# Impact of Disability Services on Academic Achievement Among College Students with Disabilities

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## Abstract

Disability service offices within postsecondary educational institutions exist to provide students with disabilities (SWD) reasonable accommodations needed to facilitate educational equity and promote inclusion and access to postsecondary education. Little is known, however, regarding how services provided by these offices contribute to academic success that predicts college persistence and graduation. Using the *International Classification of Function, Disability, and Health* (ICF) as a framework to examine the impact of student disability services and other contextual factors on academic achievement, results from this study found that sex, race/ethnicity, college major, type of disability, and time when students register for disability services predict semester grade point average (GPA). Recommendations for practitioners and researchers are discussed.

*Keywords: disability services, postsecondary education, students with disabilities*

According to the National Center for Education Statistics (NCES), about one in ten undergraduate students report having one or multiple disabilities (Snyder & Dillow, 2015). With the passage of the Americans with Disabilities Act (ADA) and earlier legislation provided by Section 504 of the Rehabilitation Act of 1973, educational institutions are prohibited from discriminating against students with disabilities (SWD). Postsecondary educational institutions that receive federal funds are mandated to provide SWD with reasonable accommodations for academic activities, such as classroom accommodations (e.g., reserved front row seating); exam accommodations (e.g., extended time); assistive technology (e.g., Smart Pen©; a ballpoint pen that has an embedded computer and digital audio recorder); auxiliary aids (e.g., reader or interpreter); and housing and transportation support services. To ensure these accommodations are provided, colleges and universities often charge disability services offices to monitor that academic accommodations and school-related activities are provided to all qualified students. These academic supports not only promote SWD's learning, but also contribute to the development of social networks important to college success.

Using a broad set of strategies to evaluate and determine appropriate accommodations, disability service personnel offers a range of support services that include career counseling; study skills training; resource identification (e.g., housing, psychological services, and tutoring centers); and disability advocacy. Although disability services are intended to support college persistence and graduation, little is known as to whether these supports as well as other factors actually contribute to academic performance and access to school-related activities. This study examined the impact of disability services on academic achievement, as well as factors that predict academic achievement of SWD. Using the *International Classification of Function, Disability, and Health* (ICF)

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framework, which suggests that academic outcomes of SWD are influenced by an amalgam of health conditions, individual considerations, and environmental influences (World Health Organization [WHO], 2002), the current exploratory study examines the impact of student disability services on academic achievement.

### Assessing Academic Achievement Using the ICF

The *International Classification of Function, Disability, and Health* (ICF) was developed by the WHO in 1980 and updated in 2002 to serve as a universal framework and classification system. The ICF is a biopsychosocial model that provides a holistic view of one's health conditions within an individual-environmental context. Rather than focusing on disability itself, the ICF model places emphasis on health and the interaction between individual functioning and contextual environmental and personal factors. This model has been widely applied in clinical assessment, outcome measurement, program evaluation, and research as a tool to help conceptualize one's level of functioning and disability with regard to health and associated contextual factors. Applications of the model have examined personal and environmental factors on long-term immune system health outcomes among people living with HIV (Chiu, Boomer, & Conyers, 2018), persons affected by fibromyalgia (Muller et al., 2017), and the impact of assistive devices on functional outcomes among children with disabilities (Henderson, Skelton, & Rosenbaum, 2008). We applied the ICF to better understand academic performance within the context of associated personal and environmental factors. In the following sections, we describe how the selected outcome variables are predictive of academic achievement within the ICF framework.

### Academic Achievement as a Functional Outcome

Within the ICF model, a functional outcome consists of three personal domains: (a) impairments such as body functions and structures, (b) activity which refers to tasks or actions a person undertakes in major life areas, and (c) participation in life situations within the community (WHO, 2002). The ICF model uses performance and capacity to measure one's level of activity and participation to understand what a person does in a specific context and to understand the person's current ability to execute a task without assistance. For example, a common functional outcome operationalized in many education research studies is student grade point average (GPA).

### Contextual Factors Contributing to Academic Success

As noted earlier, contextual factors that include personal, interpersonal, and environmental influences contribute to learning experiences and ultimately academic outcomes. An examination of each of these contextual factors as part of the ICF framework will be reviewed and how it is applied to this study.

**Personal factors.** Perhaps more than any other applied criterion, GPA is the predictor used most often in determining academic success (i.e., persistence and graduation) (Crisp, Nora, & Taggart, 2009). Although somewhat simplistic as a measured outcome, as we have seen among SWD, GPA involves an understanding of contextual factors associated with personal and environmental influences. Within the literature, influences associated with academic achievement noted among the general college population include age, aptitude, education, enrollment status (full-time vs. part-time), ethnicity/race, sex, first-generation college student, sense of belonging, socioeconomic status, study skills, and self-perceptions pertaining to advocacy, determination, efficacy, and social capital (Dutta, Schiro-Geist & Kunda , 2009; Field, Sarver, & Shaw, 2003; Getzel, 2008; Herbert et al., 2014; Lackaye & Margalit, 2006; Lombardi, Murray, & Gerdes, 2012; O'Neill, Markward, & French, 2012). Although these influences are, for the most post, similar to those for SWD, there is a unique perspective that living with a disability provides that most college students without disabilities have limited understanding or appreciation of when dealing with challenges needed to succeed in college. For example, because of the continued stigma associated with disability, SWD will often report a fear of disclosing one's disability, lack knowledge in terms in the documentation process needed to establish eligibility for student disability services, and/or express uncertainty about the types of classroom accommodations available to promote learning as well as the ability to discuss and secure them with faculty (Collins & Mowbray, 2005; Dutta et al. , 2009; Herbert et al., 2014; Mamiseishvili & Koch, 2011).

**Environmental factors**. Environmental factors are external considerations that include architectural barriers, stigma, legal and social structures, and service provisions (WHO, 2002). Research has shown that environmental factors such as campus climate (e.g., faculty attitudes toward SWD), disability-related policies, campus location, and financial aid resources are associated with SWD's academic performance and educational outcomes (Collins & Mowbray, 2005; Herbert et al., 2014).

*Academic accommodations.* Providing academic accommodations is one of the essential functions of disability services. The availability and types of accommodations, as well as university policies, have been identified in various studies as important environmental factors but, given the available literature, it is difficult to make sweeping recommendations across disability groups given the diversity that exists. As one example to demonstrate this problem, Gregg and Nelson (2012) conducted a meta-analysis on the effectiveness of providing extra time to students with learning disabilities and concluded that inconsistent findings could be explained by varying samples as a function of age, educational background, and severity of functional reading levels. These findings have, in fact, led to difficulties in making decisions about appropriate academic accommodations even when students have the same identified disability and, as a result, generate evidence-based practices that the disability services personnel may implement.

*Use of disability services.* The first step in securing services for SWD is to register with the disability services office on campus (Reilly & Davis, 2005). Typically, this process involves medical, psychological, or other specialized evaluations to determine if the students are eligible for disability services. Interestingly, despite the important role that these services provide to SWD, there is limited empirical evidence as to how disability services impact postsecondary outcomes. Of the available studies, the evidence is mixed. For example, Getzel, McManus, and Briel (2004) found that SWD who met more frequently with disability specialists had higher GPAs than those who did not follow through with their appointments. O'Neill, et al. (2012) compared a model that included student personal factors to a second model that included these same factors and the receipt of disability services and found that the later model was significantly better at explaining graduation outcomes. In contrast, a ten year longitudinal study by Herbert et al. (2014) compared students who initially sought disability services but either was found ineligible, did not provide documentation to establish the existence of disabilitydisability, or did not follow required procedures to those students who followed through and ultimately were determined eligible services. A comparison to both groups found that graduation rates were within 1% of one another with both being approximately 66%. Although it was one of the few longitudinal studies, one limitation was that it did not consider at what point students attempted to secure disability services and, as such, we do not have a clear understanding how this variable and related factors as noted in this literature review contribute

to college persistence. Given the limited number of studies available that have examined the impact of student disability services on persistence and graduation, further investigation is warranted to better understand nuances of person and environmental influences using the ICF as a framework.

The current exploratory study was undertaken to examine contextual factors that contribute to students' academic performance as measured by semester-by-semester GPA and to determine whether the use of disability services impacts students' academic outcomes. The specific research questions were as follows: (1) To what extent does registration with the disability services office impact semester GPAs among SWD; and (2) To what extent do personal and environmental factors contribute to SWD's semester GPAs?

## Methods

### Data Source

The current study used secondary data to examine the impact of personal and environmental factors on semester GPAs for SWD with an intention to understand the impact of disability services on SWD's academic performance. The data source is the disability services office at a mid-Atlantic land-grant public university. Among the 40,552 undergraduate students enrolled in 2017-2018 academic year, there were approximately 1,935 SWD registered with the disability services office. The office is housed within the Office of the Vice Provost for Educational Equity, which serves as an advocate for diverse student populations. The professional staff includes a director, six disability specialists, four administrative assistants, one exam coordinator, and two graduate assistants. Each student must provide documentation to support the existence of disability and then complete an intake evaluation to determine eligibility in order to receive academic and related accommodations. Accommodations are determined based on an evaluation of the students' functional limitations; examples may include exam accommodations, classroom accommodations, note-taking assistance, alternative textbook, assistive technology, housing accommodations, accessible transportation, and other related services.

Longitudinal data was extracted from the disability services office database at the end of Spring 2015. Demographic information, academic standing, disability-related information, and approved accommodations were entered into the database at every student appointment. One of the administrative assistants helped compile the dataset for the research team with the permission of the director. Academic records

documenting each student's semester GPA were retrieved from the university registrar's database.

Participant selection criteria included students who (1) were undergraduate students enrolled in a degree program at the main campus of the university, (2) registered themselves with the disability services office, (3) completed their intake assessments with a disability specialist, and (4) received services during the 2009-2011 academic years. Of the 566 students who met the study criteria, four individuals had missing data on gender, time of registering student disability services, and types of accommodations. We removed them from the dataset, as these variables are important for data analysis. The records of 562 students were tracked from the time they enrolled in the university until the point they graduated or by the end of spring 2015.

**Outcome Variable**

We used semester GPA as the outcome variable for measuring SWD's academic achievement. Beginning with each student's enrollment date until either the last recorded semester of enrollment or graduation, we recorded the individual GPAs of each successive fall and spring semester. Semester GPA was used as a continuous measure of semester academic performance based on the standard of a 0.0 to 4.0-point grading scale.

**Predictor Variables**

Personal factors pertaining to the ICF model were: race/ethnicity, sex, college major, disability type, intake year, gaps in academic years, and semester standing. Student demographic information was recorded at intake assessment and updated each semester if there were any changes. It should be noted that more exacting categories as they pertained to gender and race/ethnicity were not available. As a result, we had to use data as recorded. Thus, rather than examining gender categories, we used biological sex (female/male) as a categorical variable. In terms of race/ethnicity the following designations were used: Asian (Asian and Asian American), Black (Black and African American), Hispanic (Hispanic and Latino), White (White and Caucasian), oOthers (Multiracial, International, or unknown).

As far as disability categories, there were 30 different codes recorded in the database. For data analysis purposes, we used the primary disability type and grouped them into one of four broader categories: Cognitive (e.g., learning disabilities, ADHD); Psychological (e.g., psychological disabilities); Physical (e.g., hearing impairment, physical health); and Other (e.g., neurological disorder). Additionally, "*Semester*

*Standing*" (number of semesters with a reported GPA at the time of each GPA observation) was included as a predictor to allow for the study of longitudinal trends in GPA. Please see Table 1 for descriptions of other variables, including *College Major, Year of Intake,* and *Gap.*

Environmental factors were operationalized as student disability services-related variables in this study, including use of disability services, types of academic accommodations, and semester during which each student registered with student disability services. With regard to whether disability services had an effect on student GPA, we created a binary variable "*AfterService*," which indicates the timing of the outcome GPA. We also created a categorical variable "*RegTime*" to identify when, on the students' college timeline, they had had their intake appointments (i.e., registered with the disability services office). We used three classifications to indicate when students had first contacted the disability services office: "Early" (registered prior to the end of their fourth semester), "Middle" (registered during their fifth or sixth semesters), and "Late" (registered during or after their seventh semester). Table 2 presents sample demographics including race/ethnicity, sex, college major, disability type, and timeline of registration with disability services.

With regard to types of academic accommodations, we referred to the accommodations requested by students and approved by the disability services personnel. At intake and at the beginning of each semester, disability specialists would meet with students to understand their accommodation needs and, if warranted, provide a letter students could use with their instructors to insure compliance. Our database captures approved accommodations that were identified at the most recent appointment. There were more than 150 types of accommodation in the database and we grouped them into five categories: exam accommodation (e.g., extended time for exams and quizzes, testing in a distraction reduced environment, consideration with regard to rescheduling exams and quizzes); classroom accommodation (e.g., consideration to arrive late or leave early, consideration regarding absence); note taking (permission to record lectures, note taking services); assistive technology (alternative materials, use of assistive technology); and Smart Pen©. It should be noted that we considered the Smart Pen© as its own technology, as previous research (Kobayashi, 2005) indicated that different learning outcomes can occur as a function of note-taking strategies. Therefore, we differentiated the Smart Pen© from traditional note-taking services and other assistive technologies. Since each student

could receive approval for one or more accommodations, we used five separate predictors (each of which was a binary indicator of the student's approval for an accommodation in the grouping) to record student accommodation approval information. Table 3 presents the numbers of students who requested and received approval for each type of academic accommodations.

**Data Analysis**

Since this is a longitudinal study and there were multiple GPA records for each participant, a linear mixed effects model is appropriate to analyze data given the research questions of interest (Dean, Voss, & Draguljić, 2017). Prior to any formal analysis, a visual inspection was made to ensure data accuracy. Linear mixed effects model assumptions (i.e., linearity, absence of collinearity and heteroskedasticity, normality of residuals) were also evaluated using residual diagnostics. This process revealed multicollinearity between predictors *Gap* and *RegTime* and, as a result, *Gap* was deleted from the model. Additionally, because year of intake was not pertinent to our central research questions and, when it was included in the model, its coefficient was not statistically significant, we decided to remove *IntakeYear* from our final model. Our final tested model for predicting semester GPA was:

$$GPA_{ij}=\beta_0+b_{i0}+\beta_1 Semester_{ij}+\beta\_2 AfterService_{ij}+\beta_3 Gender_i+\beta_4+Race_i+\beta_5 Disability_i+\beta_6 Major_i+\beta_7 Notes_i+\beta_8 Exam_i+\beta_9 SmartPen_i+\beta_{10} Classroom_i+\beta_{11} Technology_i+\beta_{12} Other_i+\beta_{13} RegTime_i+\beta_{14} AfterService_{ij}*Semester_{ij}+\beta_{15} AfterService_{ij}*RegTime_i$$

In this model, $GPA_{ij}$ denotes the $j^{th}$ semester GPA record of the $i^{\wedge}th$ individual. Predictor variables that have the subscript $i$ vary only between participants, while the subscript $ij$ indicates that the predictor varies also between semesters. To account for correlation among multiple observations per participant, a mixed effects model assigns to each individual a different intercept. In this model, for the $i^{th}$ study participant the intercept is is $\beta_0+b_{0i}$, where $b_{0i}$ is the random effect for the $i^{th}$ individual.

The interaction of *AfterService* with *Semester* was included in this model to allow for an assessment of the relationship between registration with student disability resources and longitudinal trends in semester GPA. The interaction of *AfterService* with *RegTime* was included in this model to allow for an assessment of whether students who registered with student disability services during one of three designated periods (Early/Middle/Late), experienced different semester GPA outcomes after registration in comparison to students who registered at other stages of their matriculation.

For each non-binary categorical predictor (*Race/ethnicity, Major, Disability,* and *RegTime*), we conducted an ANOVA to assess this predictor's overall statistical significance. If the ANOVA indicates significance, further analysis incorporating multiple comparisons adjustments is required to test which values are different than other values. This procedure is needed, because mixed effects model coefficients provide only a comparison to a specified base value of the predictor, as opposed to a comparison between all possible pairs of the predictor's values (Dean et al., 2017). Separate from the primary linear mixed effects model analysis, which we used to examine the relationship between selected variables and student GPA, we were also interested in the relationship between type of disability and type of provided disability accommodations. For each of the six accommodation type groupings (*Exam, Notes, Smart Pen©, Classroom, Technology,* and *Other)*, we used a two-way contingency table relating accommodation approval to disability type to explore this relationship, and with either, a Chi-squared or Fisher's exact test to assess association significance. All analysis was done using R 3.2.3 extensions program (R Core Team, 2015) with supporting packages *nlme* (Pinheiro, Bates, DebRoy, Sarkar, & R Core Team, 2018), *lmerTest* (Kuznetsova, Brockhoff, & Christensen, 2017), *multcomp* (Hothorn, Bretz, & Westfall, 2008), MuMIn (Bartoń, 2018), and *ggplot2* (Wickham, 2009).

**Results**

The coefficient table from the mixed effects model regression analysis is shown in Table 4. This table identifies both interaction terms in the model (*AfterService* with *Semester* and *AfterService* with *RegTime*) as significant predictors of semester GPA. While the regression coefficients of *Race/Ethnicity, Major,* and *Disability Type* are not significant, ANOVA identifies each of these variables as significant, having $F$-statistics 2.66 ($p$=.03), 12.04 ($p$<.00), and 4.92 ($p$=.00), respectively. Full ANOVA results are provided in Table 5. The analysis of pairwise contrasts for these variables is summarized in Table 6.

**Personal Factors Associated with Changes in GPA**

The mixed effects model analysis of our sample (see Table 4) identifies *Sex, Race, Major,* and *Disability Type* as significant predictors of semester GPA. Inferences from the sample data suggest that the semester GPAs of female students were, on average,

0.25 grade-point higher than male SWD with other characteristics being the same. It also suggests that, on average, Black students had lower semester GPAs than White students, with the sample revealing no other racial/ethnic group pairings to have statistically significant semester GPA differences. For example, there was no statistically significant difference in the average semester GPA of White students in comparison to that of Asian students. When comparing semester GPA differences by student major, findings demonstrate that, on average, students majoring in the STEM fields had lower semester GPAs than those in Education fields or fields grouped as "Other;" moreover, on average, students majoring in Liberal Arts and Social Sciences fields had lower semester GPAs than those in fields grouped as "Other." When comparing semester GPA differences by student disability type, the model suggests that students with physical disabilities had higher semester GPAs that those with cognitive disabilities.

### Environmental Factors Associated with Changes in GPA

Figure 1 shows a scatterplot illustrating the relationship between the longitudinal behavior of semester GPA and the variable *AfterService*. For those records in the sample that occurred before/after registration with disability services, the figure shows the linear best fit lines. There is a clear decreasing time trend in semester GPA for those records that occurred before registration, with no such clear trend apparent among records that occurred after registration. The linear mixed effect model analysis (see Tables 4 and 5) also demonstrates that, for any fixed semester, if all other predictors are held constant, there was a statistically significant difference between the mean semester GPA of records occurring before registration with disability services and that of those occurring after registration, with the size of this effect dependent on when the student registered with disability services. This analysis suggests that SWD who registered early in their college timeline had higher semester GPAs after registration on average than those who registered later in their college timeline. This GPA difference was statistically significant only between Early registrants and Late registrants, however.

In terms of accommodations requested and approved, results indicate that only the provision of note-taking services had a significant effect on SWD's semester GPA (see Tables 4 and 5). Specifically, SWD who qualified for note-taking services achieved lower semester GPAs. Additionally, the separate 2-way contingency table analysis gives strong evidence for an association between *Disability Type*

and *Classroom Accommodations*, with 73% of students with Physical Disabilities being approved for an accommodation in the classroom grouping, while fewer than 33% of students with any of the other disability types were approved for accommodation in this grouping. Inferentially, all six accommodations categories resulted in statistical association between the disability grouping and the accommodation received.

## Discussion

The current study revealed the impact of personal and environmental factors on SWD's academic achievement. This study applied the ICF to examine the impact of personal and environmental factors on SWD's academic achievement. Among personal factors, sex, race/ethnicity, college major, and type of disability were significantly associated with SWD's semester GPA. We also found that environmental factors, specifically the time when disability service registration occurs, also affected their GPA trajectories. Given these findings, we present implications of each factor, as well as how our findings align with those from prior studies.

### Personal Factors Influencing Semester GPA

**Sex**. Our finding shows that female SWD had higher semester GPAs than their male counterparts; this is consistent with previous findings that suggest female SWD are more likely to graduate than their male peers (Newman et al., 2011). Although gender differences have been reported, reasons for these differences have not been examined. Research on gender differences and academic performance within the general postsecondary literature has offered a variety of explanations including differences in career choice (Olivieri, 2014), work expectations (Goldin, Katz, & Kuziemko, 2006), perceptions regarding the value of education (Diprete & Buchmann, 2006), and support-seeking behaviors (e.g., Conger & Long, 2010). To what extent these gender-related factors as well as other variables impact academic achievement among SWD have not been explored and could be a potential area for future research.

**Race/ethnicity.** We also found that race/ethnicity is associated with academic achievement among SWD. Specifically, Black/African-American SWD reported lower GPAs than White/Caucasian students. This finding is consistent with that reported in other studies indicating disparities in postsecondary education across racial groups. For example, the National Longitudinal Transition Study-2 (Wagner, Newman, Cameto, Levine, & Garza, 2005) revealed that the college degree attainment of African-American SWD

was less than half than what it was for White SWD. As applied to SWD, Pellegrino, Sermons, and Shaver (2011) found that African-American SWD were less likely than Caucasian students to seek the evaluation required to document their need for accommodations in college settings. In attempting to account for this outcome, Banks (2014) conducted a qualitative study interviewing three African American SWD in college. Their stories reveal that the ways that these students manage their, often marginalized, identities and construct social capital influence their decisions on seeking support from disability services. In essence, the academic performance barriers African-American SWD face seem to result more from external social and cultural factors than a lack of academic capability. Given the importance of this influence, a review of multicultural resources should be described as part of the disability eligibility evaluation intake process to students of color.

To address the intersectionality of race, ethnicity, and disability, disability services professionals also need to collaborate with faculty and staff on campus to examine the broader diversity issues locally and nationally. Kimball, Friedensen, and Silva (2017) maintained that SWD are a remarkably diverse population and it is important to apply an intersectionality approach to better understand their experiences in educational settings. Shallish (2017) encouraged administrators and disability professionals include disability as part of diversity initiatives and proactively advocate for educational equity instead of simply meeting minimum federal legal requirements. Faculty should also adapt a culturally relevant pedagogical approach work working with diverse students, such as the Culturally Relevant Pedagogy (Ladson-Billings, 1995) that emphasizes student-centered and holistic teaching.

**College major.** Our study demonstrates that SWD in STEM majors had lower semester GPAs than SWD in education, liberal arts and social science, and other majors. Within the general population, students in STEM fields are more likely to receive lower grades than students in non-STEM fields (Westrick, 2015). For example, Bridgeman, Pollack, and Burton (2008) found more non-STEM students reported cumulative GPAs of 3.5 or higher than did STEM students, despite the non-STEM and STEM students having similar SAT scores, high school GPAs, and school selectivity. One reason for these GPA differences cited in the literature is that grade inflation is more likely to occur in non-STEM fields (Stinebrickner & Stinebrickner, 2014). In addition, Street et al. (2012) maintained that STEM courses usually demand higher levels of executive functioning (i.e., organization,

planning, time management), which were major barriers for students with learning disabilities, ADHD, and other cognitive disabilities. Using the National Survey of Student Engagement (NSSE), Hedrick, Dizen, Collins, Evans, and Grayson (2010) conducted a study examining perceived academic differences among students with and without disabilities, as well as differences between students with STEM and non-STEM majors. Their results indicated that students with STEM majors perceived higher levels of enriching academic experiences than non-STEM students; there was no significant difference between disability status and STEM status, however. Cardoso et al. (2016) conducted a qualitative study examining experiences in the STEM majors among racial and ethnic minority SWD who participated in the MIND Alliance project in which they received individualized academic and career support services. Results indicated that interpersonal and individual factors, accommodations provided, and disability services received were major themes that impact SWD's academic success. Cardoso et al. suggested that disability services professionals should collaborate with faculty and staff to identify teaching and assessment strategies that promote academic success among SWD enrolled in STEM majors. Although impact of person and environmental influences on academic achievement of STEM students has been explored, it is clear that limited studies have considered disability services as an important consideration for SWD who pursue these academic majors.

**Type of disability.** In examining the impact of disability types on achievement outcomes in postsecondary education, we found that students with physical disabilities have higher semester GPAs than students with cognitive disabilities. This finding is consistent with those of other studies that used graduation as a binary predictor (O'Neill et al., 2012); such studies found that students with physical disabilities were twice as likely to graduate than students with cognitive disabilities and 30% more likely to graduate than students with psychological disabilities. This result may be because students with physical disabilities usually experience fewer or less severe cognitive functional impairments than students with cognitive and psychological disabilities, which may impact their experiences of requesting and receiving academic support and thus influence GPAs. Although we found statistical significance regarding GPAs among SWD with different disability types, these differences were minimal. Parallel findings from this study also suggest that semester-by-semester GPA is an appropriate indicator of academic outcomes.

## Environmental Factors Influencing GPA

Environmental factors examined in this study included time of disability services registration and types of accommodation approved.

**Impact of disability services.** To understand the impact of disability services, we examined the relationship between disability services and academic outcomes for SWD. Our analysis yielded two promising findings. First, trajectories of students' GPAs improved after they registered with the disability services office. Moreover, there was a significant association between registering with the office early in their matriculation and higher semester GPAs than registering later. These findings support previous studies' arguments regarding the positive relationship between student disability services and SWD's academic achievement. O'Neill and colleagues found when disability services were made available and accessible to SWD, they were more likely to graduate. Thus, it appears that disability services personnel play an important role in fostering and facilitating positive academic outcomes through services such as providing academic accommodations; advocating for educational access; and making academic, physical/mental health, and other service referrals. In fact, SWD who interacted with student disability services personnel were more likely to meet with their faculty and to report higher levels of satisfaction with other university services (Cawthon & Cole, 2010). These findings offer disability service personnel evidence as to the importance of continued funding when consulting with university administrators responsible for budgetary decisions.

**Types of academic accommodations.** Our analysis shows that only the provision of note-taking services significantly predicted student GPAs but in a negative direction. Specifically, SWD who qualified for note-taking services achieved lower semester GPAs. Similar to our findings, O'Neill et al. (2012) found that use of note-taking services and other assistive technologies significantly decreased the odds of graduation among SWD. One possible explanation is that SWD who qualified for note-taking services were those who encountered more academic challenges initially. According to the director of the student disability services at the study's university (K. Jervis, personal communication, June, 29, 2018), note-taking services should only be offered to students who demonstrate significant challenges and who cannot take notes on their own in class; other students are encouraged to take notes on their own using the Smart Pen©. It should be noted, however, that other studies have demonstrated that SWD find note-taking and other similar services helpful in terms of improving their academic achievement. The current study did not examine the extent to which students used these services or their perceived quality which makes it difficult to evaluate the impact of note-taking services.

In our study, provisions of other classroom accommodations and assistive technologies (e.g., Smart Pen©) did not impact GPA. This finding is inconsistent with those of earlier studies investigating the impact of accommodations on academic achievement. For example, Kim and Lee (2016) found that the providing test accommodations (extended time, alternative test format) predicted SWD's cumulative GPAs when controlling for demographic and disability variables. When considering graduation rates, O'Neill, et al. (2012) found that providing test accommodations was the greatest predictor of graduation, followed by assistive technologies and classroom accommodations. It may be that in our study, the lack of statistical significance as it pertains to the use of academic accommodations may be because students did not actually use them throughout the semester. According to the disability services director affiliated with the university where data were collected (K. Jervis, personal communication, June, 29, 2018), many SWD would not register with student disability services until they experienced challenges in their classes. Even for those who were granted accommodations at the beginning of the semester, many of these students did not use them until their grades were affected. As a result, it may have had limited impact on course grades (K. Jervis, personal communication, June, 29, 2018). This practice is consistent with our finding in regards to SWD who registered with disability services early were more likely to achieve better grades, compared to those who registered late.

There are many reasons that explain why SWD do not register with disability services or use approved academic accommodations. Squires, Burnell, McCarty, and Schnackenberg (2018) conducted a qualitative study looking at college students who self-identified as SWD and their reasons for not requesting academic accommodations. Major themes included wanting to be independent and self-sufficient and wanting to avoid disability stigma. Squires et al. suggested disability services professionals should provide greater focus on the process of disability identity and self-advocacy to help SWD understand their needs to achieve greater independence. Further, disability services professionals should become more involved with faculty as it pertains to the accommodation process. By doing so, they believe more collaborative relationships will follow that results in better student learning outcomes. In addition to these recommendations, providing an orientation regarding student

disability services procedures (eligibility, academic accommodations) should be included as part of the general orientation that SWD receive. Finally, student disability services could also partner with other student affairs offices, such as mental health services, tutoring services, and other learning centers to promote visibility and to decrease disability stigma.

## Limitations and Future Research

A limitation of this study is that data were collected from a single four-year public university and, as a result, may not generalize to other university settings. Indeed, student disability services offices at different institutions vary in terms of their eligibility criteria, quality of staff, and the scope of services provided (Kasnitz, 2011). Second, we categorized types of disabilities as physical disabilities, cognitive disabilities, and psychological disabilities. As noted earlier, we used this grouping given the number of disability codes in this dataset which would not have permitted analysis of this variable in the predicted model. In addition, we also noted that many participants had multiple disability codes and, as a result, this made it difficult to identify independent categories. In the future, a larger dataset involving multiple institutions would allow for a finer differentiation among specific disability categories. The problem of coding specific disabilities, however, is one that exists within the field as there is no uniform standard that exists across universities. As a result, it makes comparisons across studies as it pertains to types of disability very difficult to analyze.

Third, as far as type of academic accommodations, although we examined the impact of each type of approved academic accommodation on SWD's academic achievement, the extent to which SWD used these accommodations was unknown. The dataset only captured the most recent records of accommodations (K. Jervis, personal communication, June, 29, 2018), which means that we were unable to know whether participants used different types of accommodations throughout their education. Fourth, due to the nature of the dataset, we could only examine a limited number of personal (mostly demographic) variables. As evident from prior studies, other factors that impact academic performance were excluded from the present study including information about first-generation college student status (Lombardi et al., 2012) as well as type of financial situation, living situation, and college location (Herbert et al., 2014). Additionally, malleable student variables such as strategies to achieve academic and personal goals and enhance self-advocacy have been identified as contributing factors to student persistence and graduation rate for SWD (Herbert et al., 2014; Hong, Ivy, Humberto, & Ehrensberger., 2007).

Other environmental variables that may impact persistence and graduation outcomes but have seemingly been unexplored include perceived levels of faculty and disability services personnel support, qualifications of disability services personnel (work experience and academic training), and/or perceived working alliance between students and disability services personnel. Given the interaction complexity of environmental variables and its interaction with person variables articulated in the ICF model, it is clear that there are other potential influences that can impact academic achievement of SWD. Finally, we considered GPA as the sole outcome variable in this study. Future studies may consider exploring other outcomes as it relates to persistence and graduation.

## Conclusion

Given the increased awareness of the importance of educational equity, there is a growing need to understand the factors that predict the academic achievement of college students with disabilities. The ICF model serves as a useful conceptual framework for examining academic performance through a comprehensive lens that includes both personal and environmental factors. A longitudinal approach to assessing academic achievement allows us to observe continuous change over time and factors associated with changes. The current study reveals that personal factors differentially impact SWD who were racial and ethnic minorities, male, had cognitive disabilities, and those in STEM majors had lower semester GPAs. Practitioners (i.e. disability specialists, rehabilitation counselors, disability services staff) may provide target services to these student populations. For example, disability services professionals could facilitate peer support groups for racial and ethnic minority SWD or provide study skills training for students with cognitive disabilities.

The current study also underscores how disability services contribute to SWD's academic achievement. Students' longitudinal GPA trajectories positively changed after they registered with the student disability services office. Student disability services should work coordinately with academic departments to facilitate academic success. Many disability services offices, including the one in this study, do not have a systemic way to track whether SWD actually use approved accommodations or monitor the effects of the accommodations on academic achievement. In this age of fiscal accountability, with higher education

leadership held responsible for the targeted spending of funds, disability services offices must provide data to inform evidence-based practice.

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Table 1

*Variable Descriptions*

| Variable | Short-Hand | Description |
|---|---|---|
| Semester-by-Semester GPA | GPA | Range: 0.00 - 4.00; Its observations are longitudinal in Semester and observation dependent in AfterService, with all other variables changing only at the participant level. |
| After Service | AfterService | Values: Before, After. Identifies which of a student's GPA records occurred after their intake appointment with student disability resources. |
| Sex | Sex | Values: 0 ("Male"), 1 ("Female"). Identifies student's reported gender; Students without a response were excluded. |
| Race/Ethnicity | Race | Values: Asian, Black (Black and African American), Hispanic (Hispanic and Latino), White (White and Caucasian), Others; Students without a response were classified with Others. |
| Disability Type | Disability | Values: Cognitive, Psychological, Physical, Others. |
| College Major | Major | Values: EDU (Education), LASS (Liberal Arts & Social Sciences), STEM (Science, Technology, Engineering & Mathematics), OTH (Other). |
| Year of Intake | Intake Year | Values: 2009, 2010, 2011. Identifies student's cohort within the study by year of disability services registration. |
| Academic Gap | Gap | Values: 0 ("No Gap"), 1 ("Gap"); Identifies whether or not a student's academic record has a missing fall or spring semester GPA record, indicating that the student took time off. |
| Semester Standing | Semester[a] | Values: 1 - 9, and "10" (10 or higher); Identifies the student's number of Fall/Spring semesters that have had a reported GPA, at the time of each of their GPA records. |
| Semester of Registration | RegTime[b] | Values: Early (registered prior to the end of 4th semester), Middle (registered during 5th or 6th semesters), Late (registered during/after 7th semester); Identifies when in students' college timeline they had their intake appointment. |
| Accommodations | Exam | Values: 0 (not approved), 1 (approved); Exam accommodations (e.g. extended time on exams). |
| | Notes | Values: 0 (not approved), 1 (approved); Note taking services (e.g. note taker). |
| | SmartPen | Values: 0 (not approved), 1 (approved); Smart Pen (i.e. computerized and digital audio recorder) |
| | Classroom | Values: 0 (not approved), 1 (approved); Classroom Accommodations (e.g. audio recording in class). |
| | Technology | Values: 0 (not approved), 1 (approved); Assistive Technologies (e.g. screen reader). |

*Note.* [a]We grouped unusually late records as "10" to protect against influential points. Semester is treated as continuous in the analysis.  [b] All six are binary variables, where "1" indicates presence and "0" indicates absence of approval for one or more accommodations in the grouping.

Table 2

*Sample Characteristics (N=562)*

| Variable | Frequency *(n)* | Percent |
|---|---|---|
| Gender | | |
| Male | 322 | 57.30 |
| Female | 240 | 42.70 |
| Race | | |
| Asian | 12 | 2.10 |
| Black | 35 | 6.20 |
| Hispanic | 31 | 5.50 |
| White | 433 | 77.00 |
| Other | 51 | 9.10 |
| Disability | | |
| Cognitive | 338 | 60.14 |
| Physical | 114 | 20.28 |
| Psychological | 67 | 11.92 |
| Other | 43 | 7.65 |
| Major | | |
| EDU | 34 | 6.04 |
| LASS | 178 | 31.67 |
| STEM | 293 | 52.13 |
| OTH | 57 | 10.14 |
| RegTime | | |
| Early | 433 | 77.04 |
| Middle | 65 | 11.56 |
| Late | 64 | 11.38 |
| Gap | | |
| Yes | 208 | 37.02 |
| No | 354 | 62.98 |

Table 3

*Types of Academic Accommodations*

| Variable | Frequency *(n)* | Percent |
|---|---|---|
| Accommodations | | |
| Exam | 461 | 82.02 |
| Notes | 201 | 35.76 |
| SmartPen | 33 | 5.87 |
| Classroom | 130 | 23.13 |
| Technology | 124 | 22.06 |
| Other | 48 | 8.54 |

*Note.* The frequencies are the number of students who requested and got approval for each type of academic accommodation.

Table 4

*Mixed Effects Model Coeficients*

| Variable/Category | Estimate | Standard Error | P(>\|t\|) |
|---|---|---|---|
| Intercept | 2.74 | 0.20 | 0.00* |
| Semester | -0.06 | 0.01 | 0.00* |
| AfterService | -0.06 | 0.05 | 0.26 |
| Sex Female | 0.25 | 0.05 | 0.00* |
| Race Black | -0.08 | 0.18 | 0.67 |
| Race Hispanic | 0.16 | 0.18 | 0.36 |
| Race Other Disabilities | 0.16 | 0.17 | 0.35 |
| Race White | 0.21 | 0.15 | 0.17 |
| Disability Other | 0.14 | 0.09 | 0.12 |
| Disability Physical Disabilities | 0.27 | 0.07 | 0.00* |
| Disability Psychological Disabilities | 0.13 | 0.07 | 0.08 |
| Major LASS | -0.25 | 0.10 | 0.01* |
| Major OTH | 0.12 | 0.12 | 0.31 |
| Major STEM | -0.31 | 0.10 | 0.00* |
| Notes | -0.18 | 0.05 | 0.00* |
| Exam | 0.11 | 0.06 | 0.08 |
| SmartPen | -0.12 | 0.09 | 0.22 |
| Classroom | 0.04 | 0.06 | 0.54 |
| Technology | 0.03 | 0.06 | 0.63 |
| Other | 0.08 | 0.08 | 0.32 |
| RegTime Late | -0.16 | 0.09 | 0.06 |
| RegTime Middle | 0.11 | 0.08 | 0.19 |
| Semester: AfterService | 0.08 | 0.01 | 0.00* |
| AfterService: RegTime Late | -0.15 | 0.07 | 0.03* |
| AfterService: RegTime Middle | -0.37 | 0.06 | 0.00* |

*Note.* While *Race/Ethnicity, Major,* and *Disability Type* did not have statistically significant regression coefficients, separate ANOVA tests revealed each of them to be significant predictors of semester GPA (p-values: 0.002, 0.000, and < 0.000, respectively).

Table 5

*ANOVA Table*

| Variable | Sum of Squares | Mean Squares | Numerator Degrees from Freedom | Denominator Degrees from Freedom | *F* Value | *P*(>*F*) |
|---|---|---|---|---|---|---|
| *Semester* | 4.91 | 4.91 | 1 | 3748.10 | 16.88 | 0.00* |
| *AfterService* | 5.93 | 5.93 | 1 | 3772.80 | 20.38 | 0.00* |
| *Sex* | 7.70 | 7.70 | 1 | 520.20 | 26.49 | 0.00* |
| *Race* | 3.22 | 0.81 | 4 | 526.60 | 2.77 | 0.03* |
| *Disability* | 4.45 | 1.48 | 3 | 522.30 | 5.10 | 0.00* |
| *Major* | 10.93 | 3.64 | 3 | 519.00 | 12.53 | 0.00* |
| *Notes* | 3.72 | 3.72 | 1 | 518.80 | 12.79 | 0.00* |
| *Exam* | 0.87 | 0.87 | 1 | 527.00 | 2.99 | 0.08 |
| *SmartPen* | 0.43 | 0.43 | 1 | 495.00 | 1.48 | 0.22 |
| *Classroom* | 0.11 | 0.11 | 1 | 519.50 | 0.37 | 0.54 |
| *Technology* | 0.07 | 0.07 | 1 | 523.50 | 0.24 | 0.63 |
| *Other* | 0.28 | 0.28 | 1 | 516.70 | 0.98 | 0.32 |
| *RegTime* | 2.22 | 1.11 | 2 | 864.90 | 3.82 | 0.02* |
| *Semester:AfterService* | 8.64 | 8.64 | 1 | 3737.80 | 29.69 | 0.00* |
| *After Service: RegTime* | 9.87 | 4.93 | 2 | 3752.10 | 16.98 | 0.00* |

*Note.* Pseudo-R squared for the full model (fixed and random effects) is 0.5393; for the fixed effect only is 0.1611.

Table 6

*Pairwise Contrasts (Adjusted for Multiple Comparisons)*

|  | Estimate | Standard Error | P(>\|t\|) |
|---|---|---|---|
| Race/Ethnicity |  |  |  |
| Black - Asian = 0 | -0.07 | 0.17 | 0.99 |
| Hispanic - Asian = 0 | 0.16 | 0.17 | 0.88 |
| Other - Asian = 0 | 0.16 | 0.17 | 0.86 |
| White - Asian = 0 | 0.21 | 0.15 | 0.61 |
| Hispanic - Black = 0 | 0.23 | 0.13 | 0.33 |
| Other - Black = 0 | 0.23 | 0.11 | 0.24 |
| White - Black = 0 | 0.28 | 0.09 | 0.01* |
| Other - Hispanic = 0 | 0.00 | 0.12 | 1.00 |
| White - Hispanic = 0 | 0.05 | 0.09 | 0.98 |
| White - Other = 0 | 0.05 | 0.07 | 0.96 |
| Disability |  |  |  |
| Other - Cognitive = 0 | 0.13 | 0.08 | 0.38 |
| Physical - Cognitive = 0 | 0.27 | 0.07 | 0.00* |
| Psychological - Cognitive = 0 | 0.13 | 0.07 | 0.28 |
| Physical - Other = 0 | 0.13 | 0.09 | 0.51 |
| Psychological - Other = 0 | 0.00 | 0.10 | 0.99 |
| Psychological - Physical = 0 | -0.14 | 0.09 | 0.37 |
| Major |  |  |  |
| LASS - EDU = 0 | -0.25 | 0.10 | 0.06 |
| OTH - EDU = 0 | 0.11 | 0.11 | 0.72 |
| STEM - EDU = 0 | -0.30 | 0.09 | 0.00* |
| OTH - LASS = 0 | 0.36 | 0.08 | 0.00* |
| STEM - LASS = 0 | -0.05 | 0.05 | 0.65 |
| STEM - OTH = 0 | -0.42 | 0.07 | 0.00* |
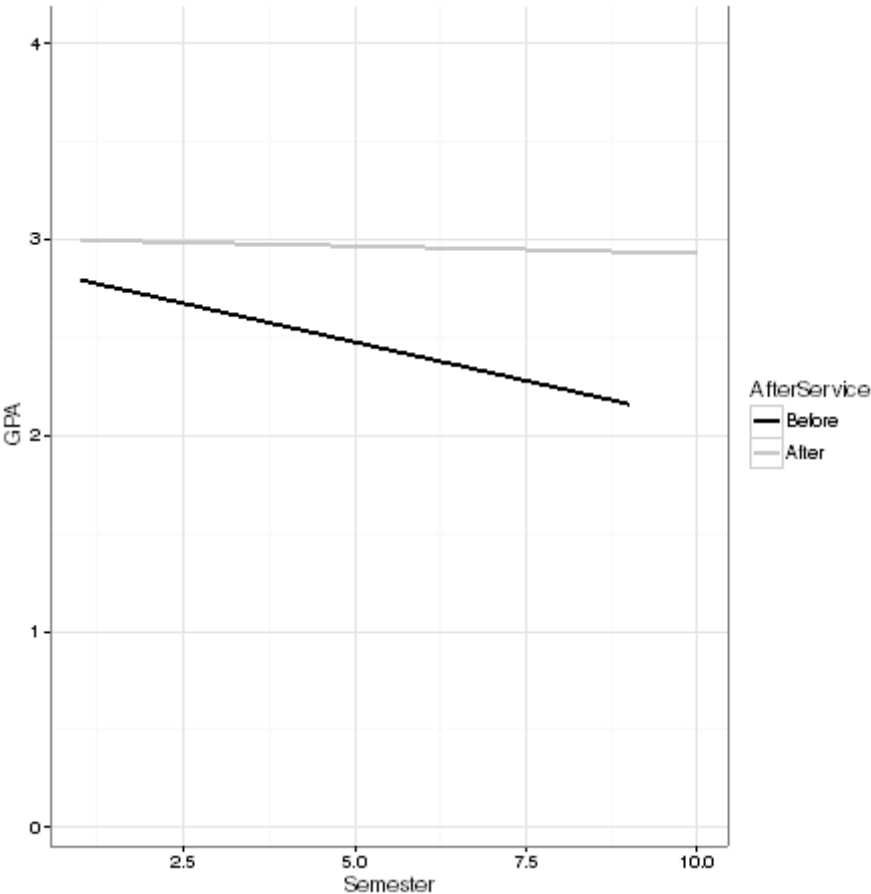
*Figure 1.* Scatter plot of semester GPA records vs. semesters before and after disability service.