have ADHD, ASD, dyslexia, dyscalculia, and/or learning disabilities. The research question guiding this SR is *What post-secondary support programs are being implemented to help neurodivergent students (specifically those with ADHD, ASD, dyslexia, dyscalculia, and/or learning disabilities) with social communication and executive functioning in relation to academic performance and/or research assistantships?*

Method: A search of four electronic databases (Academic Search Ultimate, PubMed, CINAHL, and PsychInfo) was conducted in August 2023 to identify studies that addressed the research question. Citations from the four databases were exported and then uploaded into the application Covidence, which removed 220 duplicates, leaving 605 articles to be screened. One undergraduate researcher (Reilly Gray) and one graduate researcher (Katie Pegnam) screened the 605 titles and abstracts, resolving conflicts through consensus discussion with their mentor. 465 irrelevant studies were excluded through this level of screening; To conduct full text screening with the remaining 139 studies, inclusion and exclusion criteria were defined in the categories of Population, Intervention, Outcomes, and Study Characteristics, and summarized in a flow diagram to increase the reliability of exclusion decisions, documented in Covidence. Conflicts were again resolved through consensus discussion with their mentor. Through full text screening, 109 studies were excluded, leaving 31. Additional inclusion/ exclusion criteria, focusing on study design (only group design studies were included) and publication status (unpublished

dissertations were excluded) narrowed included studies to 13, which were extracted for this review.

Results: A search of four databases found 13 programs that fit the inclusion criteria of this study. Programs included studies classified as a Cognitive Behavioral Therapy program, a working memory training program, an online executive functioning and study skills program, mentoring, coaching, or a support group program.

Conclusion: Findings indicate that Preliminary research supports CBT and mentorship-based approaches to supporting the executive functioning and social communication of neurodivergent college students, but it will be important to investigate the feasibility of these supports as they are applied into a post-secondary education setting. It will be essential to continue researching the effectiveness of strategies to support neurodiverse students, especially those like CBT and mentorship-based supports. It will also be necessary that researchers expand the focus area from academic classroom supports to other environments such as research labs.

Introduction:

Post-secondary education is a "next step" that many adults choose to pursue at some point in their lives, and it is extremely important that "providers" of post-secondary education (colleges, universities, and other settings) support the needs of all students. Neurodivergent students, who learn in ways that are different than neurotypical students, may experience difficulties with finding supports and programs that are designed for *their* specific needs. Two domains in which neurodivergent students often benefit from supports are social communication and executive functioning, both of which may have impacts on success in academic coursework and research assistantships. As such, colleges are increasingly realizing the need to create such support programs. The current research was designed to systematically review the existing literature to determine the effectiveness of existing academic and/or research-related programs in supporting the social communication and/or executive functioning of neurodivergent students pursuing post-secondary education.

Neurodiversity has been defined in a variety of ways, reflecting the perspectives of the person who is defining it. It is important to hear perspectives from those who consider themselves neurodiverse, and value their insight as to what it means to them. For this literature review, we defined Neurodiversity using a biomedical viewpoint, while acknowledging that this definition does not encompass everything that neurodiversity can mean. Using a biomedical definition, neurodiversity includes a broad range of unique differences that alter the way one learns (Halpern et al., 2022). This review narrowed the scope of neurodivergence to students who are diagnosed with attention-deficit/hyperactivity disorder (ADHD), autism spectrum disorder (ASD), dyslexia, dyscalculia, and/or learning disabilities. Neurotypical students were defined as students who learn in a more "typical" way and do not have an identified disorder or difference that affects the way in which they learn. Aside from the biomedical definition, other approaches to defining neurodiversity include "the functional approach" and the "rights-outcome approach" (Rioux, 1997). Similar to the biomedical approach, the functional approach views

disability as a condition that affects an individual, but focuses on early identification and rehabilitative treatment to address the condition's functional impact. In contrast, the rights-outcome approach views disability in light of the structural organization of society, which creates barriers to participation for those with disabilities, as well as the relationship between society's structural organization and the individual. The latter approach recognizes the key role of society in reshaping our environments to eliminate participation barriers and better support the needs of individuals (Rioux, 1997).

Importantly, neurodivergent students are pursuing higher education at increasing rates, with estimates of around 2% of post-secondary students having an autism diagnosis and around 5% reporting an ADHD diagnosis (Dwyer et al., 2023). These numbers are believed to be an underestimate, though, as they do not account for individuals with undisclosed or undiagnosed neurodivergent conditions. Thus, it is important for universities to recognize the barriers neurodivergent students may experience relative to participation in academics and research opportunities in their pursuit of post-secondary education. Academic success, required for retention in post-secondary settings, requires students to implement effective study habits, pay attention (e.g., in class, while studying), work individually or in groups to complete assignments, develop and maintain positive relationships with classmates and professors, set goals and track progress toward meeting those goals, stay organized by making timelines and to-do lists, etc. (Anastopoulos et al., 2020; Gillespie-Lynch et al., 2017; Meinzer et al., 2021; Solanto et al., 2021). Research lab participation is an opportunity for students to pursue if they have an interest in research or if their major requires it. Although few publications directly focus on providing support for neurodiverse students in a research lab, components such as effectively working with professors and peers, reading and writing, attending to details, following established steps/procedures, and prioritizing/organizing tasks are factors that are reported on more and can be applied to a research lab setting (Anastopoulos et al., 2020; Gillespie-Lynch et al., 2017; Meinzer et al., 2021; Solanto et al., 2021). In other words, success in academic and lab settings at the post-secondary level requires students to have adequate social communication and executive functioning abilities to meet expectations. Yet, many neurodivergent students face barriers to participation in academic and research opportunities within their postsecondary education (Gillespie-Lynch et al., 2017). Thus, adaptations may need to be made to support their social communication and executive functioning abilities to allow them to meet expectations within these opportunities.

Given the challenges that neurodivergent students face in post-secondary education, efforts must be made to provide supports for learning. One such effort involves offering academic accommodations for students with disabilities through student accessibility services (SAS) (Toews et al., 2021). Such accommodations include curricular modifications, assistive technology, and additional peer supports (Toews et al., 2021). However, such services are only available to those with identified disabilities who choose to pursue this option, and even if such options are pursued, their scope is limited (Toews et al., 2021). More services—and ones that are targeted to support specific needs of neurodivergent students—should be made available and then made known to students, so they can avail themselves of existing supports. Knowing these supports exist in the early stages of post-secondary education is key for student success because only responding after students fail/fall behind makes attaining success much more difficult.

When considering specific, targeted supports for neurodivergent post-secondary students, Chown and Beavan (2012) suggests that a significant barrier to academic success is social difficulties (Ncube et al., 2019). For example, students with ASD often experience significant challenges with adjusting to the social changes posed by a post-secondary environment (Ncube et al., 2019). As a result, students with ASD are much less likely to enroll in and graduate from post-secondary education when compared to neurotypical students, due to a lack of appropriate supports and services (Ncube et al., 2019). Further, Gillespie-Lynch et al. (2017) found that a group of autistic students identified social challenges as contributing to their stress levels and creating academic challenges (Gillespie-Lynch et al., 2017). Specific challenges related to social communication at the post-secondary level may include: communicating with peers and professors in one-on-one and/or group settings, presenting PowerPoints and projects, working in teams to complete tasks, or participating in any of the other complex social environments that come about in educational settings (Gillespie-Lynch et al., 2017). Importantly, neurotypical students often need supports and resources to manage these difficult situations, indicating that even more supports may be required for neurodivergent students. In one study, a group of autistic students stated that social challenges contribute to their stress levels and create academic challenges (Gillespie-Lynch et al., 2017). Addressing the barriers these social challenges pose likely necessitates the creation of more accessible, effective, and readily available supports for students across the neurodiversity spectrum.

The majority of intervention approaches aimed toward improving social communication within post-secondary education that have been researched include some form of mentoring or coaching (Gillespie-Lynch et al., 2017). This guidance can come from peers, advisors, or other figures, who help students develop social skills by 1) discussing different ways in which social skills can be utilized, 2) providing scenarios to help students apply their thoughts and their knowledge, and 3) practicing these techniques in role-play (Gillespie-Lynch et al., 2017). Mentors and coaches develop engaging activities to make learning these social skills more fun and less like instruction about personal characteristics that need to be changed (Gillespie-Lynch et al., 2017). Many students with neurodivergent diagnoses/ identifications embrace that they are different and do not want to be told that they need to act more typical (Gillespie-Lynch et al., 2017). This is important to keep in mind when mentoring students because neurodiversity should not be marginalized, and the goal of providing services to this population should only be to help them identify tools and strategies that allow them to 1) engage with others effectively, 2) support their learning, accounting for the differences in the ways they learn best, and 3) advocate for themselves, including their communication and learning styles.

Another area for specific, targeted supports for neurodivergent students in post-secondary education is executive functioning (Gillespie-Lynch et al., 2017). Research suggests that executive dysfunction strongly correlates with academic performance impairment within children and adolescents with ADHD (Solanto et al., 2021). Specific challenges related to executive functioning at the post-secondary level may include: time management, organization, memory, and prioritization. Practical outcomes of executive functioning difficulties at the post-secondary level include challenges with note taking, brainstorming, test taking, organizing assignments, and completing assignments by the specified deadlines (Gillespie-Lynch et al., 2017). Further, neurodivergent students may have trouble with time management, which can be seen through behaviors such as procrastination, missing assignments, absences/ tardiness in class, rushing on assignments/producing inaccurate content, misplacing assignments, and overall

disorganization (Solanto et al., 2021). Importantly, neurodivergent students often recognize the impact of executive functioning on their academic performance. For example, Solanto et al. (2021) reported that students felt that reading, listening, and taking notes in lectures, and organizing and writing papers were areas that they wanted to improve through intervention, suggesting that services supporting these areas were lacking. These tendencies all impact academics and research lab participation within post-secondary education, with implications for lifelong skills beyond education settings.

Several approaches for supporting executive functioning skills in neurodivergent college students have been researched, including medication. Medication, in itself, is a widely used support in helping manage the symptoms of ADHD in children and adults, but its effectiveness in post-secondary students is not clear (Solanto et al., 2021). Specifically, Solanto et al. (2021) found no association between stimulant treatment and reduced ADHD symptoms or impairment. More research is needed, but current studies suggest that behavioral intervention is needed in addition to medication to successfully target executive dysfunction and ADHD symptoms within post-secondary students with ADHD (Solanto et al., 2021). Another intervention approach for supporting executive dysfunction in students with ADHD is Cognitive Behavioral Interventions (CBIs) (Solanto et al., 2021). CBIs can be used in both individual and group settings and can be implemented with or without medication use (Solanto et al., 2021). Traditional cognitive-behavioral approaches that are incorporated into a treatment plan have also been found to effectively assist adults with ADHD, but more research on its effects in aiding college-students with ADHD is needed (Solanto et al., 2021). Finally, research also suggests that the executive functioning skills of students with ASD can be targeted through mentorship programs that teach students strategies related to note taking, brainstorming, test taking, organizing assignments, and completing assignments by the specified deadlines (Gillespie-Lynch et al., 2017).

Neurodivergent post-secondary students are often not offered the amount or type of support needed to effectively aid them in their studies as they pursue their education (Gillespie-Lynch et al., 2017). Neurodiversity is slowly becoming a more known and acknowledged concept, but widespread efficacious interventions are not yet in place. This means many neurodivergent students are attending post-secondary education with many barriers to their success, often leading to a failure to complete their degree. For example, research suggests there is a low completion rate among post-secondary students with ASD due to a lack of appropriate accommodations (*Koehler-Crawford et al.*, 2018). To best support neurodivergent students, post-secondary educational institutions must acknowledge and prioritize individualized supports and effective interventions to support the thriving of these students and their education. The question that post-secondary education programs must ultimately ask is "What types of programs are effective in supporting neurodivergent students?" Currently, the research points toward the need for specialized supports, but detailed descriptions of such supports are lacking. For example, Gillespie-Lynch et al. (2017) reported that there were no support programs with established evidence to aid in the transition period to college for students with ASD. This is problematic, as it is known that many autistic students have difficulty with less structured and socially complex environments, which are common in post-secondary education settings (Gillespie-Lynch et al., 2017). Such evidence highlights the need for more research on effective post-secondary supports. Knowing that specialized supports are needed is the first step toward becoming more inclusive, but knowing what strategies work best for improving specific problem areas and skills is what will allow for individualized supports to be effective for students with differing needs.

The purpose of the current research is to systematically evaluate publications found in four databases (Academic Search Ultimate, PubMed, CINAHL, and PsychInfo) that were concerned with academic and/or research-related support programs for neurodivergent post-secondary students who have ADHD, ASD, dyslexia, dyscalculia, and/or learning disabilities. The research question guiding this literature review is *What post-secondary support programs are being implemented to help neurodivergent students (specifically those with ADHD, ASD, dyslexia, dyscalculia, and/or learning disabilities) with social communication and executive functioning as they relate to academic performance and/or research assistantships?*

METHOD

Literature Search Procedures

A search of the literature was conducted between May 2023 and June 2023. Four databases were searched: Academic Search Ultimate, PubMed, CINAHL, and PsychInfo. These databases were selected because they were judged most likely to provide articles that align with the research question and contain publications on neurodivergent support programs in general. We excluded less relevant databases due to the substantial number of publications found in the previous four databases, as well as the considerable overlap in publications identified by these four databases. Searches were conducted using key terms identified in three peer-reviewed articles that matched the research question. Search terms were categorized into neurodivergence terms, education-level terms, intervention terms, and outcome terms. A University of New Hampshire College of Health and Human Services librarian performed a check on these key terms, ensuring they accurately reflected the unique approaches required to search each database and made any modifications that were needed. Searches using these terms identified 121 articles from Academic Search Ultimate, 605 from PubMed, 180 from CINAHL, and 338 from PsychInfo.

Criteria for Inclusion

A set of criteria was made which defined how publications would be included or excluded from the literature review. These criteria fell in the categories of population, intervention, outcomes, and study characteristics. This set of criteria is described in the following paragraphs.

1. The Population category included post-secondary aged young adults (e.g., college, university, undergraduate, higher education) and specifically neurodivergent populations (e.g., ADHD, ASD, dyslexia, dyscalculia, learning disabilities).

Rationale. The author's intent was to focus only on this age group, as this was the study's target population. Excluded from the study were the following groups: children, infants, toddlers, preschoolers, school-aged children, high-school aged adolescents, adolescents/young adults not enrolled in post-secondary education, and those that were neurotypical only. Studies that included both neurotypical and neurodivergent populations and separated the data accordingly were included. Specifically, neurodivergent populations were included as the study's aim was to

identify programs/supports that would directly benefit them. The researchers included ADHD, ASD, dyslexia, dyscalculia, and learning disabilities in their criteria for a neurodivergent student but recognize this does not represent the entire scope of neurodivergence.

2. The “outcomes” category specifically focused on social communication and executive functioning, with a focus on how such outcomes impact academics/research assistantships.

Rationale. The criteria specifically included outcomes such as social communication/pragmatic language, social skills/socialization, executive functioning (i.e., inhibition, working memory/ updating, shifting/ cognitive flexibility, planning, problem solving, organization, verbal reasoning, self-awareness/self-monitoring/self-control/self-management), relationships/interactions with professors/classmates/lab members, and academic performance (in relation to social communication/executive functioning). These were deemed the most fitting for the purpose of the current review. Other areas that were excluded from the researchers' criteria included publications that only addressed speech production, friendships in a broad sense, familial relationships, mood (e.g., depression, anxiety), and self-esteem/self-confidence without directly examining downstream effects on relationships with academics or research performance. These were deemed less fitting and not specific enough to the current research question.

3. The intervention category included programs, supports, interventions, coaching, and/or treatments. Such “interventions” were required to focus on supporting the outcomes listed above in terms of their academic coursework and/or research assistantships (e.g., included organization, planning, and prioritizing skills that were likely to benefit performance in class/research experience).

Rationale. The researchers identified the need for a program/support to be put in place within these studies. Implementing a support or program was a critical ingredient in the research the study is presenting, and although future recommendations for these programs could be useful, they do not present any new findings or data that tell if these supports would be successful in helping neurodivergent students. The focus of these supports should be on helping neurodivergent students with tasks related to being successful in academics or research. Publications were excluded if they were assessment only studies, were focusing on describing characteristics of neurodivergent students without implementing supports for those characteristics, were programs strictly geared toward transition to work, or were treatments that only involve medication.

4. The study characteristics included intervention studies using quantitative, qualitative, or mixed methods. Intervention studies were included, as were studies with significant OR nonsignificant findings.

Rationale. The researchers concluded that data coming from quantitative, qualitative, or mixed methods studies could all be potentially beneficial in their research. Intervention studies were

included in many forms, such as group, single subject design, and case studies. This criterion excluded one-time visits, psychometrics research questions, diagnostic research questions, disorder characteristic research questions, relationship research questions, and prior systematic reviews on the topic. Research needed to be original, and a program or support would need to be implemented within the study. Significant and nonsignificant findings were both included, as the researchers identified that it would be important to know what worked AND what did not work.

Additional Inclusion Criteria (for Honors Thesis)

1. These criteria focused on study design and stated that the articles had to be randomized control trials (RCT's), Two- group designs, or quasi-experimental pretest posttest designs. Additional Criteria also stated that dissertations would be excluded as well. This narrowed down the 31 articles to 13 articles. These 13 articles were sent on to be extracted.

Rationale. Based on the available time frame, researchers decided to narrow the articles to those that utilized two-group designs, randomized controlled trials, and quasi-experimental pretest posttest designs. These designs were selected to maximize the methodological rigor of included studies. Dissertations were eliminated to focus only on research that had undergone peer review.

Articles Identified and Accepted or Rejected

Citations from the four databases were exported and then uploaded into the application Covidence. Covidence removed 220 duplicates across all 4 databases, leaving 605 articles to be screened. The first round of screening was performed by one undergraduate researcher (author) and one graduate researcher. Each student screened the 605 abstracts, marking their relevance to the research question as yes, no, or maybe. The two students then met with their mentor, and conflicts were resolved through consensus discussion. After marking 465 of these publications as irrelevant, the remaining 140 were sent to the next level where the full text was reviewed. The students included or excluded each of the 140 remaining publications in Covidence, and again, any conflicts were resolved by consulting with their mentor in consensus discussion. In this screening stage, 108 publications were excluded, and the remaining 31 were sent on for extraction by the UNH Neurodiversity Team. From these 31 publications, 13 articles were included in this thesis based on the additional inclusion criteria.

The 108 articles that were excluded were all marked with an exclusion reason. The specific exclusion reasons that publications fell under were: 1) Did not implement a program, support, intervention, or treatment (no recommendations), 2) Prior review on the topic (not original research; e.g., systematic review, meta-analysis), 3) No program was implemented but provides recommendations, 4) targets appropriate outcome, but not focused on improving academic/ research, 5) Not focused on listed outcome (social communication, social skills, executive functioning, relationships with professors/classmates/lab members, and/or academic performance, 6) Implements a medication-only treatment (no behavioral program), 7) Not enrolled in post-secondary education (university, college, community college, etc.), 8) Did not

implement a program, support, intervention, or treatment (no recommendations provided), and 9) Not a neurodivergent population.

There were two publications that did not implement a program, support, intervention. Twenty-two publications were prior reviews or were not considered original research. Thirty-one publications had no program implemented but provided specific recommendations for future programs/treatments. Fourteen publications were focused on the appropriate outcome but did not focus on academics/research. Two publications did not focus on the appropriate outcomes. Two publications implemented a medication only treatment. Twenty publications had participants that were not enrolled in post-secondary education. Nine publications did not implement a program, support, intervention, or treatment and provided no recommendations. Six publications had participants that were not Neurodivergent. These results can be seen visually in a PRISMA Diagram in Figure 1 below.

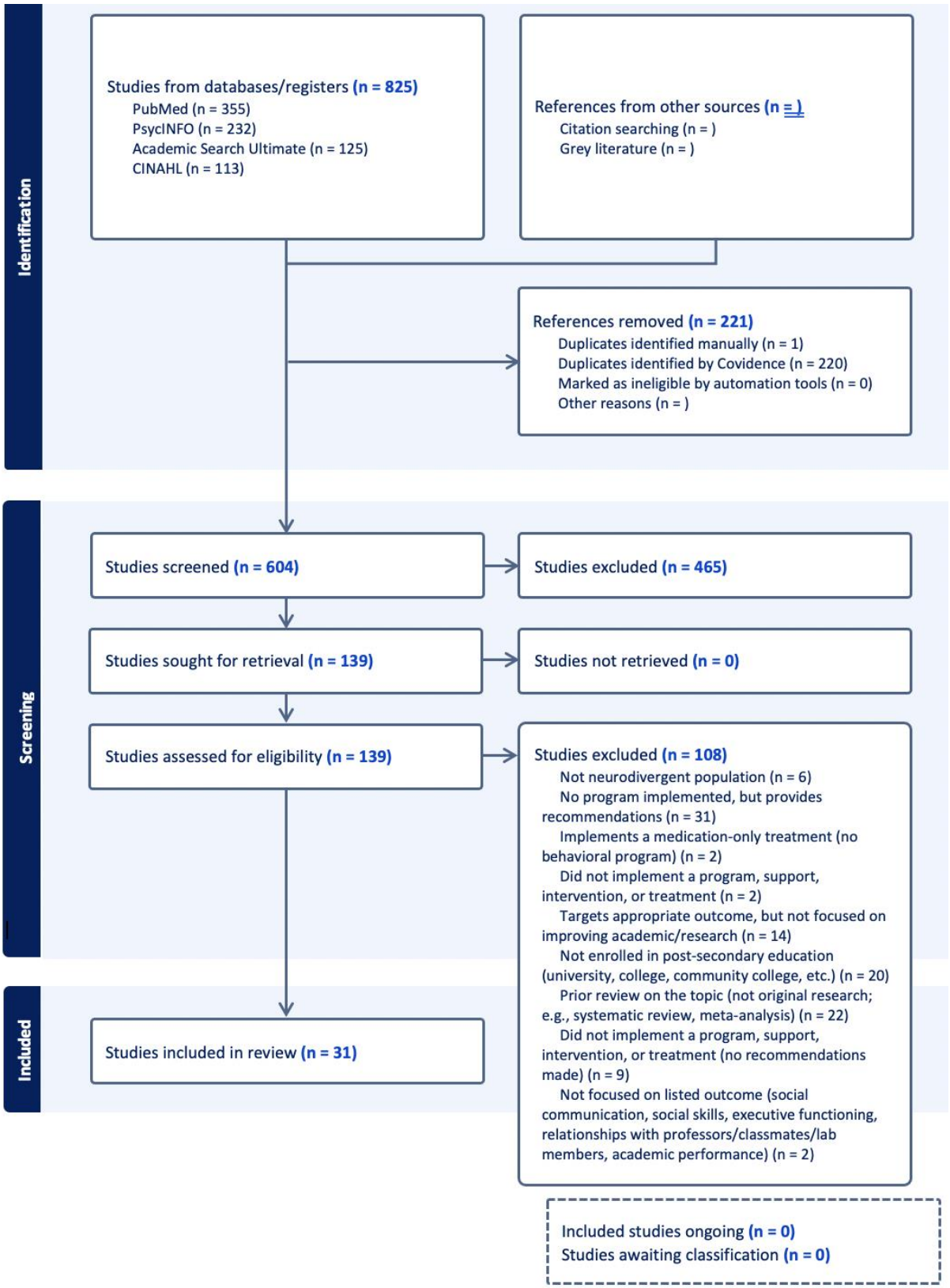

Identification
Studies from databases/registers (n = 825)
PubMed (n = 355)
PsycINFO (n = 232)
Academic Search Ultimate (n = 125)
CINAHL (n = 113)
References from other sources (n =)
Citation searching (n =)
Grey literature (n =)
References removed (n = 221)
Duplicates identified manually (n = 1)
Duplicates identified by Covidence (n = 220)
Marked as ineligible by automation tools (n = 0)
Other reasons (n =)
Screening
Studies screened (n = 604)
Studies excluded (n = 465)
Studies sought for retrieval (n = 139)
Studies not retrieved (n = 0)
Studies assessed for eligibility (n = 139)
Studies excluded (n = 108)
Not neurodivergent population (n = 6)
No program implemented, but provides recommendations (n = 31)
Implements a medication-only treatment (no behavioral program) (n = 2)
Did not implement a program, support, intervention, or treatment (n = 2)
Targets appropriate outcome, but not focused on improving academic/research (n = 14)
Not enrolled in post-secondary education (university, college, community college, etc.) (n = 20)
Prior review on the topic (not original research; e.g., systematic review, meta-analysis) (n = 22)
Did not implement a program, support, intervention, or treatment (no recommendations made) (n = 9)
Not focused on listed outcome (social communication, social skills, executive functioning, relationships with professors/classmates/lab members, academic performance) (n = 2)
Included
Studies included in review (n = 31)
Included studies ongoing (n = 0)
Studies awaiting classification (n = 0)

Figure 1. *This figure shows a PRISMA flow diagram which provides a visual summary of the screening process within this review.*

At this point in the process, the additional inclusion/exclusion criteria were added which narrowed down the 31 publications to 13 publications for the honors thesis. This can be seen visually in Table 1.

Table 1. *This table shows the breakdown in publication design of the 31 articles.*

Publication Design	**# of Publications**	**Included or Excluded?**
Two-group quasi-experimental	2	Included
One-group pre/post design	9	Included
Randomized Control Trial	2 (3 but 1 was a dissertation)	Included
Other (Qualitative, Case Study, single case research design, Dissertation, Quantitative/Qualitative Mix)	18	Excluded

Data Extraction Procedures/Data Synthesis

Within the data extraction procedures, two main methods were used. The first method was using a Covidence data extraction template created through consensus of the two student researchers and their mentor. This template was used to extract data from six articles. Each Student researcher would individually fill out the template for each article and then "publish" their data. When each student had published, a consensus meeting with their mentor would take place and discrepancies that would be highlighted by Covidence Software were discussed and a decision would be made on which student's work was more correct based on format, content, and detail within the content.

The template that was used in Covidence was broken down into two main headings; "General Information" and "Characteristics of Included Study" Under the General Information Heading, information such as Doi, full citation, year of publication, lead author contact details, country in which the study was conducted, and program/ support type were reported. This can be seen in Figure 2 of the appendix.

The "Characteristics of Included Study" header included two Sub headers, the first being "Methods" and the second being "Participants." Under the Methods header was the aim of the study. Under the Participants header, information such as Population description, inclusion and exclusion criteria, method of recruitment, total number of participants, conditions, baseline population characteristics, study design, start and end date, outcome measures, target domain, reliability/validity of outcome measures, intervention and comparisons, conclusion, limitations,

study funding sources, and possible conflicts of interest. This can be seen in the Appendix in Figures 3-6.

The second method used was a “table of evidence”. This table of Evidence captured much of the same information that Covidence did, but the students had been working with these table of evidence all along, meaning information on data was already plugged in and could be compared side by side. This eliminated the need to go into Covidence and fill in the Data Extraction Template, which was a time-consuming task. The graduate researcher went through and identified differences in the author and her tables for each of the remaining seven articles, and discrepancies were sorted out through consensus with a senior researcher.

The table of evidence asked for information such as a full citation, research question/purpose, inclusion and exclusion criteria, participant numbers and groups, experimental group/intervention, control or alternate group(s)/interventions, research design, independent and dependent variables, outcome measures, reliability and validity of the outcome measures, statistical tests used for the outcome measures, notable secondary or post hoc analyses, effect size, conclusions, study limitations, indication of clinical significance, and any other comments on the study. See Figure 7 in the Appendix.

Quality

Quality analysis was performed on the 13 articles that went on to the extraction phase. The quality analysis was conducted using Joanna Briggs Institute Checklists, which are “critical appraisal tools that assist in assessing the trustworthiness, relevance and results of published papers” (Tufanaru et al., 2020). Assessing the quality of the publications was done through consensus between the researchers and the research adviser. Two different checklists were utilized, one with guidelines pertaining to quasi-experimental studies (see Table 2 for quality results) and the other with RCT’s (see Table 3 for quality results). These checklists asked questions that would highlight key components that should be considered when assessing quality within a study. They also asked questions that were the same as one another and questions that differed, as they were catered to the study's research design. A brief description of each question asked in determining quality of these design is provided:

1. Data Extraction was completed independently by both the author and the graduate researcher. Extraction was done using a Covidence Extraction Template for 6 of the articles, and a table of evidence for 7 of the articles. Both tools were comparable when looking at the information being asked within each.
2. Quality Analysis was also completed independently by myself and a graduate researcher, using the Joanna Briggs Checklists for RCT's and Quasi-Experimental Designs.
3. Consensus meetings were performed with Dr. Greenslade to obtain agreement and finalize the extraction data and quality rating.

Results

Quality

Among the quasi-experimental studies, all 11 studies identified a clear cause and effect. Seven of the 11 studies demonstrated similarities between the participant groups that were compared, and 1 study clearly did not. None of the 11 studies had participants that were included in comparisons that were receiving similar treatment other than the intervention of interest. None of the 11 studies had a control group. Six of the 11 studies had multiple measures of the outcome both pre and post intervention exposure, whereas 5 studies did not have multiple measures of the desired outcomes. Follow-up was complete in 7 of the 11 studies, was incomplete in 2 of the 11, and was unclear in the remaining 2 studies. The outcomes of participants included within any comparisons were only measured in the same way in 1 of the 11 studies. Outcomes were only measured in a reliable way in 5 of the 11 studies. Appropriate statistical analyses were used in 10 of the 11 studies. These results are specified in Table 2.

For the RCT studies, both used true randomization for the assignment of participants to treatment groups; however, it was unclear if allocation to the treatment groups was concealed in either study. Treatment groups were similar at baseline in both studies. Participants of the intervention, those delivering the treatments, and outcome assessors were not blind to the treatment assignment in either of the two studies. Treatment groups were only treated identically (other than the intervention of interest) in one study, and follow-up was incomplete in both. In both studies, participants were analyzed in the groups to which they were randomized, and outcomes were measured in the same way for treatment groups. It was unclear if outcomes were measured reliably in either study. Both studies used appropriate statistical analyses and had an appropriate trial design, with any deviations from a typical RCT design accounted for in the conduct and analyses of the trial. These results are specified in Table 3.These data can be seen in Table 2.

Table 2: *This table shows Quality Analysis for the quasi-experimental studies included within this review*

Author	Q1. Cause/ Effect	Q2. Participant Similarity	Q3. Comparison Exposures	Q4. Control group	Q5. Multiple outcome measures at pre and post	Q6. Follow -up	Q7. Outcomes measured same across groups	Q8. Outcome reliability	Q9. Appropriate statistics
Anastopoulos, King, Besecker, O'Rourke, Bray, & Supple (year)	yes	n/a	n/a	no	yes	yes	n/a	no	yes
Gillespie-Lynch, Bublitz, Donachie, Wong, Brooks, & D'Onofrio (2017)	yes	yes	n/a	no	yes	yes	n/a	yes	yes
Hillier, Goldstein, Murphy, Trietsch, Keeves, Mendes, & Queenan	yes	yes	n/a	no	no	yes	n/a	yes	yes
Hotez, Shane-Simpson, Obeid, DeNigris, Siller, Costikas, ... & Gillespie-Lynch (year)	yes	yes	n/a	no	yes	yes	n/a	no	yes
Meinzer, Oddo, Garner, & Chronis-Tuscano	yes	yes	n/a	no	yes	yes	n/a	no	yes
Ncube, Shaikh, Ames, McMorris, & Bebko (year)	yes	yes	n/a	no	no	no	n/a	yes	yes

Prevatt & Yelland	yes	n/a	n/a	no	no	unclear	n/a	yes	yes
Solanto & Scheres	yes	no	n/a	no	yes	yes	yes	no	yes
Thompson, McDonald, Kidd, Falkmer, Bölte, & Girdler	yes	yes	n/a	no	yes	unclear	n/a	yes	yes
Wee & Abdullah	yes	yes	n/a	no	no	yes	n/a	no	yes
Weiss & Rohland	yes	unclear	no	no	no	no	unclear	n/a	n/a

Table 3: *This table shows Quality Analysis for the RCT's included within this review*

Author	Q1. True randomization	Q2. Allocation Concealment	Q3. Groups similar at baseline	Q4. Participants blind to treatment	Q5. Treatment deliverers blind to treatment	Q6. Accessors blind to treatment	Q7. Treatment groups treated same	Q8. Follow-up	Q9. Participant Analysis	Q10. Outcomes measured same across groups	Q11. Outcome reliability	Q12. Appropriate Statistics	Q13. Appropriate Design
Anastopoulos, Langberg, Eddy, Silvia, & Labban	yes	unclear	yes	no	no	no	yes	no	yes	yes	unclear	yes	yes
Gropper, Gotlieb, Kronitz, & Tannock.	yes	unclear	yes	no	no	no	unclear	no	yes	yes	unclear	yes	yes

Support Program Descriptions and Results

(First Author, year of publish) Intervention Type and Name	Intervention Strategies	Population Description / Groups	Outcome Measures/ Time Points (Mean, Standard deviation)	Results
(Anastopoulos, A. D., 2020) cognitive–behavioral therapy program delivered via group treatment and individual mentoring "Accessing Campus Connections and Empowering Student Success ACCESS"	Target Domain: Academics and EF - Program lasted for 6-10 weeks - Sessions each week were group based and used CBT -Sessions lasted for 90 minutes. - In addition to the group sessions, participants also had one-on-one 30 minute mentoring meetings. - Goals addressed were improve executive functioning skills (i.e., time managing, planning, and organizing), teach strategies to assist weaknesses in academics related to maladaptive thinking, and provide more education about ADHD	88 participants (the final sample number) only one group -Post secondary students with a diagnosis of ADHD that was determined by meeting the DSM-IV criteria	EF: <u>BRIEF-A</u> <u>Behavioral regulation:</u> Active treatment: -6.15, p < .001 Maintenance: -4.49, p < .001 <u>Metacognition:</u> Active treatment: -10.55, p < .001 Maintenance: -7.63, p < .001 Academics: <u>GPA:</u> pre: 2.58 (0.93) post: 2.75 (0.89) post maintenance: 2.77 (0.83) F= 0.91, p = not significant <u>Credit hours (attempted):</u> pre: 12.42 (3.04) post: 13.87 (2.52) post maintenance: 13.53 (2.91) F= 5.78, p = .005 <u>Credit hours (earned):</u> pre: 10.97 (4.06) post: 12.74 (3.65) post maintenance: 12.39 (3.58) F= 3.64, p = .035 <u>LASSI:</u> Information Processing: pre: 25.17 (6.42) post: 27.74 (6.70)	- Program was in fact effective in helping college students with ADHD. - During and after treatment, participants ADHD symptoms had a lesser impact and EF skills improved significantly. - No significant improvement seen in GPA from pre to post treatment - Significant change seen in the amount of credit hours attempted and the amount of credit hours that were earned.

			F= 7.18, p = .014 <u>Self-Testing:</u> pre: 17.13 (4.87) post: 19.48 (5.47) F= 5.21, p = .032 <u>Study Aids:</u> pre: 20.26 (5.47) post: 23.00 (5.70) F= 15.79, p = .001 ADHD Symptoms: <u>Inattention:</u> Active treatment: -4.43, p < .001 Maintenance: -4.56, p < .001 <u>Hyperactive impulse:</u> Active treatment: -1.82, p < .001 Maintenance: -2.12, p <.001	

(Anastopoulos, A. D., 2021)
 	
cognitive–behavioral therapy program delivered via group treatment and individual mentoring "Accessing Campus Connections and Empowering Student Success ACCESS"
	Target Domain: Academics and EF
	-The experimental group received treatment over 2 semesters.
	-The first 8 weeks were a more intense form of treatment
	- Followed up by a maintenance phase- treatment was less intense and provided less often.
	- Weekly group-based sessions utilizing and used CBT- sessions lasted for 90 minutes.
	- Participants also had one-
		-A total of 250 participants
		-119 were in the ACCESS treatment group and 131 were in the control (delayed treatment) group
		
		-Control group participates in program following year
			1. 3 time points: pre, 3 weeks post treatment, and 2 months post treatment
			
			ADHD Symptoms/EF Skills:
			<u>BRIEF GEC:</u>
			Time 1: 157.17 (18.13) // n= 118
			Time 2: 145.86 (25.05) // n= 113
			Time 3: 140.39 (24.85) // n= 93
			<u>BRIEF BRI:</u>
			Time 1: 60.70 (11.22) // n= 118
			Time 2: 58.02 (12.28) // n= 113
				-Participants that received ACCESS improved their ADHD symptoms and EF skills.
				-Authors conclude that the ACCESS program was effective in treating students with ADHD in college.
				- Immediate ACCESS participants displayed statistically significant declines in their overall ADHD symptomatology, indicated by a decline in their self-reported inattention symptoms.

	on-one 30-minute mentoring meetings.
	- Goals addressed in weekly meetings included improving executive functioning skills and knowledge about ADHD
			Time 3: 56.88 (11.86) // n=93
			BRIEF MCI:
			Time 1: 95.62 (14.71) // n= 118
			Time 2: 87.58 (15.23) // n= 113
			Time 3: 89.51 (15.07) // n= 93
			CAARS Total:
			Time 1: 34.48 (9.16) // n= 117
			Time 2: 29.64 (9.28) // n= 111
			Time 3: 28.46 (9.48) // n= 95
			CAARS IN:
			Time 1: 19.93 (4.57) // n= 117
			Time 2: 16.25 (5.20) // n= 111
			Time 3: 15.05 (5.24) // n= 95
			CAARS HI:
			Time 1: 14.55 (5.74) // n= 117
			Time 2: 13.39 (5.32) // n= 111
			Time 3: 13.41 (5.57) // n= 95
			ACS-CV:
			Time 1: 36.27 (7.88) // n= 119
			Time 2: 32.93 (7.84) // n= 110
			Time 3: 31.91 (8.13) // n= 95
			
			Academics:
			SFS:
			Time 1: 46.74 (10.97) // n= 119
			Time 2: 61.16 (11.64) // n= 112
			Time 3: 61.18 (12.27) // n= 93	

(Gillespie-Lynch, K., 2017) Mentoring	Target Domain: Social communication and academics - Weekly 1 hour mentor-led group meetings-	-One group of 28 students enrolled in post-secondary education autism diagnosis (included official	1. The Social Responsiveness Scale-A (SRS-A) Pre: (M = 58.24, SD = 28.95) Post: (M = 49.30, SD =3 0.33) 2. Student Self-report of Academic Self-efficacy	- Participants found program to improve their social communication. - After completion of the program, many participants were participating in more

Project REACH mentorship program	curriculum varied each semester and/or weekly 1 hour one-on-one meetings with a mentor. - Mentees filled out self-report assessments at the beginning (pre-test) and end (post-test) of each term. - One-on-one mentorship was available from enrollment through finals (up to 14 weeks). Group meetings occurred over 9 or 10 weeks depending on holidays. - Groups were available each day of the week and were led by a guiding mentor with the help of one or two program facilitators - The number of mentees enrolled in each group ranged from two to nine mentees. - Students who preferred not to attend group meetings were offered the group curriculum during one-on-one mentoring.	diagnosis as well as self-diagnosis)	Pre: (M = 8.79, SD = 1.89) Post: (M = 9.75, SD = 2.03)	social interactions with their peers - Quasi-experimental results suggest that social skills training is associated with a decrease in ASD symptoms among neurodiverse students. - Participation in the self-advocacy training was associated with heightened academic self-efficacy
(Gropper, R. J., 2014) Online Training/ coaching? "Working Memory Training Program"	Target Domain: Academics and EF -Participants completed 25 training sessions (about 45 min per session) of "Cogmed QM" over 5 weeks. - The program was provided on a CD and used on a personal computer	- A total of 62 participants enrolled in post-secondary program at college level and previous diagnosis of ADHD, learning disabilities (LD), or comorbid ADHD + LD	Working Memory: WAIS-IV: $p < 0.05$ Experimental: baseline: 8.21 (2.40) post-treatment: 10.21 (2.99) follow-up: 10.79 (2.36) CANTAB: Experimental (spatial span): $p < .0001$	- Significant effects from training were seen on the tasks focused on visual-spatial and auditory verbal. - Authors also concluded that while some improvements were seen in working memory, they were not seen in relation to academic

	- During each session participants completed a set of auditory-verbal and visual-spatial WM tasks, and responded by clicking on displays with the computer mouse. - Individualized training plans, but the typical plans included 12 different WM training exercises - Participants completed 8 tasks every day, 15 trials of each task. - Average training time each day was about 45 min	- Experimental group: 39 students - Control group: 23 students (did not receive treatment)	baseline: 0.067 (0.830) post-treatment: 0.907 (0.844) follow-up: 1.04 (0.822) Experimental (between errors): baseline: -0.152 (1.34) post-treatment: 0.168 (1.12) follow-up: 0.257 (1.18) Experimental (strategy scores): baseline: -0.226 (0.836) post-treatment: 0.197 (1.09) follow-up: 0.596 (1.36) PASAT: Experimental: (Set A T-Score) baseline: 44.46 (10.23) post-treatment: 52.47 (14.50) follow-up: 54.74 (13.68) Experimental: (Set B T-Score) baseline: 41.53 (12.01) post-treatment: 56.98 (11.43) follow-up: 58.90 (11.76) Academics: <u>The Nelson Denny Reading Test:</u> Experimental: baseline: 200.33 (30.24) post-treatment: 210.15 (29.36) follow-up: 211.05 (28.75) <u>The Woodcock-Johnson-III Tests of Achievement:</u> Experimental: baseline: 96.53 (12.01) post-treatment: 98.17 (10.87) follow-up: 98.70 (12.16) ADHD Symptoms: <u>ASRS:</u> Experimental:	performance like they had hypothesized. - Participants report that improved recall of verbal information allows them to learn and retain information from lectures and books, without having to re-read multiple times. -Several participants reported that they were able to sustain attention and feel more alert for longer periods of time.

			baseline: 42.07 (13.45) post-treatment: 35.29 (16.29) follow-up: 35.46 (18.02) <u>CFQ: p<0.05</u> Experimental: baseline: 55.86 (14.03) post-treatment: 47.00(19.78) follow-up: 46.17 (23.69)	
(Hillier, A., 2018) Support group "Connections Program"	Target Domain: Academics - Groups met weekly for 1 hour for a total of 7 weeks - 4-7 participants per group - Additional info addressing common challenges seen among autistic students in a university setting. - Same weekly structure: 5 min free chat; 10 min "check in" (progress on goals (homework) for that week); 30 min for that week's topic; 10 min for questions; and 5 min review	52 Post-secondary Students with ASD diagnosis who are registered with Student Disability Services (SDS)	1. <u>The Counseling Center Assessment of Psychological Symptoms-34 Scale</u> (Academic Distress) - Intervention 1 Pre (Mean, SD) (5.56, *not reported*) Intervention 1 Post (Mean, SD) (5.66, *not reported*)	- Of the 52 participants, 41 have either successfully graduated or are still enrolled - No significant difference seen on the subscale academic distress - participants reported the program as "worthwhile"
(Hotez, E., 2018) summer transition program/ mentoring "(STP2)"	Target Domain: Social communication, EF, and academics -Two autistic college students assumed a leadership role and acted as "mentors" - Autistic college students participated in the program as "mentees." - weeklong summer program	10 participants- incoming college students with ASD	<u>Social responsiveness scale SRS</u> pre: 67.30 (28.45) post: 62.40 (24.80) Z, p: Z= -2.14, p= 0.03 <u>Academic Self-efficacy Scale</u> pre: 9.00 (1.12) post: 8.90 (1.85) Z,p: Z= -0.07, p= 0.94	- Significant decrease in self-reported ASD traits from pre- to post-test - Questionable as to whether decreases in autism severity reflect meaningful and sustainable change.

	- 5 hours of instruction/ recreation over 5 days. - On the fifth day post-tests were completed - Many aspects of the program were modeled after a typical college classroom environment - 45-minute lectures with small breaks - Facilitators led each training module by discussing a skill, demonstrating the appropriate use of the skill, and then asking each student to use the skill with a peer			- This research suggests that participation in a brief, but intensive summer transition program may help prepare autistic college students to self-advocate and engage with diverse peers in college contexts. - No significant changes seen in academic self-efficacy (may take more time to develop)
(Meinzer, M. C., 2021) Mentoring Students Understanding College Choices: Encouraging and Executing Decisions for Success; SUCCEEDS	Target Domain- EF and Academics - Over course of a semester, consists of weekly group, individual coaching, and optional study halls - 1 session weekly over 15 weeks -60 minutes and facilitated by SUCCEEDS coaches. - Concrete tasks, manageable goals, and activities that align with the student's values within each major life area (e.g., academics, relationships)	8 undergrad students with ADHD who are willing to pay program fees	1.ADHD and related impairment Barkley adult ADHD rating scale (BAARS) Pre: (M, SD) (40.00, 10.34) 1: 43 2: 42 3: 26 4: 36 5: 48 6: 33 7: 59 8: 33 Post: (M, SD) = (34.38, 9.13) 1: 40 2: 34 3: 26 4: 30 5: 33 6: 32 7: 54 8: 26 2. Strategies for success (SFS) Pre: (M, SD) (49.75, 7.78) 1: 39 2: 64 3: 49 4: 45 5: 48 6: 55 7: 44 8: 54 Post: (M, SD) = 60.25 (11.36) 1: 56 2: 52 3: 73 4: 41 5: 71 6: 72 7: 55 8: 62 3. Weiss functional impairment rating scale (WFIRS) Pre: (M, SD) (63.25, 38.38)	-No students demonstrated significant improvement in ADHD symptoms - 5 of 8 students showed significant improvements in organizational skills - Did not reflect significantly improved self-reported impairment in majority of students - Majority of students significantly improved in terms of their organizational, time management, and planning skills

			1: 79 2: 96 3: 118 4: 27 5: 73 6: 4 7: 76 8: 33 Post: M(SD)= (51.13, 30.43) 1: 47 2: 89 3: 62 4: 77 5: 27 6: 6 7: 79 8: 22 <u>4. GPA</u> Pre N/A Post 1: not reported 2: 3.02 3: 2.83 4: 2.32 5: not reported 6: not reported 7: not reported 8: 2.53	
(Ncube, B. L., 2019) Peer Mentoring- <u>Autism Mentorship Program (AMP)</u>	Target Domain: Social Comm and Academics - Student centered approach - One on one mentor- student meetings occur every two weeks - Students chose topics/ goals of their interest - First meetings involve questionnaires to identify student goals- can help guide future meetings - Mentors assist students by providing tips, scaffolding, and companionship	23 students enrolled in their first year of the AMP with self-identified ASD diagnosis.	<u>1. Social Provisions Scale</u> Pre- (123.5, 47.4) Post (129.0, 45.8) <u>2. The Cambridge Friendship Questionnaire</u> Pre (50.1, 22.3) Post (52.3, 15.6)	- 68% of students identified improvement of grades and their study skills as a goal amongst other goals, 77% of 13 students asked, reported meeting their goals - Did not find any significant differences in perceived social support - AMP students reported high satisfaction with the program and expressed interest in returning to the program
(Prevatt, F., 2015) ADHD Coaching	Target Domain: Social communication, EF, and academics - 8-week program- 1 session per week - Total of 26 coaches provided services.	A total of 148 participants over a span of 5 years, and there was about 10 clients each semester - must be diagnosed with ADHD (self-reported) enrolled in college (but	EF/Study Skills: <u>LASSI:</u> Concentration: pre: 18.46(5.87) post: 23.50 (7.38) F= 20.96, d= 0.76 Information Processing: pre: 26.08 (6.46) post: 28.70 (6.22)	-Overall, improvements were noted in EF and academics. - It was hypothesized that participants would show pre–post improvements in study and learning strategies, self-esteem, emotional distress, and satisfaction with school

	- At the beginning of the semester the clients set 2-3 long-term goals, broken down into 3-4 short-term weekly goals. - Weekly assignments - Sessions involved discussing if short term goals were achieved. If not, problem solving strategies were taught - Participants in the study were recommended to reward themselves for motivation. -participants had to pay around $100. - Combined cognitive-behavioral therapy with psychoeducational techniques	5 % not enrolled currently)	F= 12.46, d= 0.41 Time Management: pre: 17.26 (6.62) post: 24.30 (8.30) F= 38.94, d= 0.89 <u>OQ-45:</u> Interpersonal Functioning: pre: 13.53 (6.94) post: 11.76 (7.03) F= 3.29, d= not reported Academics: Study Aids: pre: 21.18 (6.50) post: 24.78 (6.82) F= 16.52, d= 0.54 Test Strategies: pre: 23.38 (6.29) post: 27.08 (6.25) F= 11.11, d= 0.59	and work. All hypotheses were supported. - Largest effect sizes were found for time-management and concentration - Results were consistent across 5 years of coaching, across different semesters and time of semester, and with a variety of different coaches
(Solanto, M. V., 2021) group cognitive-behavioral treatment "CBT"	Target Domain: EF and Academics - Conducted in 12 sessions - Implemented cognitive and behavioral strategies to facilitate development of skills in executive self-management - Cognitive components included daily scheduling, prioritizing, planning, and self-activation/initiation.	- Comparison group of typical students (only pre no post) -38 total participants, 20 in comparison group (Typical), 18 in experimental group (ADHD). - Participants in CBT were required to be undergraduate or graduate students	Executive Function Outcome Measures: - <u>Barkley Deficits in Executive Functioning (BDEFS)</u> (INTERVENTION GROUP ONLY) See article for Comparison Group. **1**: <u>Self-management to time</u> Pre: (95.67, 6.89) Post: (87.22, 9.16) **2**: <u>Organization</u> Pre: (92.39, 7.14)	-Significant improvement in executive function on subscales of time management, organization, and total executive function - No significant improvements seen with academics - Results on empirical measures and narrative self-reports provide preliminary support for the

	- Behavioral components included contingent self-reinforcement; breaking down complex tasks; distraction control, visualization to sustain motivation toward distant rewards; and application of these strategies to tasks involving reading, note-taking, and organizing/writing academic papers. - Each weekly 2-hr session had 4 components: review of the previous week's home exercise; presentation of the new skill; in-class exercises; and reviewing the upcoming home exercise.	between the ages of 18 and 30 with a DSM-5 diagnosis of ADHD	Post: (86.83, 10.33) **3**: Motivation Pre: (93.78, 11.66) Post: (93.28, 6.61) **4**: Total executive function - The Learning Study Skills Inventory (LASSI-3rd edition) Pre: (93.50, 7.42) Post: (90.83, 7.54) **5**: Time management Pre: (8.50, 13.02) Post: (22.06, 24.85) **6**: Concentration Pre: (5.00, 5.99) Post: (21.00, 18.05) **7**: Motivation -CAARS: Pre: (7.33, 13.54) Post: (16.83, 24.38) **8**: Inattentive symptoms Pre: (80.22, 7.37) Post: (70.28, 8.66) **9**: Inattention/memory Academics -Learning and Study Skills Inventory (LASSI-3rd edition) Pre: (73.72, 8.30) Post: (62.17, 10.83) **10**: Grade Point Average (GPA) Pre: (6.86, 0.89) Post: (6.66, 1.56)	feasibility, acceptability, and effectiveness of this cognitive-behavioral intervention
(Thompson, C., 2020) Mentoring "specialist peer mentoring (SPM)"	Target Domain: Social Comm, Academics - Primarily a one-on-one session that occurred between the participants and their mentors	-Total of 30 undergraduate autistic university students -25 completed the quantitative aspect -23 completed the qualitative aspect	**1.** SRS-2: total and subscales Total: beginning: 89.72 (24.00) end: 79.66 (26.66) (t= 2.52, p= 0.02) Social Awareness:	-The authors found that the SPM peer mentoring program did help students improve their social communication skills. - Results indicated that the mentor-mentee partnership

	- Additional social group that allowed for application of the skills being learned. -Over the course of one semester, -One-on- one meetings between mentors and mentees lasted between one and two hours.	only one group -participants had self-reported diagnosis of ASD (at least),	beginning: 9.50 (3.14) end: 9.11 (3.06) (t= 0.67, p= 0.51) <u>Social Cognition:</u> beginning: 15.27 (5.88) end: 14.05 (5.39) (t= 1.20, p= 0.24 <u>Social Communication:</u> beginning: 29.94 (7.89) end: 25.50 (11.29) (t= 2.24, p= 0.03) <u>Social Motivation:</u> beginning: 18.22 (5.88) end: 16.00 (5.91) (t= 2.27, p= 0.03) <u>Restricted Interests and Repetitive Behavior:</u> beginning: 16.88 (7.50) end: 14.94 (6.50) (t= 1.65, p= 0.11) <u>2. PRCA:</u> beginning: 71.37 (4.60) end: 73.25 (9.29) (t= -0.64, p= 0.53) <u>3. SCAM:</u> beginning: 78.61 (4.91) end: 77.72 (8.18) (t= 0.54, p= 0.59) <u>4. SPCC:</u> beginning: 51.77 (17.48) end: 54.05 (14.22) (t= -0.63, p= 0.54) <u>5. SPS:</u> beginning: 70.22 (15.64) end: 69.38 (13.27) (t= 0.40, p= 0.69) ""t= -0.63, p= .0.54"" (p. 634)	was a crucial active ingredient of SPM. This partnership appeared to modify social cognition and motivation for autistic university students through modelling and practicing communication. - Results demonstrate that SPM can support participation at universities for autistic students.

(Wee, R., 2023) Online executive functioning and study skills program - iStudySmart programme	Target Domain: EF and Academics - Intervention for approximately 20 weeks, two terms in 2021 - Intervention combines both e-learning and online learning approaches. - Multi-modalities and key teaching principles have also been built into the design and content of the e-learning course materials - The content was delivered online on any compatible devices such as a desktop, laptop, tablet or phone. - About 1.5 hours to 2 hours of weekly work. - In addition to the e-learning content, there were a total of six stipulated face-to-face online consultation sessions - Facilitators meet with their assigned students virtually to provide the support and guidance - Intervention concludes with a live final presentation where the students present and answer questions	28 upper secondary and tertiary students coming from mainstream secondary schools, and private universities.	Time Management and Prioritization Skills **1.** "I review my progress towards my goals every now and then and revise my plans accordingly." d= 0.4, small **2.** "I prioritize my tasks so that I do the most important and urgent ones first." d=0.3, small Planning and Organization Skills **3**. "I break difficult tasks down into smaller components so that I can accomplish them one step at a time." d= 0.8, large **4**. "I am able to moderate my distractions and not affect the completion of my task." d= 0.7, moderate Tertiary Writing Skills **5**. "I know how to find relevant information from various sources (e.g. internet, newspapers & books, etc.). d= 0.7, moderate **6**. "I know the structure and language features of a speech." d= 0.82, large	- Most students showed improvements in the acquisition of skills in planning and organization -Effect size ranged from moderate to large - Intervention showed students can improve study and executive function skills effectively, with an online and e-learning delivery model surrounding these learning needs
(Weiss, A. L., 2015) Mentoring: Communication Coaching Program (CCP)	Target Domain: Social comm, EF, Academics - Includes disability counseling, communication coaching, peer coaching, social groups, and campus resources	Group 1: 55 students with diagnoses of ASDs have registered for services through the DSS office. Of those 5, 23 students with ASDs known to the disability	1. Graduation rate Pre: n/a Post: 8 graduated "thus far" 2. Dismissal rate/reason Pre: n/a Post: 0 dismissed	- Students in CCP achieved appreciable gains for three general goals: (1) EF/planning needed for academic and social activities (2) Ability to set relevant and attainable goals

		services office have participated in the CCP in some/ all aspects of program. Group 2: ASD students not enrolled in CCP		(3) Social-communication skills through conversation management. - Evidence would be strengthened if student participants' progress was tracked throughout their college experience in comparison with students not enrolled in program

Results from the 13 studies will be presented in intervention categories: cognitive behavioral therapy programs, working memory training program, executive functioning/study skills program, mentoring, coaching, and support group programs.

Cognitive Behavioral Therapy program

Cognitive behavioral therapy was the intervention type used in 3 studies, all of which had target domains of executive function and academics (Anastopoulos et al., 2020; Anastopoulos et al., 2021; Solanto et al., 2021). Looking across the 3 studies, CBT involved a group component plus one-on-one mentoring, which targeted individualized executive function skills (Anastopoulos et al., 2020; Anastopoulos et al., 2021; Solanto et al., 2021). All 3 studies showed significant gains in executive function skills and reduced inattentive symptoms (Anastopoulos et al., 2020; Anastopoulos et al., 2021; Solanto et al., 2021). In Anastopoulos et al. (2020), there was reported evidence of an increase in the number of credits taken, but no measurable increase in GPA (Anastopoulos et al., 2020). In Anastopoulos et al. (2021), authors concluded that the ACCESS program was effective in treating students with ADHD in college but reported no specific academic findings. Finally, Solanto et al. (2021) reported no academic improvement.

Working memory training program

Gropper et al. (2014) was the only working memory training program within the 13 studies. This intervention had target domains that included both executive function and academic outcomes. The program was provided on a CD, which was used on a personal computer, and included sessions targeting auditory verbal and visual spatial working memory tasks. Participants would complete 8 tasks every day, and 15 trials of each task. A typical plan included 12 different working memory training exercises, but individualized options were available for those who wanted them. Results identified significant effects on the tasks focused on visual-spatial and auditory verbal, as well as improvement in working memory, but not in relation to academics (Gropper et al., 2014).

Online executive functioning and study skills program

Wee et al. (2023) was the only investigation of an online executive function and study skills program within the included studies. The target domains included executive function and academic outcomes. The intervention was a 20-week program that included e-learning/online approaches as well as 6 weeks of face-face online consultations. The content was delivered on an electronic device (laptop, iPad, smartphone, etc.) and included about 1.5-2 hours of weekly work. Results showed that most students made improvements in the acquisition of skills in planning and organization (moderate to large effect size), indicating improvement in both executive function skills and study skills (Wee et al., 2023).

Mentoring

Six of the included interventions were classified as “mentoring” programs. Four studies identified improvements in executive functioning, social communication, and/or academic outcomes. Meinzer et al. (2021) implemented a mentorship program called Students Understanding College Choices: Encouraging and Executing Decisions for Success or “SUCCEEDS” and had target domains of executive function and academics. This intervention led to improvements in executive function skills only, specifically organization, time management, and planning skills (Meinzer et al., 2021). The interventions implemented by Gillespie-Lynch et al. (2017) (the “Project REACH mentorship program”) and Thompson et al. (2020) (“specialist peer mentoring (SPM)”) both had target domains of social communication and academics. Both studies showed improvements in social communication skills (Gillespie-Lynch et al., 2017; Thompson et al., 2020). Finally, the intervention in Weiss et al. (2015) (“Communication Coaching Program (CCP)”) had target domains of social communication, executive function, and academics. This intervention included disability counseling, communication coaching, peer coaching, social groups, and campus resources, and led to improvement in both executive function and social communication skills (Weiss, et al., 2015).

Two studies did not identify improvements in executive functioning, social communication, or academic outcomes. Hotez et al. (2018) implemented a summer transition program/mentoring intervention called, which has target domains of social communication, executive function and academics. Ncube et al. (2019) implemented the Autism Mentorship Program (AMP), which has target domains of social communication and academics. Neither of these studies showed improvements in the domains of interest (Hotez et al., 2018; Ncube et al., 2019).

Coaching

Prevatt et al. (2015) utilized a Coaching program. This intervention’s target domains were social communication, executive functioning, and academics, which were addressed through an 8-week program that included 1 session per week. Coaches encouraged participants to set long-term goals, which were then broken down into short-term weekly goals. This approach combined cognitive behavioral therapy with psychoeducational techniques and implemented weekly assignments aligned with participant goals. Results showed improvement in executive function skills, with the largest effect sizes observed in time management and concentration. There were no reported improvements in social communication measures or in academics. The study also highlights that these results were consistent across 5 years of coaching, across different semesters and time of semester, and with various coaches (Prevatt et al., 2015).

Support group program

Hillier et al. (2018) was the only study that was considered a "support group" intervention. This intervention was called the “Connections Program,” which implemented a 7-week program including a weekly hour-long meeting which maintained the same structure throughout the program. This structure included 5 minutes of free chat, 10 minutes of “check in” which allowed for talk of progress made on goals and the homework for that week, 30 minutes for that week’s topic, 10 minutes for questions; and a 5-minute review. This study included two types of data:

qualitative data, which was beyond the scope of the current literature review, and quantitative data. These data related to academic outcomes, rather than social communication or executive function outcomes. Specifically, these outcomes included completion rate/ success rate, with 41 of 52 of the participants either graduating or still being enrolled in their education. Further, no significant difference was observed on the subscale of academic distress. Finally, it should be noted that participants reported this program as being "worthwhile" (Hillier et al., 2018).

Discussion

Neurodivergent students face many barriers to accessing education at the post-secondary level, including impacts of executive functioning and social communication on their academic performance. Post-secondary institutions are increasingly recognizing the need to support neurodivergent students. As this literature review reveals, research has documented preliminary support for two approaches: cognitive behavioral therapy (CBT) and mentoring/coaching. However, there continues to be a need for additional research documenting the effectiveness of all programs designed to support neurodiverse post-secondary students.

Carryover effects of CBT and mentoring on academics

The current review identified 4 studies that supported the use of a CBT (+ coaching) approach for improving executive functioning abilities in neurodivergent college students. However, there was limited evidence of carry-over effects on academics (e.g., number of enrolled credits). Additionally, five studies found that mentoring/coaching led to improvements in executive functioning and/or social communication, with limited to no benefits translating to academic outcomes.

Future research should investigate the feasibility of CBT programs in post-secondary educational settings. While trained professionals can create and implement such programs, training faculty to support their students in this way would likely be beyond most faculty members' scope of practice. Instead, faculty and/or student accessibility services personnel could be trained in specific CBT strategies/ingredients, such as working with students to develop timelines for completing assignments, identifying ways to use planners and other external aids to organize and prioritize assignments, and breaking down assignments into smaller chunks, which they could share with students in one-on-one meetings (e.g., during office hours). Ultimately, the question of appropriate implementation should be asked through research focused on identifying key CBT strategies, exploring carryover effects of CBT on academics, and investigating the effects of faculty trainings.

In contrast, mentorship shows great potential for benefiting neurodivergent students across post-secondary settings, if appropriate mentors are identified and trained. Improvements to executive functioning and/or social communication could have far-reaching effects. However, to date, limited carryover effects on academics have been found. Thus, further investigation into these

carryover effects is warranted, as it may be that academics are being impacted but in subtle ways that were not detected by the outcome measures used.

Components of successful interventions

This literature review also identified components of successful interventions, which may prove useful in designing future support programs. The findings that include these components are separated below into the targeted outcomes- executive function and social communication.

1. *Executive Functioning*

In terms of successful strategies for supporting executive functioning, CBT interventions included 90-minute group sessions that would utilize the CBT treatment and 30-minute one-on-one sessions with a mentor (Anastopoulos et al., 2020; Anastopoulos et al., 2021; Solanto et al., 2021). Targets within these interventions were focused on executive functioning skills, time management, organization, and planning. Dosage was weekly group sessions, and weekly individual mentoring sessions, with a combined total of 1.5-2 hours per week (Anastopoulos et al., 2020; Anastopoulos et al., 2021; Solanto et al., 2021).

Wee et al.'s (2023) online executive function and study skills program was characterized by these components: an E-learning or online learning multimodality approach, six face-to-face online consultation sessions that provided support and guidance, and live final presentations where students would present and answer questions. Targets of this intervention were executive functioning skills, writing and presentation skills, and study skills. Dosage was about 1.5- 2 hours per week.

Mentoring was included within 6 studies (Gillespie-Lynch et al., 2017; Hotez et al., 2018; Meinzer et al., 2021; Ncube et al., 2019; Thompson et al., 2020; Weiss, et al., 2015). All studies included an approach that embraced student or peer coaches with or without adding communication coaches. These coaches met with students weekly. Interventions all had strategies that included concrete tasks, manageable goals, and activities that aligned with the students' values within each major life area (academics being one of these areas). Intervention targets included organizing academic materials, utilizing a calendar, creating prioritized to-do lists, working collaboratively with peers, and finding locations to study or complete work. Dosage was weekly group sessions, weekly individual sessions, and sometimes optional study halls (Gillespie-Lynch et al., 2017; Hotez et al., 2018; Meinzer et al., 2021; Ncube et al., 2019; Thompson et al., 2020; Weiss, et al., 2015).

Prevatt et al.'s (2015) coaching program was the only intervention of its category, but some key factors from this intervention were identified. First, the approach combined cognitive behavioral therapy with psychoeducation and required students to set 2-3 long term goals which were then broken down into 3-4 short term weekly goals. Strategies included one-on-one sessions with a coach to monitor mastery of CBT homework, discuss goals, reflect on goal attainment as well as

success and barriers, teach problem-solving strategies to meet goals, and set new goals. Session notes were immediately emailed to clients to facilitate CBT homework and support reflection and memory. The dosage was 8 sessions delivered on a weekly basis.

2. Social Communication In terms of effective social communication interventions, all 3 studies were considered Mentoring programs (Meinzer et al., 2021; Gillespie-Lynch et al., 2017; Weiss et al, 2015). Many commonalities were observed between these studies. First, successful interventions utilized an approach in which mentors met with students on a weekly basis, group meetings offered comfortable settings to practice social skills, and an environment was established that normalized that students can be making mistakes and knowing that this was okay (Meinzer et al., 2021; Gillespie-Lynch et al., 2017; Weiss et al, 2015). Strategies included video demonstrations, role plays, group conversations about role plays, and various writing and/or art activities (Meinzer et al., 2021; Gillespie-Lynch et al., 2017; Weiss et al, 2015). The dosage of these interventions included weekly mentor-led group sessions, with or without additional one-on-one sessions (Meinzer et al., 2021; Gillespie-Lynch et al., 2017; Weiss et al, 2015). Some of these programs had distinctions that stood out from the others within this category. For example, Gillespie-Lynch et al. (2017) utilized an intervention that followed standardized curriculum embracing universal design strategies, which included an option to only participate in one-on-one sessions. In these cases, mentors would incorporate aspects of the group work into one-on-one sessions, personalizing the intervention to student needs (Gillespie-Lynch et al., 2017). Weiss et al. (2015) implemented an intervention that provided communication coaching in authentic settings by going on field trips. This allowed mentors to help students navigate the campus bus, increase student efficiency in getting to class, and assist students if they were lost or confused (Weiss et al., 2015).

Carryover effects of interventions in a research lab setting

The initial intent of this review was to identify effective supports in the areas of academics and research lab engagement. Unfortunately, no publications were found that focused on aiding neurodivergent students in a research lab. It is critical that researchers investigate how post-secondary students can be supported in opportunities like research labs, as this is a valuable part of many post-secondary students' education. Looking at the findings from the academic supports, several identified strategies could be translated over into a lab setting. These strategies include considering the principles of universal design of learning, offering options to individualize student engagement, considering targeted supports around writing and presenting, and considering peer mentors within or outside of the lab. When looking at "within the lab" mentoring, this could include advice or recommendations on organizing lab materials, using a calendar, making to-do lists, and working collaboratively with a mentor/other peers within the lab. When looking at "outside the lab" support, results indicated that some students may prefer a neurodivergent mentor, which may require finding a mentor outside of the student's lab group (Gillespie-Lynch et al., 2017). Another possible strategy could be to encourage students to meet outside of scheduled lab meetings, as some may benefit by using this opportunity to prepare the

thoughts they may want to contribute within a lab meeting. Other possible strategies include offering multiple ways to engage in lab activities and options on how to complete lab work, providing coaching in authentic settings, and considering role play for commonly occurring issues that may arise in the lab (allowing students to be familiar with scenarios where something could go wrong).

Limitations and Future Directions

Despite the wealth of information gained through this literature review, some limitations should be noted. First, studies that did not use a group design or were unpublished dissertations were excluded. Due to the timeline and amount of research that went into this study, narrowing the 31 studies down to 13 studies eliminated other valuable study designs and publications that could have influenced this review's results. Thus, future research should explore results from single subject designs, qualitative designs, case study designs, and grey literature, including unpublished dissertations. Next, additional research should explore the effectiveness of CBT, mentorship-based approaches, and other strategies to support neurodiverse college students. With the findings coming from such a small group of included studies, more research is needed on these strategies. Along with effectiveness, the feasibility of these programs being implemented in a post-secondary educational setting should also be investigated. Determining how they can be altered to improve feasibility, while maintaining high levels of effectiveness will be important.

Further, many studies were excluded from the current review because they did not address potential carryover effects of executive functioning and/or social communication support programs on academic outcomes. Future research should focus on this critical outcome to determine how generalizable results are in terms of students' overall educational experience. Lastly, research investigating methods for supporting neurodiverse undergraduate researchers is needed. Out of all the studies included, none addressed the application of support strategies for neurodiverse students regarding engagement/success in a research lab. This is a more specialized outcome than general academic outcomes. However, given the important opportunities provided through engagement in research labs (e.g., gaining increased depth of knowledge related to advancements in their interest area, improving their networking skills, increasing their marketability post-graduation), research labs and mentors need to learn effective ways to accommodate their students' needs, so an inclusive environment is present for individuals with various learning styles.

Conclusion

This literature review sought to answer the research question "what post-secondary support programs are being implemented to help neurodivergent students with social communication and/or executive functioning in relation to academic performance and/or research assistantships?" Although multiple literature reviews have examined support programs for neurodivergent post-secondary students, this review differed as it targeted social communication and executive function outcomes in relation to academic performance. This review identified

preliminary research that supported CBT and mentorship-based approaches as means of improving executive functioning and social communication outcomes in relation to academics for neurodivergent college students. Critical next steps will involve investigating the feasibility and effectiveness of these approaches as they are applied in different post-secondary education settings. Research will also need to expand the focus from academic classroom supports to other environments, such as research labs. The supports that are effective in academic/classroom settings may or may not be translatable to other settings; thus, there is a critical need for research to investigate the translation of supports. Regardless of the precise path of future research, advocating for appropriate supports for neurodiverse students should continue to be a priority. As highlighted by the rights-outcome perspective on neurodiversity, we live in a world that is programmed to support the majority, which inherently creates barriers for those who are not part of that majority. Thus, strategies such as universal design and personalization of supports must be emphasized so that those who are not the “majority” feel supported and recognized for all that they contribute.

References

Anastopoulos, A. D., King, K. A., Besecker, L. H., O'Rourke, S. R., Bray, A. C., & Supple, A. J. (2020). Cognitive-behavioral therapy for college students with ADHD: Temporal stability of improvements in functioning following active treatment. *Journal of Attention Disorders*, *24*(6), 863–874. https://doi.org/10.1177/1087054717749932

Anastopoulos, A. D., Langberg, J. M., Eddy, L. D., Silvia, P. J., & Labban, J. D. (2021). A randomized controlled trial examining CBT for college students with ADHD. *Journal of Consulting and Clinical Psychology*, *89*(1), 21–33. https://doi.org/10.1037/ccp0000553

Dwyer, P., Mineo, E., Mifsud, K., Lindholm, C., Gurba, A., & Waisman, T.C. (2023). Building neurodiversity-inclusive post-secondary campuses: Recommendations for leaders in higher education. *Autism Adulthood*, *5*(1), 1-14. doi:10.1089/aut.2021.0042

Gillespie-Lynch, K., Bublitz, D., Donachie, A., Wong, V., Brooks, P. J., & D'Onofrio, J. (2017). "For a long time our voices have been hushed": Using student perspectives to develop supports for neurodiverse college students. *Frontiers in Psychology*, *8*. https://doi.org/10.3389/fpsyg.2017.00544

Gropper, R. J., Gotlieb, H., Kronitz, R., & Tannock, R. (2014). Working memory training in college students with ADHD or LD. *Journal of Attention Disorders*, *18*(4), 331–345. https://doi.org/10.1177/1087054713516490

Halpern, J., Arral, M., & Gesun, J. (2022, August). Work-in-Progress: Inclusive Mentoring Strategies for Neurodivergent Undergraduate Researchers in STEM. In *2022 ASEE Annual Conference & Exposition*.

Hillier, A., Goldstein, J., Murphy, D., Trietsch, R., Keeves, J., Mendes, E., & Queenan, A. (2018). Supporting university students with autism spectrum disorder. *Autism*, *22*(1), 20–28. https://doi.org/10.1177/1362361317699584

Hotez, E., Shane-Simpson, C., Obeid, R., DeNigris, D., Siller, M., Costikas, C., Pickens, J., Massa, A., Giannola, M., D'Onofrio, J., & Gillespie-Lynch, K. (2018). Designing a summer transition program for incoming and current college students on the autism spectrum: A participatory approach. *Frontiers in Psychology*, *9*, 46. https://doi.org/10.3389/fpsyg.2018.00046

Koehler Crawford, L. J. (2018). Students with autism spectrum disorder support while attending a four-year institution of higher education [Doctoral dissertation, University of the Pacific]. ProQuest.

Meinzer, M. C., Oddo, L. E., Garner, A. M., & Chronis-Tuscano, A. (2021). Helping college students with attention-deficit/hyperactivity disorder SUCCEED: A comprehensive care model. *Evidence-Based Practice in Child and Adolescent Mental Health*, *6*(1), 11–27. https://doi.org/10.1080/23794925.2020.1796548

Ncube, B. L., Shaikh, K. T., Ames, M. E., McMorris, C. A., & Bebko, J. M. (2019). Social support in postsecondary students with autism spectrum disorder. *International Journal of Mental Health and Addiction, 17*(3), 573–584. https://doi.org/10.1007/s11469-018-9972-y

Prevatt, F., & Yelland, S. (2015). An empirical evaluation of ADHD coaching in college students. *Journal of Attention Disorders, 19*(8), 666–677. https://doi.org/10.1177/1087054713480036

Rioux, M.H. (1997). Disability: the place of judgement in a world of fact. *Journal of Intellectual Disability Research, 41*(2), 20-28. doi:10.1111/j.13652788.1997.tb00686.x

Solanto, M. V., & Scheres, A. (2021). Feasibility, acceptability, and effectiveness of a new cognitive-behavioral intervention for college students with ADHD. *Journal of Attention Disorders, 25*(14), 2068–2082. https://doi.org/10.1177/1087054720951865

Thompson, C., McDonald, J., Kidd, T., Falkmer, T., Bölte, S., & Girdler, S. (2020). "I don't want to be a patient": Peer mentoring partnership fosters communication for autistic university students. *Scandinavian Journal of Occupational Therapy, 27*(8), 625–640. https://doi.org/10.1080/11038128.2020.1738545

Toews, S. G., Johnston, R., Kurth, J. A., Ruppar, A. L., McQueston, J. A., & McCabe, K. M. (2021). Alignment of supplementary aids and services with student needs and placement. *Intellectual and Developmental Disabilities, 59*(3), 187–203. https://doi.org/10.1352/1934-9556-59.3.187

Tufanaru C, Munn Z, Aromataris E, Campbell J, & Hopp L. (2020). Chapter 3: Systematic reviews of effectiveness. In E Aromataris & Z Munn (Eds.), JBI Manual for Evidence Synthesis. Available from https://synthesismanual.jbi.global

Wee, R., & Abdullah, S. (2023). Executive functioning, study skills, and dyslexia—Examining the effectiveness of an online programme for upper secondary and post-secondary students. *Asia Pacific Journal of Developmental Differences*, *10*(1), 65–97. https://doi.org/10.3850/S2345734123000336

Weiss, A. L., & Rohland, P. (2015). Implementing a communication coaching program for students with autism spectrum disorders in postsecondary education. *Topics in Language Disorders, 35*(4), 345–361. https://doi.org/10.1097/TLD.0000000000000071

Appendix

Figure 2

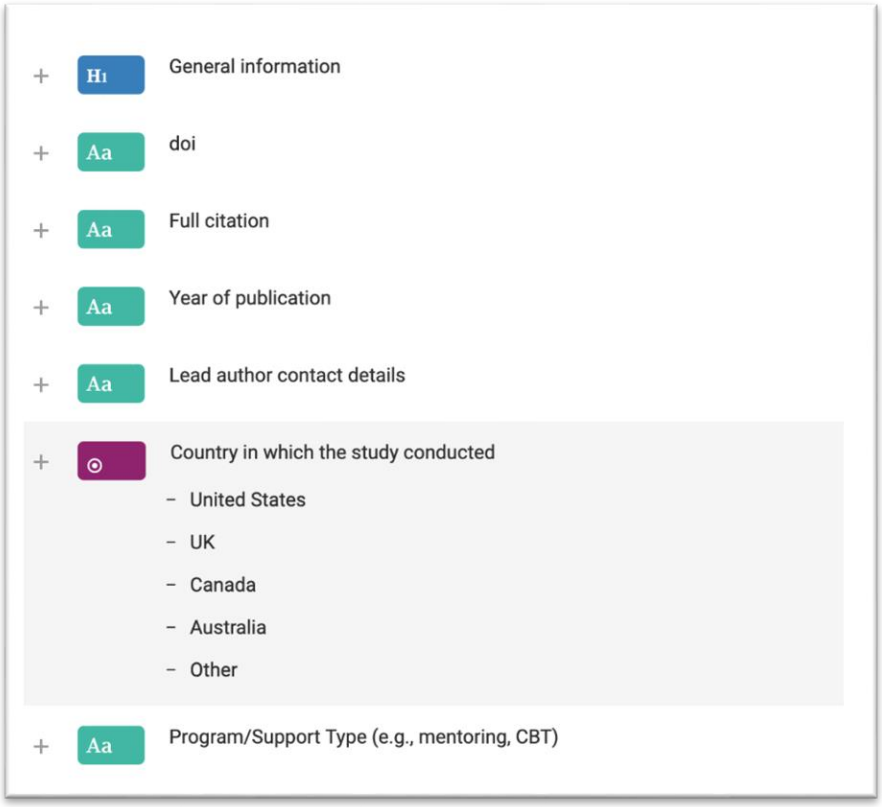


Figure 3-6

+ H1 Characteristics of included studies

+ H2 Methods

+ Aa Aim of study (research question/purpose)

+ H2 Participants

+ Aa Population description (diagnosis, age, number per group)

+ Aa Inclusion criteria

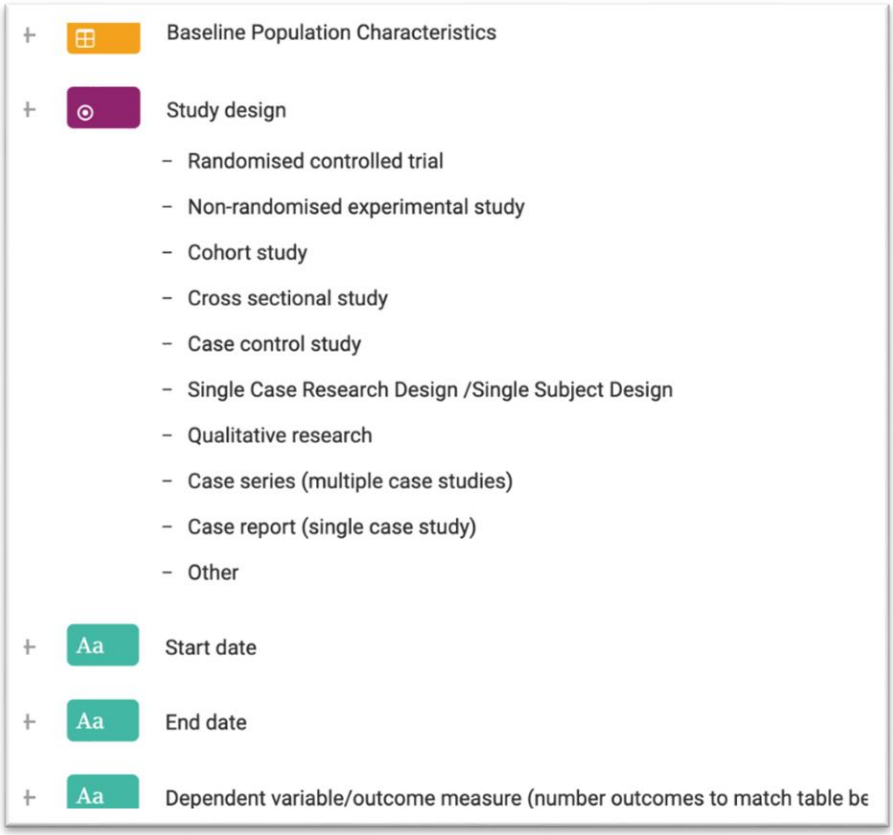
+ Aa Exclusion criteria

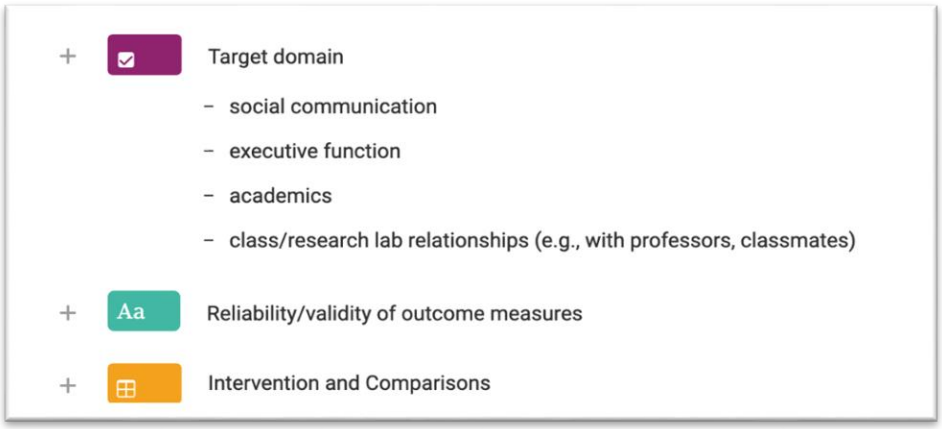
+ ◎ Method of recruitment of participants

- Phone
- Mail
- Clinic patients
- Voluntary
- Other

+ Aa Total number of participants (including breakdown by condition and timepoi

+ Aa Conditions (indicate Intervention 1, Intervention 2 if applicable - note: contro


Baseline Population Characteristics
Study design
- Randomised controlled trial
- Non-randomised experimental study
- Cohort study
- Cross sectional study
- Case control study
- Single Case Research Design /Single Subject Design
- Qualitative research
- Case series (multiple case studies)
- Case report (single case study)
- Other
Aa
Start date
Aa
End date
Aa
Dependent variable/outcome measure (number outcomes to match table be


Target domain
- social communication
- executive function
- academics
- class/research lab relationships (e.g., with professors, classmates)
Aa
Reliability/validity of outcome measures
Intervention and Comparisons

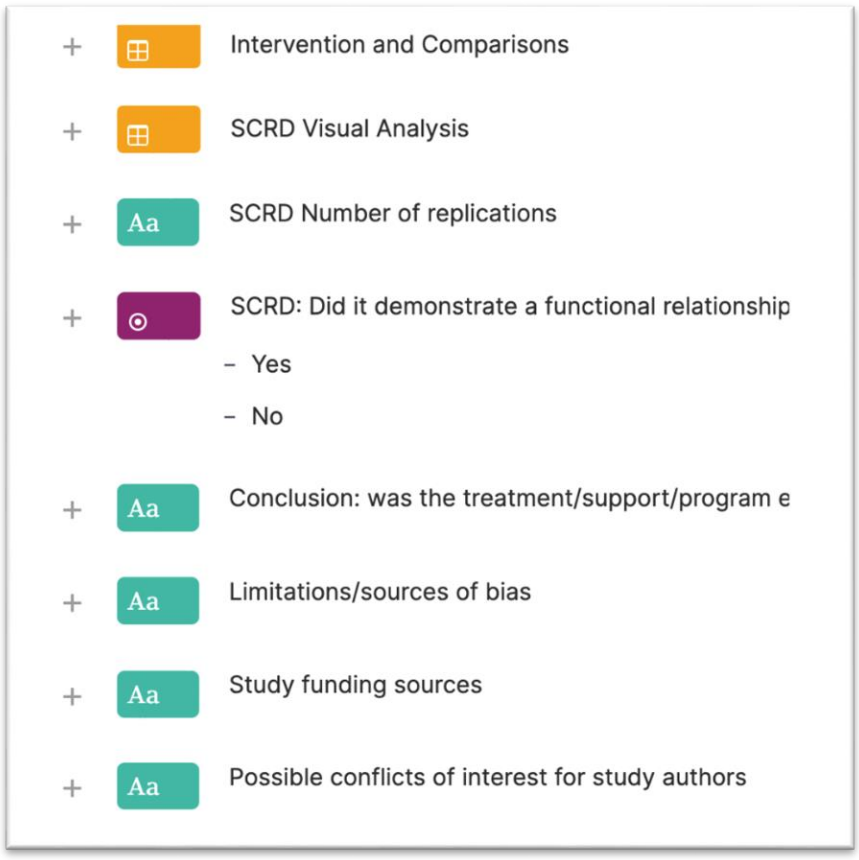

Intervention and Comparisons
SCRD Visual Analysis
Aa
SCRD Number of replications
SCRD: Did it demonstrate a functional relationship
Yes
No
Aa
Conclusion: was the treatment/support/program e
Aa
Limitations/sources of bias
Aa
Study funding sources
Aa
Possible conflicts of interest for study authors

Figure 7

Introduction	Reference in APA format	Provide the full reference for each article in APA format (copy and paste formatted reference from Endnote or Zotero for ease).
	What is the research question / purpose as stated by the authors?	State the research question or purpose – typically found at the end of the introduction section of an article.
Research Participants	Inclusion & exclusion criteria	Participant inclusion and exclusion criteria as stated by the authors
	Participant #s and groups	Groups and number of participants in each group
	Experimental group / intervention	What treatment or exposure or other experimental condition is the experimental group given?
	Control or alternate group(s) / interventions	Is this a "no treatment" control group? Or, what condition or treatment is the control group exposed to? What differentiates the control group from the experimental group?
Research Design	Describe the research design	Here, label the specific design. You may use terminology of the authors, or if that is not provided, decide what type of design it is. For example, is this a RCT, a cohort study, a longitudinal study with a single group, a single subject design, etc.
	Independent variable(s)	Identify the independent variable(s). Specify how they were measured (for example, voice therapy measured in number of sessions).
	Dependent variable(s)	Identify the dependent variable(s). Specify how they were measured (for example, voice handicap as measured by the Voice Handicap Index).
Outcome Measures	What is the primary outcome measure (or measures)?	This should be similar information to the "dependent variable" cell above. In this cell, focus on how the outcome was measured i.e. what rating scale or questionnaire.
	What evidence do the authors provide of reliability / validity of the primary measure?	Describe efforts made by the authors to document how their methods were reliable and valid. Did they use validated instruments? Did they evaluate reliability across judges? Did they use blinding to reduce bias and improve reliability? Other information?
Statistical Analyses	What statistical test was used for the primary outcome measure?	What was the statistical test completed (example: t-test, Pearson's correlation, ANOVA, etc.). Do your best to understand what was done.
	Notable secondary or post hoc analysis	Describe the results of any secondary or post hoc analysis.
	Did the authors include effect size? If	Report effect size if it was calculated.

	so, what was the effect size?	
Conclusions	What conclusions do the authors draw from this study?	Summarize the results of the study (according to the authors) in just a statement or two.
	What are one or two key limitations of the study per the authors	What do the authors describe as the key limitations or needed future directions of this research?
	Did the authors include any indication of clinical or personal significance?	Report any information the authors gave to report either clinical or personal significance. What is the evidence that the outcomes were relevant to the participants?
	Any other comments	Optional: Use this space to make any notes about this study that you think are relevant to your research question