The role of attention problems in predicting applying to college among high school girls with disabilities

Katherine W. Bromley[1], Atika Khurana[1], Leslie D. Leve[1], and Lauren Lindstrom[2]

[1] University of Oregon

[2] University of California, Davis

Correspondence concerning this article should be addressed to Katherine W. Bromley, Research Associate, University of Oregon, 5260 University of Oregon, Eugene, OR 97403. Email: kwagner3@uoregon.edu. P: (541) 346-3591. F: (541) 346-2594

Acknowledgements

The Version of Record of this manuscript has been published and is available in Educational Psychology 09 Nov 2023 https://doi.org/10.1080/01443410.2023.2279503

This study was supported by the Institute for Education Sciences (IES), US Department of Education, through grant R324A170148. The opinions expressed are those of the authors and do not represent views of the IES or the U.S. Department of Education. The authors report there are no competing interests to declare. The raw data and materials used in this manuscript are available for restricted-use through ICPSR (ICPSR-124181).

Abstract

Students with disabilities have higher rates of attention problems than those without disabilities. This can impede their academic success and postsecondary transition, but these effects have not been well-studied. Understanding these effects is especially critical among high school girls with disabilities who additionally experience significant other barriers to college enrollment. Using longitudinal data from 366 high school girls with disabilities, we examined whether attention problems predicted a lower likelihood of applying to college, and whether this effect was mediated by academic difficulties. We also tested whether attention problems moderated the effect of students' future aspirations on likelihood of applying to college. Consistent with our predictions, attention problems were associated with a lower likelihood of applying to college. The individual paths through academic difficulties were significant, but the bootstrap estimation of the indirect effect was not significant. Attention problems did not moderate the effect of future aspirations. Attention training interventions have the potential to improve postsecondary educational outcomes.

Keywords: Attention problems, students with disabilities, academic difficulties, applying to college, future aspirations

The role of attention problems in predicting applying to college among high school girls with disabilities

Introduction

Attention control is defined as the ability to focus one's attention on what is task-relevant and being able to flexibly switch focus from one task to another (Rueda, Posner, & Rothbart, 2005). It is a core skill that underlies working memory (Cowan et al., 2005), inhibitory control (Kane et al., 2007) and other key executive functions. Students with attention problems have a hard time concentrating and following directions in class (McClelland et al., 2013), which negatively impacts their academic performance (Breslau et al., 2009; Snyder et al., 2015) and is linked to disruptive behaviors (Atherton et al., 2019; Snyder et al., 2015) and emotional reactivity (Posner & Rothbart, 2000). Longitudinal evidence suggests that attention problems in early and middle childhood can reliably predict lower educational attainment in young adulthood (McClelland et al., 2013; Veronneau et al., 2012). Most of these findings, however, stem from studies done with typically developing students. Few studies have examined the role of attention problems in predicting educational outcomes among youth with disabilities. This is a critical gap considering that students with disabilities have greater difficulties with attention control than students without disabilities (Anastopoulos et al., 2011; Baird et al., 2009). Understanding the role of attention control difficulties in predicting educational outcomes is even more pertinent in the case of female students with disabilities who experience unique and significant barriers to postsecondary outcomes (Doren et al., 2011).

According to data from the National Longitudinal Transition Study – 2 (NLTS2), the enrollment rates of youth with disabilities at four-year colleges are half that of their peers without disabilities (Newman et al., 2011). These low rates of college enrollment are especially

concerning for girls with disabilities, as postsecondary education can be critically important to securing gainful employment and gender pay equity (Doren et al., 2011). Young women with disabilities are less likely to be employed, work fewer hours, and have lower earnings than young men with disabilities (Lindsay, 2018; Newman et al., 2009; Wagner et al., 2003). Among typically-developing youth, enrollment in postsecondary educational programs is linked to increased earnings and higher rates of employment, even if they do not complete their training (Baum et al., 2013; Oreopoulos & Petronijevic, 2013). As such, identifying malleable factors that can improve college enrollment rates among girls with disabilities could have a cascading effect on their future employment, financial and overall well-being.

Attention problems could operate as a significant impediment to postsecondary transition among girls with disabilities, however its effect has not been systematically examined with the exception of a few studies that have focused on boys or students with specific disability types, such as attention deficit hyperactivity disorder (ADHD) or autism spectrum disorder (Samyn et al., 2011; Samyn et al., 2015; Wu et al., 2002). These studies found that attention control skills significantly predicted academic performance in math, reading and spelling, even when accounting for effects of verbal IQ (Preston et al., 2009). In the limited research on attention problems among girls with disabilities, a 10-year longitudinal study of preadolescent girls diagnosed with ADHD found that executive function skills including attention control predicted better social functioning and fewer school suspensions during high school, and better employment outcomes in young adulthood (Miller & Hinshaw, 2010; Miller, Ho, & Hinshaw, 2012). Furthermore, in comparing the effects among girls with and without ADHD, Miller, Nevado-Montenegro, & Hinshaw (2012) reported similar findings regarding the role of attention

control in predicting educational outcomes regardless of the disability status, albeit having a compounding effect in the case of girls with disabilities.

More research is needed to better understand the effects of attention problems on educational outcomes of girls with disabilities and to develop more targeted supports during high school, prior to postsecondary transition (Monahan et al., 2020). The present study addressed this gap by examining the role of attention problems as a predictor of applying to college among high school girls with disabilities and further exploring whether the influence of attention problems operated through academic difficulties (i.e., absenteeism, suspensions/expulsions, detention, history of drop-out, credit deficiency, modified diploma track). Academic difficulties can significantly decrease the odds of students with and without disabilities graduating from high school (McKinley Yoder et al., 2022). Students who experience academic difficulties (e.g., low attendance, suspensions) are also much less likely to enroll in college (Fraysier et al., 2020). Although there may be other mechanisms by which attention difficulties impede postsecondary educational attainment (e.g., low grade point average) which should be explored in future research, here we focus on academic difficulties because they operate as strong risk factors for graduation outcomes and not pursuing postsecondary education. To the extent that attention problems are linked to academic challenges among high school girls with disabilities, we can intervene and address these gaps, facilitating successful postsecondary transition.

Attention problems can also attenuate the effect of other known predictors of applying to college such as students' future aspirations (i.e., hopes and beliefs about future outcomes, specifically related to education, and/or intentions to attend college (Beal & Crockett, 2010; Kirby et al., 2019; Ou & Reynolds, 2008). Many college outreach programs focus on promoting future aspirations with promising effects on college enrollment outcomes (Domina, 2009; Perna

& Swail, 2001). Even though youth with disabilities report high postsecondary aspirations, similar to those of their peers without disabilities (Lipscomb et al., 2017), they still have much lower rates of college enrollment. This is likely due to additional barriers that are experienced by youth with disabilities that make it harder for them to realize their aspirations. For instance, youth with disabilities tend to engage in fewer steps (e.g., taking college entrance exams) and receive less support (e.g., help from school staff to apply to college) to prepare for postsecondary education than those without disabilities (Lipscomb et al., 2017). It is possible, though not yet tested, that attention problems operate as an additional barrier for students with disabilities, attenuating the potential positive effect of future aspirations on likelihood of applying to college.

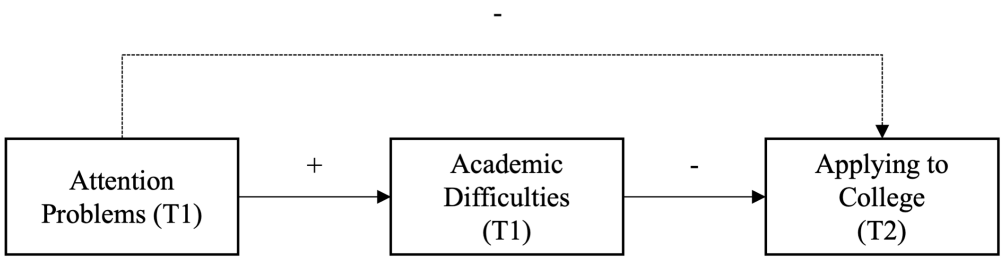
Current Study

The present study sought to examine the role of attention problems in predicting likelihood of applying to college in a longitudinal sample of 366 high school girls with disabilities who were recruited from 26 U.S. public schools as part of an efficacy trial of a gender-based, career-development intervention (CITATION OMITTED). We also tested whether the effect of attention problems on applying to college was mediated by academic difficulties experienced in high school. Finally, we tested whether attention problems moderated the potential positive effect of students' future aspirations on likelihood of applying to college. Guided by prior findings, we hypothesized that participants with greater attention problems would have lower likelihood of applying to college, and that some of this effect would be mediated by academic difficulties experienced during high school. Further, we hypothesized that attention problems would attenuate the potential positive effect of future aspirations on applying to college (see Figure 1).

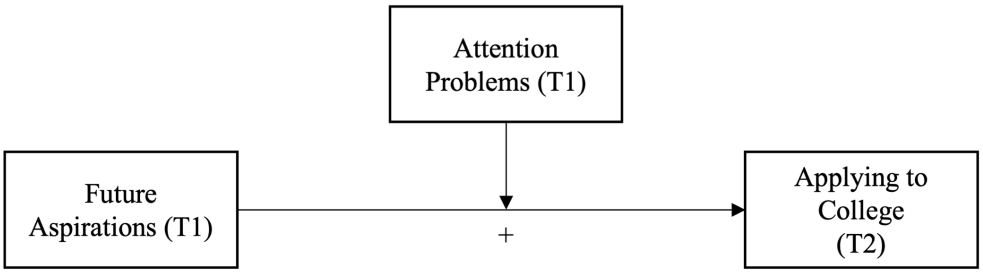
Figure 1

Hypothesized Models

1a. Direct and Indirect Effects of Attention Problems on Applying to College



1b. Moderating Effect of Attention Problems



Method

Participants

Participants were recruited from a convenience sample of schools as part of an efficacy trial examining the effects of a career development intervention for young women with disabilities (CITATION OMITTED). Special education teachers and school counselors in 26 participating high schools in the Northwest region of the United States identified young women with disabilities to participate in the study who: (a) identified as female, (b) were currently enrolled in grades 9 through 12 at a participating high school, (c) were eligible for special education services due to a high incidence disability (i.e., learning disability, other health impairment, autism spectrum disorder, speech/language disability, and emotional disability), and (d) possessed at least fifth- to sixth-grade reading, writing, and language skills.

The study sample comprised 366 high school girls with disabilities ($M_{\text{baseline age}}$ = 16.55, *SD* = 1.10; Range = 14-21 years), 61% of whom identified as white, 14% multiracial, 13% other or unknown, 5% Black or African American, 5% American Indian or Alaskan Native, 2% Asian American, and less than 1% Native Hawaiian or Pacific Islander. Nineteen percent of participants identified as Hispanic or Latina. Teachers reported that most participants were

eligible for special education services for specific learning disabilities (55%), followed by other health impairments (e.g., ADHD; 15%), emotional disturbance (6%), intellectual disability (6%), unknown disability (6%), speech or language impairment (4%), and other disabilities (i.e., visual, orthopedic, or hearing impairment; traumatic brain injury; deafness; 8%). The representation of the different disability types in our sample was comparable to national estimates of female students with disabilities in high schools receiving special education services (National Center for Education Statistics, 2016).

Procedure

Parents or guardians provided consent and participants provided assent prior to data collection. A total of 386 students consented and enrolled in the study. Only 366 reported on student surveys, data from these 366 participants were used in present analyses. The research team collected self-report data from participants and their teachers using an online survey administered in schools. All measures were constructed in Qualtrics, an online survey platform, and teachers and participating students self-reported data using the Qualtrics survey. A research team member was present to provide information about the project, collect consent/assent forms, and to answer questions during the survey administration. Teachers responded to the survey only once, at baseline, while student participants were assessed at four time points over the course of the main study: (a) baseline, (b) midway through the academic year (for schools implementing the intervention across a full year), (c) post-intervention (approximately four to six months following baseline for most schools, nine months following baseline for schools implementing the intervention across a full year), and (d) six-month follow-up (i.e., six months following post-intervention). For the current study, we analyzed data from two timepoints – baseline and post-intervention, hereafter referred to as T1 and T2. The career development intervention consisted

of 75 lessons divided into four modules: (a) self-awareness, (b) disability knowledge, (c) gender identity, and (d) career and college readiness. The intervention was designed to be delivered in a small, girls-only classroom context (e.g., 12 students) across 18 weeks, with each lesson taking approximately 50 minutes. Study procedures were approved by the institutional and school district review boards. Additional details about study procedures are described in (CITATION OMMITTED).

Measures

Attention Problems (T1)

Attention problems were assessed using the attention subscale of the Early Adolescent Temperament Questionnaire – Revised (EATQ-R; Ellis & Rothbart, 2001). The seven-item subscale assesses the capacity to focus and shift attention when desired (e.g., it is easy for me to really concentrate on homework problems) on a 5-point rating scale from (1) *almost always untrue* to (5) *almost always true* (α =.60). Items were reverse scored such that higher scores indicated greater attention problems. A composite attention problem score was calculated as an average of all completed items if participants completed at least 70% of items in the scale (M = 3.00, SD = 0.59).

Future Aspirations (T1)

Future aspirations were assessed using the future aspirations subscale of the Student Engagement Instrument (SEI; Appleton et al., 2006). The five-item subscale (e.g., I plan to continue my education following high school) is measured on a four-point scale from (1) *strongly disagree* to (4) *strongly agree* (α =.88). A composite score was calculated as an average of all completed items if participants completed at least 70% of items in the scale (M = 3.32, SD = 0.56).

Academic Difficulties (T1)

Academic difficulties were assessed using teacher reports of the types of academic difficulties each participant experienced at T1, including the following 6 items: absenteeism, suspensions/expulsions, detention, history of drop-out, credit deficiency, and being on track for a modified diploma. A total score was calculated for each participant representing the total number of academic difficulties endorsed by their teacher (M = 0.92, SD = 1.12; Range = 0-5).

Applying to College (T2)

Students reported on the steps they had taken to apply to college, on a four-point scale: (0) *I have not tried to get information on applying for admission*, (1) *I have not tried to get information on applying for admission, but I have talked to someone about how to get the information*, (2) *I have all the information I need and will soon apply for admission*, (3) *I have all the information I need and have applied for admission* or *I have already been admitted to college* (M = 1.16, SD = 0.98).

Covariates (T1)

We included T1 assessments of age, race, ethnicity, family socioeconomic status (SES), disability type, and group assignment (intervention vs. control) as covariates (Fleming & Fairweather, 2012; Sanford et al., 2011). Participants self-reported their date of birth which was used to calculate their age, and self-reported their race using the following categories: white, multiracial, other or unknown, Black or African American, American Indian or Alaskan Native, Asian American, Native Hawaiian or Pacific Islander. Participant race was recoded into three categories given the distribution: white (61%), multiracial (14%), and other (25%; which included other/unknown, Black/African American, American Indian/Alaskan Native, Asian American, and Native Hawaiian/Pacific Islander). Participants reported their ethnicity, which

was coded as Hispanic/Latina (1) and non-Hispanic/non-Latina (0). Family SES was assessed using student reports on the Hollingshead Two-Factor Index (M = 38.29, SD = 12.29, Range = 16.00-66.00; Hollingshead, 1975). Information about disability type was obtained by teacher reports of the primary IDEA disability category under which participants were eligible for special education services. Participant disability type was recoded into three categories given the distribution: learning disability (55%), other health impairment (15%), and other disability types (24%; including autism spectrum disorder, deafness, emotional disturbance, hearing impairment, intellectual disability, multiple disabilities, orthopedic impairment, speech or language impairment, traumatic brain injury, visual impairment, including blindness, other). Group assignment (intervention vs. control) was included as a covariate to account for potential intervention effects.

Analytic Strategy

The current study utilizes a correlational research design to test hypotheses. Specifically, a series of path models in M*plus* version 8.2 were tested, using full information maximum likelihood estimation with robust standard errors. The COMPLEX command was used to account for the nesting of participants within schools (Asparouhov, 2005). Bootstrap confidence intervals were calculated for indirect effects (MacKinnon, 2008). For the bias-corrected bootstrap test for the indirect effect ($\alpha^*\beta$), with a sample size of 366, we were sufficiently powered (at .80) to detect effects sizes between 0.14 and 0.26 for the α-β paths (Fritz & MacKinnon, 2007). Model fit was evaluated using the following criteria: Comparative Fit Index (CFI) $\geq$ .95, Root Mean Square Error of Approximation (RMSEA) $\leq$ .06, and Standardized Root Mean Square Residual (SRMR) < .08 (Hu & Bentler, 1999). Missing data on main analysis variables ranged from .5% to 11% and from .5% to 41% on covariates.

Results

Table 1 includes the bivariate correlations among the study variables. At a bivariate level, attention problems were significantly and negatively associated with applying to college (r = -0.23, p < .001) and future aspirations (r = -0.24, p < .001), and positively associated with academic difficulties (r = 0.19, p < .001). Students' future aspirations were positively correlated with applying to college (r = 0.18, p = .001) and negatively correlated with academic difficulties (r = -0.16, p = .003). Academic difficulties were also significantly and negatively associated with applying to college (r = -0.13, p = .03).

Table 1

Bivariate Correlations among Study Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Applying to college	-												
2. Attention problems	-0.23***	-											
3. Future aspirations	0.18**	-0.24***	-										
4. Academic difficulties	-0.13*	0.19***	-0.16**	-									
5. Age	0.23***	-0.08	-0.02	0.06	-								
6. White	-0.02	0.00	-0.00	0.08	0.05	-							
7. Multiracial	-0.04	0.10	-0.02	-0.01	-0.07	-0.66***	-						
8. Other race	0.06	-0.07	0.02	-0.10	-0.01	-0.72***	-0.18***	-					

9. Latina/Hispanic	0.03	-0.02	0.02	-0.04	0.01	-0.37***	0.09	0.45***	-				
10. Family SES	0.13	-0.03	0.08	-0.07	-0.01	0.13	-0.06	-0.13	-0.20**	-			
11. Learning disability	0.06	-0.10	0.01	-0.12*	-0.13*	0.03	-0.08	0.03	0.03	-0.10	-		
12. Other health impairment	0.09	-0.02	0.06	0.03	0.02	0.06	-0.05	-0.05	-0.07	0.10	-0.53***	-	
13. Other disability	-0.15**	0.12*	-0.06	0.11*	0.13*	-0.09	0.13*	0.00	0.03	0.03	-0.70***	-0.23***	-
14. Intervention group	0.15**	0.11*	-0.06	0.08	0.06	-0.04	0.12*	-0.04	-0.01	-0.18**	-0.04	0.08	-0.02

[a]Assessed at T2, all other variables assessed at T1.

*** $p < .001$, ** $p < .01$, * $p < .05$.

Direct and Indirect Effects of Attention Problems on Applying to College

Results from the path analyses, including covariates, revealed that attention problems (at T1) had a significant negative effect on applying to college (at T2), (B = -0.30, SE =0.09, p = .001), and a small, non-significant portion of the effect was channeled through academic difficulties. Specifically, attention problems were significantly associated with academic difficulties at T1, (B = 0.36, SE =0.09, p < .001), which in turn was a significant predictor of applying to college at T2, (B = -0.10, SE =0.05, p = .04). These effects were significant accounting for the effects of model covariates, including age, race, ethnicity, family SES, disability type, and intervention (vs. control) group assignment. Accounting for the indirect effect, attention problems had a significant, left-over direct effect on applying to college, (B = -0.26, SE =0.09, p = .003), indicating that attention problems were uniquely associated with subsequent steps taken to apply to college even when the indirect effect pathway involving academic difficulties was taken into account. The bootstrap estimated confidence intervals of the indirect effect of attention problems on applying to college, as mediated by academic difficulties, were not statistically significant at p < 0.05 (B = 0.04, SE =0.02, p = .05, 95% CI (-0.001, 0.075). Of the covariates, the effects of age (B = 0.19, SE =0.07, p = .01), family SES (B = 0.01, SE =0.001, p = .01), and intervention group assignment (B = 0.40, SE =0.12, p = .001) on applying to college were significant.

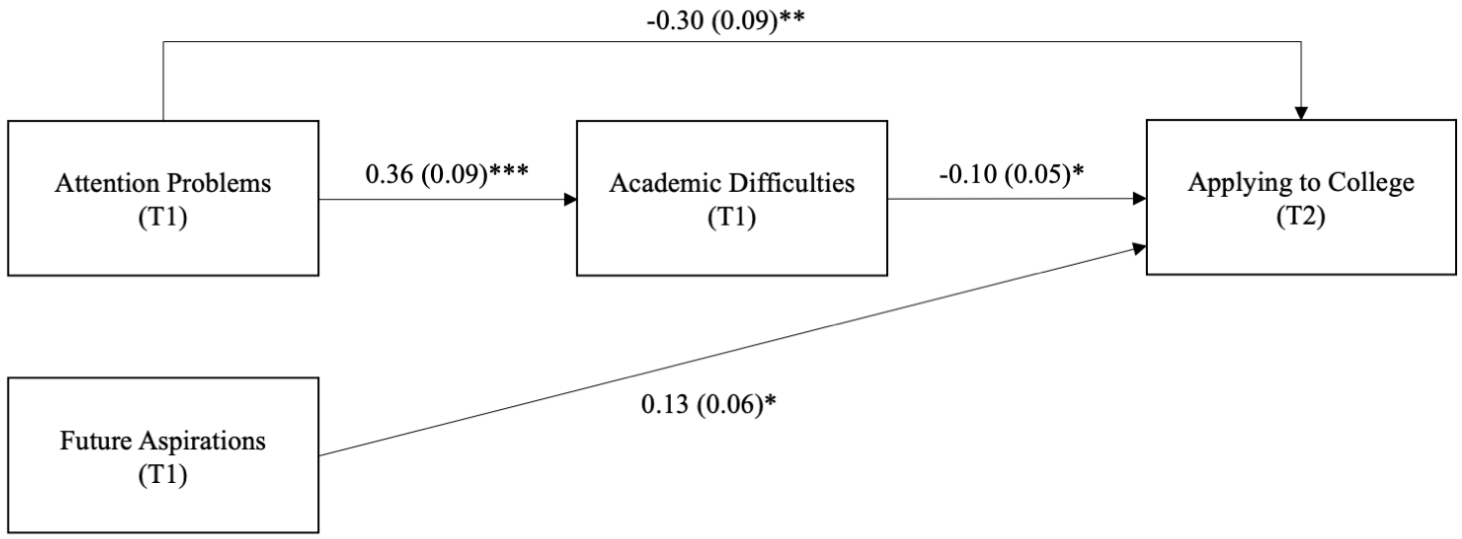
Moderating Effect of Attention Problems

As expected, future aspirations had a significant positive effect on applying to college, (B = 0.23, SE =0.10, p = .02). However, contrary to our hypothesis, attention problems did not attenuate the positive effect of future aspirations (B = 0.05, SE =0.08, p = .56). The interaction effect was not retained in the final model.

Overall fit of the final model was good: $\chi^2(df=10) = 13.24$, $p = .21$; CFI = .95; RMSEA (95% CI) =.03 (0.00, 0.07), SRMR = .02. Standardized estimates of direct and indirect effects are presented in Figure 2, unstandardized estimates are presented in Table 2.

Figure 2

Final Path Model Showing Standardized Estimates of Direct and Indirect Effects of Attention Problems on Applying to College



*** $p < .001$, ** $p < .01$, * $p < .05$.

Table 2

Unstandardized Estimates and Standard Errors for Final Model

Pathway of influence	*B*	*SE*	*p*
Effects on outcome			
Attention problems → Applying to college	-0.26	0.09	.003
Academic difficulties → Applying to college	-0.10	0.05	.04
Future aspirations → Applying to college	0.23	0.10	.02
Effect on mediator			
Attention problems → Academic difficulties	0.36	0.09	<.001
Covariate effects on outcome			
Age → Applying to college	0.19	0.07	.01
Multiracial → Applying to college	-0.01	0.13	.92
Other race → Applying to college	-0.03	0.10	.77
Latina → Applying to college	0.10	0.12	.39
Family SES → Applying to college	0.01	0.001	.01
Other health impairment → Applying to college	0.04	0.14	.77
Other disability → Applying to college	-0.28	0.18	.12
Intervention group → Applying to college	0.40	0.12	.001

Note. All variables except the outcome were assessed at T1.

Discussion

The purpose of this study was to examine the role of attention problems as a predictor of applying to college in a sample of high school girls with disabilities. Research with typically-developing samples has consistently demonstrated the critical role of attention control and

related executive functions as predictors of academic success and postsecondary educational attainment. Even though students with disabilities have higher rates of attention problems (Anastopoulos et al., 2011; Baird et al., 2009) and lower college enrollment rates than their peers without disabilities (Newman et al., 2011), few studies have examined the role of attention problems as a deterrent to college enrollment among students with disabilities. This is particularly important in case of female students with disabilities who experience unique and significant barriers to postsecondary educational attainment, which may be compounded by attention control difficulties. The present study addressed this gap by examining this association in a large, longitudinal sample of high school girls with disabilities. We also tested if the effect of attention problems on likelihood of applying to college was mediated by academic difficulties experienced during high school, and if attention problems attenuated the potential positive effect of future aspirations on applying to college.

Consistent with our hypotheses, students who reported greater attention problems at T1 had lower likelihood of applying to college at T2, with a small portion of this effect being channeled through academic difficulties, although the bootstrap estimated confidence intervals of the indirect effect were not statistically significant (p = .05). The effect of attention problems on academic difficulties was significant and consistent with prior research with girls with ADHD that found greater attentional problems predicted higher likelihood of school suspensions or expulsions (Miller, Nevado-Montenegro, & Hinshaw, 2012). Even after accounting for this indirect pathway, attention problems had a significant direct effect on applying to college, suggesting that other factors besides academic difficulties (e.g., grades, navigating college application paperwork) could be constrained by underlying attention problems and could lower the likelihood of applying to college. These findings are consistent with prior research that found

a direct effect of preschool attention problems on postsecondary graduation outcomes in a typically-developing sample (McClelland et al., 2013). Here too the authors noted that academic performance in early childhood did not significantly mediate the effects of attention problems on college completion. Our findings show that attention problems operate as a significant barrier to college enrollment among high school girls with disabilities. Future research should examine if attention problems potentially exacerbate the effects of other barriers to postsecondary transition (e.g., academic performance, self-determination) among high school youth with disabilities.

Our findings also indicated that girls with disabilities who have attention problems are more likely to experience academic difficulties, such as absenteeism, suspensions/expulsions, detention, history of drop-out, credit deficiency, and being on track for a modified diploma, which are associated with lower likelihood of applying to college. These findings are consistent with prior research among youth with and without disabilities (Breslau et al., 2009; Snyder et al., 2015) and suggest that attention problems can lead to difficulties in concentration, emotional and behavioral regulation (Atherton et al., 2019; McClelland et al., 2013). Attention problems are also associated with academic disengagement and lack of persistence in school settings, which in turn negatively impacts academic achievement (Duncan et al., 2007). Future research should examine other factors (e.g., students' grade point average) that might operate as mediators of the association between attention control difficulties and postsecondary educational attainment.

Prior evidence suggests attention control is malleable and attention training interventions can lead to significant improvements in attention skills (Rueda, Rothbart et al., 2005). Although attention skills are relatively malleable, much of the research on attention training has focused on younger children (Rueda, Rothbart et al., 2005; Diamond et al., 2013), it is unclear how such interventions may influence skill development in adolescents and how improved skills transfer to

academic performance or behavioral regulation (Rueda et al., 2010). Future research should examine attention training interventions for youth with disabilities with sufficient follow-up to examine differences in long-term outcomes (e.g., academic performance and educational attainment).

Consistent with prior evidence, study participants who reported high future aspirations were also more likely to apply to college (Beal & Crockett, 2010; Ou & Reynolds, 2008). However, we did not find any evidence of moderation, suggesting that regardless of attention problems, participants with high future aspirations were more likely to apply to college. The lack of a moderation effect may be related to our measure of future aspirations which was broader in focus and not specifically related to college enrollment, hence its effect may not be as dependent on individual differences in attention problems. Future research should examine potential moderating effects using other, more specific measures of postsecondary educational aspirations. Also, students' future aspirations are shaped and influenced by contextual factors such as parental expectations (O'Donnell et al., 2022) and family income and wealth (Cheatham et al., 2013). Considering the significant direct effect of future aspirations on likelihood of applying to college, future research and intervention efforts should focus on contextual factors that influence the future aspirations of girls with disabilities to better support their transition to postsecondary education.

Implications for Practice

Our findings suggest that attention control plays an important role in influencing young women with disabilities' process of applying to college and the academic barriers they experience in high school. Strengthening attention control abilities thus has the potential to influence both in-school and post-school outcomes. Although recommending specific practices is

beyond the scope of the findings, there is prior evidence regarding types of interventions and practices that increase attention control. Two specific training strategies, network training and state training, have been shown to improve attention (Tang & Posner, 2009; Posner et al., 2015). Network training refers to practicing cognitive tasks believed to exercise brain networks involved in attention (e.g., computerized exercises, video games, curricula focused on executive functions), and state training refers to practices that influence attention by developing a specific brain state (e.g., exercise, meditation; Posner et al., 2015). There is some evidence to suggest network (e.g., Kirk et al., 2016; Tamm et al., 2013) and state training interventions (e.g., Milligan et al., 2019) improve attention among youth with disabilities, though additional research is needed regarding girls with disabilities in particular.

Increased aspirations to attend college may also lead girls with disabilities in high school to take steps to apply to college. While to our knowledge, there are no interventions that specifically target postsecondary educational aspirations among girls with disabilities, transition planning and services can provide them with knowledge about postsecondary education options as well as supports needed to pursue them (e.g., help with filling out college applications and financial aid forms). To support these efforts, school personnel should ensure transition planning and services include: (1) goals addressing postsecondary education (Chiang et al., 2012; Trainor et al., 2016), (2) student participation in transition planning (Test et al., 2009), and (3) engagement with families to support postsecondary expectations (Chiang et al., 2012; Doren et al., 2012).

Limitations and Future Research

The findings should be interpreted in light of the following limitations. First, a majority of our study participants had learning disabilities and other health impairments, which limits our

ability to draw conclusions about how these effects may operate for high school girls with other primary disabilities (e.g., autism spectrum disorder). Relatedly, because our sample was only comprised of girls with disabilities, we do not have comparison groups (e.g., boys with disabilities, girls without disabilities) to identify effects specific to girls with disabilities. Future research should include comparison groups to better understand if the effects found are unique to girls with disabilities. Second, because our sample comprised predominantly of white participants, our findings may not be generalizable to other racial identities. Third, academic difficulties were measured based on teachers' subjective appraisals of disciplinary and academic challenges experienced by participants, which may not have been accurate and lack specificity. Future research should utilize academic records to identify challenges in these areas more thoroughly and with greater specificity (e.g., grade point average, number of office discipline referrals in the previous three months). Relatedly, self-report data is subject to social desirability bias and issues of shared method variance. Fourth, although we examined prospective associations between attention problems and applying to college, we were unable to test for time-ordered mediation using two timepoints. Conclusions regarding the mechanistic pathways of influence would be strengthened by including additional timepoints. Fifth, we collected follow-up data while the participants were still in high school and were limited to asking about their steps to apply to college rather than college enrollment or degree attainment. Future research could include longer periods of follow-up to determine how attention problems impact long term educational attainment.

Conclusion

Very few studies have examined the role of attention problems in predicting educational outcomes among youth with disabilities. Most prior research has examined the effects of

attention problems on in-school and post-school outcomes among youth in general (McClelland et al., 2013), with a small number of studies focused specifically on girls with ADHD (Miller & Hinshaw, 2010; Miller, Ho, & Hinshaw, 2012; Miller, Nevado-Montenegro, & Hinshaw, 2012). Our findings contribute to this small body of research and suggest high school girls with disabilities with lower attention control are less likely to take steps to apply to college and more likely to experience greater academic difficulties. These findings underscore the important role attention control plays in the educational trajectories of girls with disabilities and highlight a need for additional research to examine the mechanisms of influence through which attention control effects educational outcomes for this population. Interventions that can be leveraged within special education classrooms, such as attention training interventions, should be investigated as potential avenues to improve postsecondary educational outcomes.

References

Anastopoulos, A. D., Smith, T. F., Garrett, M. E., Morrissey-Kane, E., Schatz, N. K., Sommer, J. L., Kollins, S. H., & Ashley-Koch, A. (2011). Self-regulation of emotion, functional impairment, and comorbidity among children with AD/HD. *Journal of Attention Disorders, 15*(7), 583–592. https://doi.org/10.1177/1087054710370567

Appleton, J. J., Christenson, S. L., Kim, D., & Reschly, A. L. (2006). Measuring cognitive and psychological engagement: Validation of the Student Engagement Instrument. *Journal of School Psychology, 44*, 427-445. https://doi.org/https://doi.org/10.1016/j.jsp.2006.04.002

Asparouhov, T. (2005). Sampling weights in latent variable modeling. *Structural Equation Modeling: A Multidisciplinary Journal, 12*(3), 411-434. https://doi.org/10.1207/s15328007sem1203_4

Atherton, O. E., Zheng, L. R., Bleidorn, W., & Robins, R. W. (2019). The codevelopment of effortful control and school behavioral problems. *Journal of Personality and Social Psychology, 117*(3), 659-673. https://doi.org/10.1037/pspp0000201

Baird, G. L., Scott, W. D., Dearing, E., & Hamill, S. K. (2009). Cognitive self-regulation in youth with and without learning disabilities: Academic self-efficacy, theories of intelligence, learning vs. performance goal preferences, and effort attributions. *Journal of Social and Clinical Psychology*, *28*(7), 881-908. https://doi.org/10.1521/jscp.2009.28.7.881

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173-1182.

Baum, S., Kurose, C., & McPherson, M. (2013). An overview of American higher education. *The Future of Children, 23*(1), 17-39.

Beal, S. J., & Crockett, L. J. (2010). Adolescents' occupational and educational aspirations and expectations: Links to high school activities and adult educational attainment. *Developmental Psychology, 46*(1), 258-265. https://doi.org/10.1037/a0017416

Breslau, J., Miller, E., Breslau, N., Bohnert, K., Lucia, V., & Schweitzer, J. (2009). The impact of early behavior disturbances on academic achievement in high school. *Pediatrics, 123*(6), 1472-1476. https://doi.org/10.1542/peds.2008-1406

Cheatham, G. A., Smith, S. J., Elliott, W., & Friedline, T. (2013). Family assets, postsecondary education, and students with disabilities: Building on progress and overcoming challenges. *Children and Youth Services Review, 35*(7), 1078-1086. https://doi.org/https://doi.org/10.1016/j.childyouth.2013.04.019

Chiang, H.-m., Cheung, Y. K., Hickson, L., Xiang, R., & Tsai, L. Y. (2012). Predictive factors of participation in postsecondary education for high school leavers with autism. *Journal of Autism and Developmental Disorders, 42*, 685-696. https://doi.org/http://dx.doi.org/10.1007/s10803-011-1297-7

Cowan, N., Elliott, E. M., Scott Saults, J., Morey, C. C., Mattox, S., Hismjatullina, A., & Conway, A. R. A. (2005). On the capacity of attention: Its estimation and its role in working memory and cognitive aptitudes. *Cognitive Psychology, 51*(1), 42-100. https://doi.org/https://doi.org/10.1016/j.cogpsych.2004.12.001

Diamond, A. (2013). Executive functions. *Annual Review of Psychology, 64*(1), 135-168. https://doi.org/10.1146/annurev-psych-113011-143750

Domina, T. (2009). What works in college outreach: Assessing targeted and schoolwide interventions for disadvantaged students. *Educational Evaluation and Policy Analysis, 31*(2), 127-152. https://doi.org/10.3102/0162373709333887

Doren, B., Gau, J. M., & Lindstrom, L. (2011). The role of gender in the long-term employment outcomes of young adults with disabilities. *Journal of Vocational Rehabilitation, 34*(1), 35-42. https://doi.org/10.3233/JVR-2010-0532

Doren, B., Gau, J. M., & Lindstrom, L. E. (2012). The relationship between parent expectations and postschool outcomes of adolescents with disabilities. *Exceptional Children, 79*(1), 7-23. https://doi.org/https://doi.org/10.1177/001440291207900101

Ellis, L. K., & Rothbart, M. K. (2001, April). *Revision of the Early Adolescent Temperament Questionnaire* [Poster presentation]. Biennial Meeting of the Society for Research in Child Development, Minneapolis, MN, United States.

Fan, J., McCandliss, B. D., Sommer, T., Raz, A., & Posner, M. I. (2002). Testing the efficiency and independence of attentional networks. *Journal of Cognitive Neuroscience, 14*(3), 340-347. https://doi.org/10.1162/089892902317361886

Fleming, A. R., & Fairweather, J. S. (2012). The role of postsecondary education in the path from high school to work for youth with disabilities. *Rehabilitation Counseling Bulletin, 55*(2), 71-81. https://doi.org/10.1177/0034355211423303

Fraysier, K., Reschly, A., & Appleton, J. (2020). Predicting postsecondary enrollment with secondary student engagement data. *Journal of Psychoeducational Assessment*, *38*(7), 882-899. https://doi.org/10.1177/0734282920903168

Fritz, M. S., & Mackinnon, D. P. (2007). Required sample size to detect the mediated effect. *Psychological Science*, *18*(3), 233–239. https://doi.org/10.1111/j.1467-9280.2007.01882.x

Hollingshead, A. B. (1975). *Four factor index of social status* [Unpublished manuscript]. Yale University.

Hu, L. t., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1-55. https://doi.org/10.1080/10705519909540118

Kane, M. J., Brown, L. H., McVay, J. C., Silvia, P. J., Myin-Germeys, I., & Kwapil, T. R. (2007). For whom the mind wanders, and when: An experience-sampling study of working memory and executive control in daily life. *Psychological Science, 18*(7), 614–621. https://doi.org/10.1111/j.1467-9280.2007.01948.x

Kirk, H. E., Gray, K. M., Ellis, K., Taffe, J., & Cornish, K. M. (2016). Computerised attention training for children with intellectual and developmental disabilities: A randomised controlled trial. *Journal of Child Psychology and Psychiatry, 57*(12), 1380-1389. https://doi.org/https://doi.org/10.1111/jcpp.12615

Kiyonaga, A., & Egner, T. (2014). The working memory stroop effect: When internal representations clash with external stimuli. *Psychological Science, 25*(8), 1619–1629. https://doi.org/10.1177/0956797614536739

Lindsay, L., Cagliostro, E., Albarico, M., Srikanthan, D., & Mortaji, N. (2018). A systematic review of the role of gender in securing and maintaining employment among youth and young adults with disabilities. *Journal of Occupational Rehabilitation*, *28*(2), 232-251. https://doi.org/10.1007/s10926-017-9726-x

Lipscomb, S., Haimson, J., Liu, A. Y., Burghardt, J., Johnson, D. R., & Thurlow, M. L. (2017). *Preparing for life after high school: The characteristics and experiences of youth in special education. Findings from the National Longitudinal Transition Study 2012. Volume 1: Comparisons with other youth*. U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance. https://ies.ed.gov/ncee/projects/evaluation/disabilities_nlts2012.asp

MacKinnon, D. P. (2008). *Introduction to statistical mediation analysis*. Erlbaum.

Mazzotti, V. L., Rowe, D. A., Sinclair, J., Poppen, M., Woods, W. E., & Shearer, M. L. (2016). Predictors of post-school success: A systematic review of NLTS2 secondary analyses. *Career Development and Transition for Exceptional Individuals, 39*(4), 196-215. https://doi.org/10.1177/2165143415588047

McClelland, M. M., Acock, A. C., Piccinin, A., Rhea, S. A., & Stallings, M. C. (2013). Relations between preschool attention span-persistence and age 25 educational outcomes. *Early Childhood Research Quarterly*, *28*(2), 314-324.

McKinley Yoder, C., Cantrell, M. A., & Hinkle, J. L. (2022). Disparities in high school graduation by identity and disability using intermediate and long-term educational outcomes. *The Journal of School Nursing*. Advance online publication. https://doi.org/10.1177/10598405221078989

Miller, M., & Hinshaw, S. P. (2010). Does childhood executive function predict adolescent functional outcomes in girls with ADHD? *Journal of Abnormal Child Psychology, 38*(3), 315-326. https://doi.org/10.1007/s10802-009-9369-2

Miller, M., Ho, J., & Hinshaw, S. P. (2012). Executive functions in girls with ADHD followed prospectively into young adulthood. *Neuropsychology, 26*(3), 278-287. https://doi.org/10.1037/a0027792

Miller, M., Nevado-Montenegro, A. J., & Hinshaw, S. P. (2012). Childhood executive function continues to predict outcomes in young adult females with and without childhood-diagnosed ADHD. *Journal of Abnormal Child Psychology, 40*(5), 657-668. https://doi.org/10.1007/s10802-011-9599-y

Milligan, K., Sibalis, A., McKeough, T., Lackner, C., Schmidt, L. A., Pun, C., & Segalowitz, S. J. (2019). Impact of mindfulness martial arts training on neural and behavioral indices of attention in youth with learning disabilities and co-occurring mental health challenges. *Mindfulness, 10*(10), 2152-2164. https://doi.org/10.1007/s12671-019-01161-3

Monahan, J. L., Lombardi, A., Madaus, J., Carlson, S. R., Freeman, J., & Gelbar, N. (2020). A systematic literature review of college and career readiness frameworks for students with disabilities. *Journal of Disability Policy Studies*. Advance online publication. https://doi.org/https://doi.org/10.1177/10442073209068

Newman, L., Wagner, M., Cameto, R., & Knokey, A.-M. (2009). *The post-high school outcomes of youth with disabilities up to 4 years after high school. A report of findings from the National Longitudinal Transition Study-2 (NLTS2)*. SRI International. https://files.eric.ed.gov/fulltext/ED505448.pdf

National Center for Education Statistics. (2016, October). Table 204.50. Children 3 to 21 years old served under Individuals with Disabilities Education Act (IDEA), Part B, by age group and sex, race/ethnicity, and type of disability: 2014-15. https://nces.ed.gov/programs/digest/d16/tables/dt16_204.50.asp

Newman, L., Wagner, M., Knokey, A.-M., Marder, C., Nagle, K., Shaver, D., Wei, X., Cameto, R., Contreras, E., Ferguson, K., Greene, S., & Schwarting, M. (2011). *The post-high school outcomes of young adults with disabilities up to 8 years after high school: A report from the National Longitudinal Transition Study-2 (NLTS2)*. SRI International. https://ies.ed.gov/ncser/pubs/20113005/pdf/20113005.pdf

O'Donnell, A. W., Redmond, G., Arciuli, J., Robinson, S., Skattebol, J., Raghavendra, P., Thomson, C., Wang, J. J. J., & Emerson, E. (2022). The association between parental educational expectations and school functioning among young people with disabilities: A longitudinal investigation. *Exceptional Children, 89*(1), 60–78. https://doi.org/10.1177/00144029221087392

Oreopoulos, P., & Petronijevic, U. (2013). Making college worth it: A review of the returns to higher education. *The Future of Children, 23*(1), 41-65.

Ou, S.-R., & Reynolds, A. J. (2008). Predictors of educational attainment in the Chicago Longitudinal Study. *School Psychology Quarterly, 23*(2), 199-229. https://doi.org/10.1037/1045-3830.23.2.199

Perna, L. W., & Swail, W. S. (2001). Pre-college outreach and early intervention. *Thought & Action*, *17*(1), 99-110.

Posner, M. I., & Rothbart, M. K. (2000). Developing mechanisms of self-regulation. *Development and Psychopathology, 12*(3), 427-441. https://doi.org/10.1017/S0954579400003096

Posner, M. I., Rothbart, M. K., & Tang, Y.-Y. (2015). Enhancing attention through training. *Current Opinion in Behavioral Sciences, 4*, 1-5. https://doi.org/https://doi.org/10.1016/j.cobeha.2014.12.008

Preston, A. S., Heaton, S. C., McCann, S. J., Watson, W. D., & Selke, G. (2009). The role of multidimensional attentional abilities in academic skills of children with ADHD. *Journal of Learning Disabilities, 42*(3), 240-249. https://doi.org/10.1177/0022219408331042

Rueda, M. R., Checa, P., & Rothbart, M. K. (2010). Contributions of attentional control to socioemotional and academic development. *Early Education and Development, 21*(5), 744-764. https://doi.org/10.1080/10409289.2010.510055

Rueda, M. R., Rothbart, M. K., McCandliss, B. D., Saccomanno, L., & Posner, M. I. (2005). Training, maturation, and genetic influences on the development of executive attention. *Proceedings of the National Academy of Sciences of the United States of America, 102*(41), 14931-14936. https://doi.org/10.1073/pnas.0506897102

Rueda, M. R., Posner, M. I., & Rothbart, M. K. (2005). The development of executive attention: Contributions to the emergence of self-regulation. *Developmental Neuropsychology, 28*(2), 573-594. https://doi.org/10.1207/s15326942dn2802_2

Samyn, V., Roeyers, H., & Bijttebier, P. (2011). Effortful control in typically developing boys and in boys with ADHD or autism spectrum disorder. *Research in Developmental Disabilities, 32*(2), 483-490. https://doi.org/10.1016/j.ridd.2010.12.038

Samyn, V., Roeyers, H., Bijttebier, P., Rosseel, Y., & Wiersema, J. R. (2015). Assessing effortful control in typical and atypical development: Are questionnaires and neuropsychological measures interchangeable? A latent-variable analysis. *Research in Developmental Disabilities, 36*, 587-599. https://doi.org/10.1016/j.ridd.2014.10.018

Sanford, C., Newman, L., Wagner, M., Cameto, R., Knokey, A.-M., Shaver, D., Buckley, J. A., & Yen, S. J. (2011). *The post high-school outcomes of young adults with disabilities up to 6 years after high school. Key findings from the National Longitudinal Transition*

Study-2 (NLTS2). SRI International. https://ies.ed.gov/ncser/pubs/20113004/pdf/20113004.pdf

Snyder, H. R., Gulley, L. D., Bijttebier, P., Hartman, C. A., Oldehinkel, A. J., Mezulis, A., Young, J. F., & Hankin, B. L. (2015). Adolescent emotionality and effortful control: Core latent constructs and links to psychopathology and functioning. *Journal of Personality and Social Psychology, 109*(6), 1132-1149. https://doi.org/10.1037/pspp0000047

Tamm, L., Epstein, J. N., Peugh, J. L., Nakonezny, P. A., & Hughes, C. W. (2013). Preliminary data suggesting the efficacy of attention training for school-aged children with ADHD. *Developmental Cognitive Neuroscience, 4*, 16-28. https://doi.org/https://doi.org/10.1016/j.dcn.2012.11.004

Tang, Y.-Y., & Posner, M. I. (2009). Attention training and attention state training. *Trends in Cognitive Sciences, 13*(5), 222-227. https://doi.org/https://doi.org/10.1016/j.tics.2009.01.009

Test, D. W., Mazzotti, V. L., Mustian, A. L., Fowler, C. H., Kortering, L., & Kohler, P. (2009). Evidence-based secondary transition predictors for improving postschool outcomes for students with disabilities. *Career Development for Exceptional Individuals, 32*(3), 160-181. https://doi.org/10.1177/0885728809346960

Tiberio, S. S., Capaldi, D. M., Kerr, D. C., Bertrand, M., Pears, K. C., & Owen, L. (2016). Parenting and the development of effortful control from early childhood to early adolescence: A transactional developmental model. *Development and Psychopathology*, *28*(3), 837–853. https://doi.org/10.1017/S0954579416000341

Veronneau, M.-H., Hiatt Racer, K., Fosco, G. M., & Dishion, T. J. (2014). The contribution of adolescent effortful control to early adult educational attainment. *Journal of Educational Psychology, 106*(3), 730-743. https://doi.org/10.1037/a0035831

Wagner, M., Cadwallader, T., Marder, C., Cameto, R., Cardoso, D., Garza, N., Levine, P., & Newman, L. (2003). *Life outside the classroom for youth with disabilities. A report from the National Longitudinal Transition Study-2 (NLTS2).* SRI International. www.nlts2.org/reports/2003_04-2/nlts2_report_2003_04-2_complete.pdf.

Wu, K. K., Anderson, V., & Castiello, U. (2002). Neuropsychological evaluation of deficits in executive functioning for ADHD children with or without learning disabilities. *Developmental Neuropsychology, 22*(2), 501-531. https://doi.org/10.1207/S15326942DN2202_5