Demographic differences in post-secondary outcomes following participation in the Diagnostic Assessment and Achievement of College skills Intervention

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Demographic Differences in Post-Secondary Outcomes Following Participation in the
Diagnostic Assessment and Achievement of College Skills Intervention

Jana L. Vanderslice-Barr

A Dissertation
Submitted to the University at Albany, State University of New York State
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School of Education
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Abstract

The majority of high school seniors are unprepared for post-secondary coursework in mathematics and reading (National Assessment of Educational Progress, 2019). Research shows traditional methods for bolstering college readiness skills to be ineffective, unnecessary for the majority of students, and associated with negative outcomes (Jaggars & Stacey, 2014). Another approach to enhancing college readiness is to offer newly enrolled college students the opportunity to assess their level of readiness, and take steps to become better prepared on their own. The Diagnostic Assessment and Achievement of College Skills (DAACS) system was developed with this purpose in mind. The DAACS is intended for use outside the confines of coursework or graded circumstances. The results are not intended for use by instructors, but for the students themselves and their advisors to use towards improvement of academic skills. The research on post-secondary outcomes associated with participation in college readiness programs is severely limited (Kolbe et al., 2018). The intent of this study is to add to the body of research on post-secondary outcomes associated with participation in college readiness interventions. The current study will also address a gap in the research literature relating to whether students’ demographic characteristics are associated with performance in college after participation in readiness interventions.
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Chapter 1: Introduction

Seventy-five percent of all high school seniors are unprepared for post-secondary coursework in mathematics, and 63% are unprepared for coursework in reading (National Assessment of Educational Progress, 2019). Over half of all 2019 high school graduates nationwide took the ACT. Of these, almost 40% failed to meet any of the four ACT College Readiness Benchmarks (ACT, 2019). Lack of readiness for study at the post-secondary level is not a new issue. Methods for addressing student gaps in readiness for post-secondary study date back to the mid-16th century, when Harvard University instituted a new policy requiring prospective students to pass entrance exams prior to enrollment. The introduction of these onerous criteria for admittance resulted in a rapid increase in preparatory instruction prior to postsecondary attendance (Arendale, 2002). This was the origin of current developmental or remedial education.

Recent data show that over half of incoming community college students place into mandatory remedial education (Chen, 2016). This is not surprising considering the number of students unprepared for post-secondary study. Unfortunately, while the intent of remedial placement is to increase student readiness for post-secondary study, numerous studies show the practice to be ineffective, unnecessary for the majority of students, and associated with negative outcomes (Jaggars & Stacey, 2014).

Large-scale efforts to increase academic readiness prior to enrollment in post-secondary study (with the goal of avoiding the need for remedial coursework) primarily began at the federal level in the 1960s. These efforts were developed in response to the existence of a clear gap in post-secondary attainment in underrepresented student populations. The intent of these interventions was to bolster college readiness in underrepresented groups prior to exiting high
school. In contrast to traditional remedial education, which focuses almost exclusively on increasing academic skills, these programs generally provide instruction in both academic and non-academic skill attainment (U.S. Department of Education, 2014). Unfortunately, as will be discussed in the literature review later, there is minimal research investigating the effectiveness of these programs in increasing success in post-secondary outcomes.

A different approach to enhancing college readiness is to offer newly enrolled college students the opportunity to assess their level of readiness, and take steps to become better prepared on their own. The Diagnostic Assessment and Achievement of College Skills (DAACS; https://daacs.net/) system was developed with this purpose in mind. The DAACS was created in 2016 with the intent of shifting the control to the learner instead of having assessment performance used by others to determine remedial placement or other interventions (Bryer et al., 2020). Traditional college readiness interventions focus primarily on subject knowledge while the DAACS also places particular emphasis on self-regulated learning, as it has been shown to be a component of post-secondary success.

DAACS is an online diagnostic assessment tool that takes approximately 90 to 120 minutes to complete and assesses four main domains: (1) Self-regulated learning, (2) Writing, (3) Reading, and (4) Mathematics. This format enables learners to take an active role in the educational process by providing them the opportunity to review feedback on their academic strengths and areas that could hold them back, and offers resources for improvement. The DAACS is intended for use outside the confines of coursework or graded circumstances, and the results are not intended for use by instructors, but for the students themselves and their advisors to use towards improvement of academic skills.

According to Bryer et al. (2020), the DAACS:
was developed based upon a social-cognitive conception of reciprocal determinism, SRL theory, and the feedback literature. That is, DAACS feedback and the advisors who help students utilize it, serve as key social determinants of students’ beliefs, perceptions, and knowledge (person factors) which, in turn, can influence the quality of students’ academic behaviors. The students interact with DAACS feedback and their advisors in reciprocal and dynamic ways, and thus can self-regulate each of the core dimensions. Thus, DAACS reflects the Model of Assessment as the Regulation of Learning (Andrade, 2013). This model emphasizes the student as the key player in all feedback processes, including regulating and monitoring progress toward desired goals, as well as interpreting external feedback from teachers, peers, and technology. Self-regulated learning (SRL) is included because academic difficulties are not the only challenges leading students to drop out. Successful students tend to be self-regulated learners who benefit from feedback about their knowledge, skills, and attitudes toward learning. Feedback that guides adaptation is a hallmark of SRL theories, most of which depict SRL as a goal-directed, cyclical process whereby individuals plan, enact learning strategies, deploy monitoring techniques to sustain awareness, and then evaluate and adapt, as needed. (p. 4)

Bryer et al. (2019) presented initial results that did not find any statistically significant differences in post-secondary outcomes between students that participated in the DAACS and those that did not (see Appendix A, Table 1 for detailed statistical test results). However, the study did find that higher level of engagement with the provided feedback was associated with increased success in completing the first six months of coursework on-time, earning credits at both term 1 and term 2, and term-to-term retention. Simpson’s paradox offers one possible
explanation for why the study did not identify main effects of the DAACS intervention. According to Simpson’s paradox, sometimes trends occur in different groups of data but disappear or reverse when these groups are analyzed as one (Pearl, 2014). This means a true effect may be masked if sample groups are analyzed in aggregate instead of breaking them out into meaningful subgroups, such as by sex or race. Thus, the impetus for the current study. The intent of this study is to determine if participation in the DAACS intervention influences post-secondary outcomes when subgroup membership is taken into consideration.

**Problem Statement**

The research on the post-secondary outcomes associated with participation in college readiness programs is severely limited (Kolbe et al., 2018). The intent of this study is to add to the body of research on outcomes associated with participation in college readiness interventions. In addition, research shows differences in academic performance dependent on sex or race/ethnicity (Voyer & Voyer, 2014; Aud et al., 2010). However, a literature search did not identify any research on whether these differences affect performance in college after participation in readiness interventions. It is possible that participation in college readiness interventions differentially benefits participants based on sex or race/ethnicity. This is a possibility that needs to be explored so that any identified differences in intervention impact can be addressed appropriately. The current study will also address this gap in the research literature.

**Statement of Purpose**

The intent of this research is to assess whether participation in the DAACS intervention combined with student subgroup membership (e.g., sex, race/ethnicity) results in differences in post-secondary academic success (e.g., credits earned).

**Research Questions**
The research questions include:

(1) Does the combination of treatment group assignment and sex significantly predict post-secondary outcomes?

(2) Does the combination of treatment group assignment and race significantly predict post-secondary outcomes?
   a. If the combination of treatment group assignment and race significantly predict post-secondary outcomes, do first-generation status or income act as significant covariates in these relationships?

(3) If significant differences in post-secondary outcomes are found for treatment group and either sex or race/ethnicity, are these differences moderated by DAACS scores?

(4) If significant differences in post-secondary outcomes are found for treatment group and either sex or race/ethnicity, are these differences moderated by use of specific components of the DAACS (e.g. feedback)?

**Organization of the Dissertation**

The next chapter includes a review of the results of a defined literature search on post-secondary outcomes following participation in large-scale college readiness programs. First, the Upward Bound program will be described and the lack of peer-reviewed research on post-secondary outcomes discussed. Following this is review of the limited research on post-secondary outcomes for the AVID, GEAR UP, and California’s Early Assessment programs. Following each program review is a discussion of the methodological issues noted across and within the studies. Chapter three details the methodological plans for the current study, including the intended inferential analyses. Chapter 4 reviews the results of the statistical analyses. Finally,
chapter 5 includes a discussion of the results, limitations and significance of the study and suggestions for future research.
Chapter 2: Literature Review

This literature review focuses on postsecondary academic outcomes following participation in large-scale programs intended to enhance college readiness. Small-scale interventions at the individual high school, college, or course level are beyond the scope of this review because the generalizability of these unique interventions is unknown. The DAACS is relatively new but has the potential for implementation across diverse populations, which is why the review will focus on large-scale programs. This review will not include research on assessment of academic college readiness for determining need for postsecondary remedial coursework, as one main goal of enhancing college readiness is to prevent placement in remedial coursework (Conley, 2007). Dual-enrollment programs, also called early college programs, are not true interventions, but simply enrollment in college-level coursework during high school. Hence, research on dual-enrollment programs is not included in this review. Discussion of differences in program outcomes by gender and race/ethnicity will follow the review of research on college readiness programs.

Search Strategy

The literature search involved the use of four search engines: EBSCOhost, PsycInfo, Web of Science (WoS), and Google Scholar. The core limiters used during each search included: (1) publication between 2000 and 2020; (2) peer-reviewed academic journal; (3) written in English. The final search was limited to publications between 2000 and 2020 as an initial search noted nothing relevant published prior to 2000. The results of the literature search are summarized in Table 2.

Table 2. Literature Search Results

<table>
<thead>
<tr>
<th>Search terms</th>
<th>EBSCOhost</th>
<th>Google Scholar</th>
<th>PsycInfo</th>
<th>WoS</th>
</tr>
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<tbody>
<tr>
<td>“college readiness program”</td>
<td>21</td>
<td>813</td>
<td>128</td>
<td>338</td>
</tr>
</tbody>
</table>
The inclusion and exclusion criteria are listed in Table 3. Of the sources identified in the literature search, only seven were deemed relevant enough for inclusion in this review. There were a number of studies that, at first, appeared relevant, but, upon further inspection, only measured factors assumed to relate to actual postsecondary academic performance (i.e., high school GPA, SAT scores, AP scores) or rates of postsecondary enrollment and not actual college performance (i.e., college grades, persistence). Presumably, this is because obtaining data on both high school and college performance is burdensome. The fact that there is a very limited amount of research identified on actual measures of college success following participation in a college readiness program is noted in the literature and calls to fill in this gap have been made (Martinez & Klopott, 2003; Kolbe et al., 2018).

Table 3. Literature Search Inclusion and Exclusion Criteria

<table>
<thead>
<tr>
<th>Categories</th>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publication Type</td>
<td>Peer-reviewed empirical studies published as articles</td>
<td>Non-peer-reviewed articles or reports; dissertations; book chapters; conference papers; reviews of books; commentaries; articles on best practices</td>
</tr>
<tr>
<td>Context</td>
<td>College readiness program impact/outcomes; gender or race/ethnicity differences in academic outcomes following participation in college readiness programs</td>
<td>Individual, small-scale college readiness initiatives (e.g., initiatives only used at one school or within a single course); research on testing with the intent for remedial placement; research on dual-enrollment aka early college programs</td>
</tr>
<tr>
<td>Targeted Population</td>
<td>Students (high school and college)</td>
<td>Non-students or in grades below high school</td>
</tr>
<tr>
<td>Language</td>
<td>English</td>
<td>All other languages</td>
</tr>
<tr>
<td>Country</td>
<td>All countries</td>
<td>None excluded</td>
</tr>
<tr>
<td>Discipline</td>
<td>All academic disciplines</td>
<td>None excluded</td>
</tr>
</tbody>
</table>
Literature Review

Seven studies identified during the literature search on post-secondary outcomes following participation in large-scale college readiness programs are reviewed here. First, the Upward Bound program is described, and the lack of peer-reviewed research on post-secondary outcomes discussed. Following this is review of the limited research on post-secondary outcomes for the AVID, GEAR UP, and California’s Early Assessment programs. Following each program review is a discussion of the methodological issues noted across and within the studies.

Upward Bound Program

The Upward Bound program is a federally funded program established under the authority of the Economic Opportunity Act of 1964. The goal of the program is to increase completion of secondary and post-secondary education. The program operates through individual grants provided through the United States Department of Education. During the 2013 fiscal year, the program granted 816 awards amounting to $249,857,649 in funding; providing services to approximately 59,000 students. The program primarily serves high school students from low-income families and students from families in which neither parent holds a bachelor's degree. Grantees must provide certain services, including lessons in literature, composition, foreign language, math, and laboratory science. Other services may include academic tutoring, counseling, mentoring, cultural enrichment, work-study programs, information on federal financial aid, guidance and assistance on secondary school reentry, alternative education programs, or entry into general educational development programs or postsecondary education (U.S. Department of Education, 2014; U.S. Department of Education, n.d.).

No peer-reviewed articles containing research on post-secondary outcomes following participation in the Upward Bound program during high school were identified during the search
process. The U.S. Department of Education contracted with Mathematica, a private employee-owned company, to conduct longitudinal program evaluation studies. However, these studies did not meet the criteria for inclusion in this review, as they were not published as peer-reviewed articles. Regardless, it is interesting to note that there is controversy on the accuracy of the final report.

According to Cahalan and Goodwin (2014), in 2009, the U.S. Department of Education (ED) published the final report, conducted by Mathematica, of a longitudinal national evaluation of Upward Bound. According to the report, the only overall impact of participation in Upward Bound was on certificate attainment. However, the results of an in-house ED evaluation of the same data found significantly more positive outcomes related to participation in Upward Bound. The in-house analysis found that participation in Upward Bound resulted in an increased likelihood of obtaining a baccalaureate degree within six years compared to those who did not participate in other college readiness services and those who participated in less intensive college readiness services. Considering the conflicting research results, it is difficult to determine the true effects of participation in Upward Bound.

**AVID Program**

The Advancement via Individual Determination (AVID), a non-profit program, began in 1980 with the intent of increasing the college readiness skills of disadvantaged students. AVID’s mission is to “close the achievement gap by preparing all students for college readiness and success in a global society” (AVID Center, n.d.). The AVID program serves over 2 million students in approximately 7,000 primary, secondary and post-secondary schools in 47 states in the U.S., and is active internationally as well.
The search process identified only three peer-reviewed articles containing research on post-secondary outcomes following participation in the AVID program during high school. The first study, by Watt et al. (2011) investigated whether participation in the AVID program during high school affected measures of college success. Participants included 50 seniors selected from five AVID-offering high schools located in South Texas who graduated in 2007.

Two measures of post-secondary success included whether a student (1) enrolled in college for both semesters of the academic year immediately following high school graduation and earned a freshman GPA of 2.0 or more; and (2) did not take any remedial coursework during freshman year in college. Another, alternative measure of college success assessed whether students earned at least 20 credits in their first year and were, therefore, on track to graduate within six years. The study did not report any results of inferential statistics assessing the outcomes of the alternative measure of college success; the results only noted that 60% of the sample met this alternative measure. The results did not find a significant relationship between participation in AVID during high school and later college success as per the first measure of college success.

The second study, by Huerta et al. (2013) attempted to replicate and expand upon previous findings from Watt et al. (2011). Participants were selected from twelve AVID program-offering high schools located in Texas who were seniors in 2008. To be selected, students had to be Hispanic or first-generation college students; have participated in AVID for a minimum of two years; and have enrolled in either a community college or university in the fall semester immediately following graduation from high school. The final study sample included 85 participants enrolled in either a public university (50 students) or community college (35 students).
The study used two measures of college success. As in the Watt et al. (2011) study design, the first measure of college success was defined as whether a student: enrolled in college for both semesters of the academic year immediately following high school graduation; obtained a freshman GPA of 2.0 or more; and, did not take any remedial coursework during freshman year in college. The second measure of college success also mirrored the Watt et al. (2011) study design, and assessed whether a student earned at least 20 credits in their first year and was, therefore, on track to graduate within 6 years. One additional measure assessing student retention, defined as enrolling for a second academic year, was added to the potential outcomes.

Overall participation in AVID during high school did not significantly predict post-secondary success. Again, as in the Watt et al. (2011) study, no inferential statistical analysis was conducted to measure differences in outcomes related to the alternative measure of college success. It was simply noted that 58% of the AVID graduates were on track to graduate within six years. In terms of the final measure, assessing student retention, the results did indicate that students in the community college group had a significantly higher first-year retention rate than their institutions’ average retention rate.

The third and final study by Huerta and Watt (2015) compared the post-secondary outcomes for students who participated in a high school AVID program and attended either a community college or university upon graduation. Participants needed to participate in an AVID program for a minimum of one year while in high school and enroll in college during the fall semester after graduation from high school. The sample included 329 students that enrolled in 22 different colleges. Two-hundred and sixty-three enrolled in universities and six enrolled in a community college. The study report did not include any information on the locations of the high schools or the colleges.
The outcomes measures of post-secondary success included whether a student enrolled in both the fall and spring semesters of college immediately after high school; remained in college from the first fall semester as a freshman to the second fall semester; earned at least 20 credits per academic year; and earned 40 credits within the first two years of college. Participation in AVID during high school did not predict any of the measures of post-secondary success.

**Limitations of Research on the AVID Program**

Limitations were noted in all three of the studies. Firstly, each study had a very small sample size. Secondly, none of the studies included a comparison group of non-AVID participating students. Therefore, none of the outcomes could be put into a meaningful perspective as to whether participation in AVID made a significant difference in comparison to their non-participating peers. Thirdly, the majority of the participants were Hispanic and located in the Southwest, which severely limits the generalizability of the results.

One specific issue with the first study was that the sample selection criteria only allowed inclusion of students that enrolled in a single, specific college. This means that the sample was severely limited as the full pool of 2007 graduates from the five AVID offering high schools located in South Texas was undoubtedly much larger. As a result, the study only gives a very limited view into AVID student outcomes; the unselected AVID participants from the 2007 graduating classes could have gone on to all succeed or fail. Another issue with the first study was that the selected students participated in the AVID program during high school for varying amounts of time; the researchers noted that 48% enrolled for all 4 years, 37% enrolled for 3 years, and 15% enrolled for only 2 years. The study did not control for length of time in AVID.

In the second study, it was unclear whether a student could attend any post-secondary institution or whether the researchers had to have a relationship with the institution for the
student to be included in the study. Considering this was the case in the previous Watt et al. (2011) study, it is likely the latter was true. If true, this means the sample was artificially limited and, therefore, excluded a likely large number of potential subjects that enrolled in institutions with which the researchers had no relationship.

One of the purposes of the third study was to compare AVID graduates’ first-year retention rates with state and/or national data. The national data used for comparison was an average, which has questionable applicability since the range of the original data is unknown. Hence, the percent for the AVID subjects (e.g., the students enrolled in community colleges had a fall-to-fall retention rate of 65% compared to a national average community college retention rate of 55%) could be lower or higher than that of comparable graduates from the same high schools that did not participate in AVID.

The research on post-secondary outcomes subsequent to participation in the AVID college readiness program is minimal and lacking in terms of generalizability and ability to make any causational inferences. The results are not generalizable as the samples are generally small, homogenous, and taken from very limited populations. Next, I will review the research on post-secondary outcomes following participation in the GEAR UP college readiness program.

**GEAR UP Program**

Gaining Early Awareness and Readiness for Undergraduate Programs (GEAR UP) is a federal program created in 1998 with the intent of promoting equal access to higher education for low-income students. The program provides discretionary six or seven year grants to States and partnerships to provide services middle and high schools serving low-income populations. Both State and partnership grants must include an early intervention component designed to increase college attendance and success. State grants must also offer a scholarship component; this is
optional for partnership grants. GEAR UP grantees must offer the program to a cohort of students starting at least in the seventh grade and ending at the end of high school (U.S. Department of Education, n.d.).

The search process identified only three peer-reviewed articles containing research on post-secondary outcomes following participation in the GEAR UP program during high school. The lack of research on post-secondary outcomes following GEAR UP participation is noted in the literature (Haskins & Rouse, 2013). While there is more research available than that for the Upward Bound program, it is still severely limited.

The first study identified during the literature search by Knaggs et al. (2015) analyzed high school and post-secondary data on 412 students (210 GEAR UP participants) from a single high school located in northwest Ohio. The purpose was to determine whether participation in GEAR UP was associated with increased general college enrollment, enrollment in four-year post-secondary institutions, and persistence in comparison to non-participant peers. In addition, the study assessed whether students from traditionally underrepresented groups who participated in GEAR UP had significantly greater general college enrollment, enrollment specifically in four-year post-secondary institutions, and persistence in comparison to non-participant peers.

The results of the study found that, compared to students that did not participate in GEAR UP, GEAR UP students were significantly more likely to attend college, to enroll in four-year postsecondary institutions, and to persist in college by remaining in college by the end of their fourth post high school year or had graduated. However, no significant relationships were found in post-secondary outcomes between minority students that participated in GEAR UP versus those that did not. Students meeting the criteria for low-SES were significantly more likely to
attend college and had significantly greater persistence when compared to low-SES students who had not participated in GEAR UP.

The second study by Bowman et al. (2018) investigated the impact of GEAR UP Iowa on college enrollment and persistence. The study included 17,605 students who graduated from high school between 2010 and 2015 in Eastern Iowa. The sample included students from all 19 high schools, six of which offered a GEAR UP program. The study assessed whether GEAR UP participation predicted enrollment in postsecondary education in the first year after high school graduation, enrollment within two years of high school graduation, and persistence to the second year of postsecondary education. No association was found between participation in the GEAR UP program and college enrollment or persistence.

The third and final study by Sanchez et al. (2018) investigated the post-secondary outcomes associated with participation in GEAR UP during high school. Post-secondary outcomes for 298 students who participated in GEAR UP in an undisclosed State and then enrolled in a single university were compared with 1,841 freshmen from the same undisclosed State at the same university. The results stated that in their first college term, GEAR UP students completed a similar number of credits and had similar GPAs as non-GEAR UP students. However, this finding was only supported by reporting the means and standard deviations for both groups; no inferential analysis results were provided. Results of a subsequent path analysis did not find a statistically significant relationship between participation in GEAR UP and first-term GPA or persistence.

**Limitations of Research on the GEAR UP Program**

The results of each of the three studies are not generalizable as each study sample only included participants from narrow populations (412 students from a single high school in
northwest Ohio, over 17,000 students from 19 high schools in Eastern Iowa, and 298 students from an undisclosed State who enrolled in a single post-secondary institution). The studies also lacked a consistent method of quantifying participation in GEAR UP, with some simply indicating a yes or no (first study) with others somewhat accounting for more or less use of the program (second study). Since students are required to participate starting in seventh grade as a cohort, this means a student could have started but stopped early or stayed in the program until high school graduation, which are very different levels of participation.

One specific issue noted with the first study was the use of two different graduating cohorts for comparison of GEAR UP versus non-GEAR UP participating students. The cohort of students that did not participate in GEAR UP graduated in 2004 while the GEAR UP participating cohort graduated in 2007. The use of different cohorts of students to assess treatment outcomes introduces possible error into the validity of the outcomes. The two cohorts may have diverged significantly simply due to the difference of approximately three years of age of each group and the resulting distinct timeframes for which data was collected.

The third study involved a very limited sample, as only GEAR UP students awarded a GEAR UP college scholarship were included. The scholarship eligibility criteria requires high school graduation with a standard diploma and a 2.0 overall GPA, in-state residency, and acceptance and enrollment in 12 or more credits per semester at an institution within the state’s higher education system. According to the criteria for scholarship eligibility, this subsample of students are likely unrepresentative of the average student participating in a GEAR UP program. This sample selection process also excludes any number of GEAR UP students, some of which may have waited to enroll in college, enrolled in a college out-of-state, or enrolled in college
part-time. This retrospective method of participant selection severely limits any conclusions deduced from the study results.

Again, as found for the AVID program, the research on post-secondary outcomes subsequent to participation in the GEAR UP college readiness program is minimal and lacking in terms of generalizability and ability to make any causational inferences. The results are not generalizable as the samples are generally small, homogenous, and taken from very limited populations. Next, I will review the research on post-secondary outcomes following participation in California’s Early Assessment Program.

**California’s Early Assessment Program**

The purpose of the Early Assessment Program is to inform California high school juniors about their academic readiness for post-secondary study at California State University campuses. The intent of the program is to identify students in their junior year of high school who need help in building skills in English and/or mathematics in preparation for college study. In eleventh grade, students are given the opportunity to complete fifteen additional multiple-choice questions in each of the mandatory California Standards Tests in English and math. Students that complete the optional items and receive scores above the threshold are then exempt from taking the CSU placement exam and any related remedial coursework. If they score below the threshold, they receive advisement on what courses to take in their senior year and are directed to additional resources to develop their college readiness. Participation in all aspects of the program is voluntary (Howell et al., 2010).

The search process identified only one peer-reviewed article containing research on post-secondary outcomes following participation in California’s Early Assessment program. Howell et al. (2010) investigated whether participation in California’s Early Assessment program
resulted in lower rates of remedial placement for eleventh grade students enrolled in California public high schools who graduate in 2002 or 2005 and later enrolled in California State University Sacramento. The sample included 7,311 students, approximately half of whom participated in the Early Assessment Program. Results found that, compared to non-participating students, participation in the Early Assessment Program significantly reduced the probability of remediation at CSU by 6.1 percentage points in English. Participation in the program also lowered the probability of remediation in math but was not statistically significant.

**Limitations of Research on California’s Early Assessment Program**

The generalizability of the study results is limited as the sample only included students attending one of the colleges within the California State University system. Because of this, the results cannot reliably extend to students attending other colleges in the same system. In addition, selection of the cohorts of students that participated in the Early Assessment Program differed in year of graduation from those that did not participate in the program. This means the students may have differed substantially simply due to the timeframe in which they graduated.

The research on post-secondary outcomes subsequent to participation in the AVID, GEAR UP, and California’s Early Assessment college readiness programs is lacking overall. As mentioned previously, the results are not generalizable as the samples are generally small, homogenous, and taken from very limited populations. The study designs do not allow for any determination of causation between participation in college readiness programs and post-secondary outcomes. The available research provides little evidence that these programs have any effect on post-secondary outcomes. This severe lack of evidence provides a sound argument for the need of more carefully designed research in this area, particularly in terms of demographic differences.
Gender/Sex Differences in Post-secondary Outcomes

The literature search did not identify any research on sex dependent differences in post-secondary outcomes following participation in college readiness programs, yet related research shows significant differences in reaction to information on performance between the sexes. Given research that shows that men and women tend to respond differently to evaluative feedback (Roberts & Nolen-Hoeksema, 1989; Roberts & Nolen-Hoeksema, 1994), it is reasonable to hypothesize that individual reaction to scores and feedback obtained on the DAACS might influence how much a student interacts with the feedback and suggested resources, as well as academic outcomes.

Social role theory explains why men and women tend to have different reactions to performance evaluation. Essentially, the social role theory proposes that sex differences in social behavior occur due to alignment with societal gender norms (Eagly, 1987). According to social role theory, men behave in an agentic fashion (e.g., assertive, competitive, independent, and masterful) while women act more communally when faced with the same situations (Eagly & Wood, 1991). The research on sex differences in reaction to feedback generally aligns with social role theory.

Research on reactions to feedback on performance shows that women respond to both positive and negative evaluative statements while men tend to only engage with positive evaluative statements and dismiss those that are negative. Women more frequently perceive the content of evaluative feedback to be a true reflection of their ability, and are influenced more by the feedback (Roberts & Nolen-Hoeksema, 1989; Roberts & Nolen-Hoeksema, 1994). Research has also shown women to exhibit greater agreement with evaluative feedback scores and to have their self-esteem directly manipulated by the tone of evaluative feedback: Positive feedback...
increased self-esteem while negative feedback significantly decreased self-esteem (Johnson & Helgeson, 2002). In addition, compared to men, women have been shown to interpret subjective negative feedback to mean their true performance was poor as opposed to just the opinion of an observer. This pattern of interpretation resulted in the women placing less importance on the skill or knowledge being evaluated (Biernat & Danaher, 2012). Men were relatively unaffected by either positive or negative evaluative feedback (Johnson & Helgeson, 2002; Biernat & Danaher, 2012).

The research on sex differences in response to computerized evaluative feedback shows similar patterns to those found in written or oral situations. Research investigating how sex may influence response to computerized as opposed to written or verbal feedback found that, compared to men, women were significantly more likely to value and use the presented information for the purpose of improvement (Djamasbi & Loiacono, 2006). Djamasbi and Loiacono (2008) found that women, compared to men, improved their performance more in response to negative feedback on a computerized decision making exercise. The women’s moods were also significantly more negative following negative feedback while the men’s were unaffected. Stone (2014) found that women were more likely than men to report feeling easily hurt by negative feedback on performance; this finding suggests a reason for the increase in negative mood following negative feedback found by Djamasbi and Loiacono (2008).

The takeaway from this research is that women and men react to performance feedback in ways congruent with social role theory. Women react to both positive and negative feedback, while men respond less to feedback in general. Women, more than men, tend to utilize information provided on performance significantly more for behavioral change (Djamasbi & Loiacono, 2008). Given this information, it is reasonable to assume that individual student sex
may influence reaction to information on DAACS scores and subsequent feedback. That is, men and women might obtain unequal outcomes in post-secondary success due to their differential reactions to feedback in general. However, it remains to be seen whether the patterns in sex-dependent differential reaction to performance feedback are present in DAACS usage and outcomes. The current study is needed to address this gap in knowledge.

**Racial/Ethnic Differences in Post-secondary Outcomes**

Only one of the studies identified in the literature review assessed post-secondary outcomes dependent on race/ethnicity following participation in the GEAR UP program (Knaggs et al., 2015). The study did not find a significant difference in post-secondary outcomes between minority students that participated in GEAR UP versus those that did not. The results of the one study identified on this topic do not go far in providing reliable information on true outcomes. Clearly, research on racial/ethnic differences on post-secondary outcomes following participation in college readiness programs is severely lacking.

Based on related theory and research, it seems reasonable to expect differences in post-secondary outcomes following participation in college readiness programs between racial/ethnic subgroups. In example, there is some research showing differential outcomes by race following traditional remedial placement (Brathwaite & Edgecombe, 2018). Stereotype threat is one theoretical framework for explaining how racial or ethnic differences can affect performance and reaction to feedback. Stereotype threat occurs when a person is worried about being judged and possibly treated poorly due to negative stereotypes associated with a group to which they belong (Steele 1997; Spencer et al., 2016).

Multiple studies demonstrate the effects of stereotype threat on academic performance. The main theme of many of the findings is that the reduction of stereotype threat results in
students outperforming non-treatment counterparts in academic outcomes (Aronson et al., 2002). Massey and Fisher (2005) proposed two pathways by which stereotype threat affects academic performance. Externalization is the first pathway; in this, individuals belonging to a stereotyped minority group believe that non-minority group members believe them to be less intelligent and therefore judge them negatively on their academic performance. Internalization is the second pathway, between stereotype threat and reduced academic performance and occurs when those belonging to a minority group believe the negative stereotypes about their group and hence their own poorer academic abilities. Research has shown strong support for a direct relationship between the internalization pathway and decreased academic performance, along with weaker support for the impact of the externalization pathway. The internalization pathway is thought to lead to decreased academic performance via a reduction in academic effort due to an attempt to distance oneself psychologically from self-directed negative group stereotypes (Owen & Massey, 2011; Mendoza-Denton, 2014).

These results suggest that stereotype threat negatively affects academic performance and provides some ideas about how this occurs. It is reasonable to assume that stereotype threat, via both the externalization and internalization pathways, may result in decreased effort on the DAACS, along with lack of engagement with feedback and resources. While there is no way to test this directly with the available data, if differences are found on DAACS scores and usage of feedback and resources between racial/ethnic groups, stereotype threat is one theoretically supported way to conceptualize possible poorer post-secondary outcomes for students from minority groups. If differences are identified in this study, this would indicate need for further research to determine if these results, at least in part, are due to stereotype threat.

**Summary and Critique of Extant Research**
Overall, the reviewed studies had numerous methodological issues that limit the credibility of the results. First, none of the research includes the use of experimental designs. One of the studies noted that non-significant findings meant that students that participated in a particular college readiness program did not differ in their post-secondary outcomes relative to their non-participating peers (Bowman et al., 2018). This outcome could be interpreted to mean that the college readiness program at least prepared the students to perform as well as their peers on the measured post-secondary outcomes. However, without an experimental design with a control condition this theoretical interpretation is indefensible.

The studies were also lacking in consistency in both independent and dependent measures, making comparisons across studies difficult. One glaring issue with efforts to assess outcomes related to the reviewed college readiness programs is that they have a multitude of components not offered in a consistent manner across individual high schools. The studies rarely accounted for the type of service or amount of participation each student had in the college readiness programs. This makes it impossible to determine which aspects of the programs are truly effective and if the amount of participation makes a difference.

The literature search did not identify any research on sex differences, and only one study assessing the differences dependent on race/ethnicity in post-secondary outcomes related to participation in a college readiness program. The study assessing differences in outcomes dependent on race/ethnicity did not find significant differences in post-secondary outcomes.

Research on social role theory and stereotype threat predict differential performance on the DAACS between the sexes and racial/ethnic subgroups. While the patterns of differential reactions to evaluation and resulting academic performance may be similar for post-secondary outcomes following participation in the DAACS, this study will be the first step toward
determining if there are any differences on DAACS scores, or usage of feedback or resources, between male and female students or between students of different racial/ethnic subgroups. If the current study identifies differences, subsequent research will be needed to pinpoint whether the theoretical explanations suggested here adequately explain these differences.

The current study will improve upon some of the limitations of the reviewed research as the data was collected using an experimental research design, a large sample size, as well as clear definitions of post-secondary outcomes and concrete measurement of participation level in the intervention.
Chapter 3: Methodology

The main purpose of this study is to determine if differences exist in academic success (e.g., retention, credits earned), dependent on student subgroup membership (e.g., sex, race/ethnicity), between those that participate in the DAACS intervention and those that do not. An additional intent is to determine if level of feedback and support received after taking the DAACS assessments impacts post-secondary outcomes.

Research Sample and Data Sources

Original Study Sample

The current study uses secondary data collected as part of a randomized control trial (RCT) investigating post-secondary outcomes associated with use of the DAACS (Bryer et al., 2020). The original study sample included 23,482 newly enrolled undergraduate students from two private, non-profit online colleges in the United States, Excelsior College and Western Governors University, who enrolled between April 15, 2017 and December 31, 2017. Excelsior College is based in Albany, New York, and Western Governors University is based in Salt Lake City, Utah. The sample from Excelsior College included 10,282 subjects and the sample from Western Governors University included 13,200 subjects.

Current Study Sample

The sample for the current study includes only those subjects from Western Governors University (Table 4). The data from the Excelsior College component of the study is not included in the sample, as just under 2,200 of the student participants in the treatment group did not receive the treatment according to the study protocol. Meaning, participants in the Excelsior College treatment group self-selected the treatment; they were not randomly assigned.
Table 4. *Current Study Sample Demographics for Western Governors University Students*

<table>
<thead>
<tr>
<th></th>
<th>Treatment</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>n</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>3646</td>
<td>3820</td>
</tr>
<tr>
<td>Male</td>
<td>2614</td>
<td>2627</td>
</tr>
<tr>
<td>Total</td>
<td>6260</td>
<td>6447</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>687</td>
<td>620</td>
</tr>
<tr>
<td>Hispanic</td>
<td>698</td>
<td>675</td>
</tr>
<tr>
<td>White</td>
<td>4295</td>
<td>4473</td>
</tr>
<tr>
<td>Total</td>
<td>5680</td>
<td>5768</td>
</tr>
</tbody>
</table>

**Data Collection Methods**

*Original Study Data Collection Methods*

The original study randomly assigned newly enrolled students to one of two versions of the orientation course: the treatment condition with the DAACS and the control condition without the DAACS. Students in the treatment condition (1) took all four DAACS assessments, (2) received individualized feedback (3) received suggestions based on their resulting SRL; and (4) were assigned to one of approximately 350 academic advisors trained to use DAACS information during their advising.

The DAACS is a suite of open source, online assessments and includes three disciplinary (reading, math, writing) and one general (self-regulated learning) diagnostic assessments. The SRL survey consists of 47 Likert-type items adapted from established SRL measures. The 47 items cover three domains: metacognition, motivation, and learning strategies. The SRL survey has excellent psychometric qualities, suggesting that the inferences drawn from the survey scores are valid and reliable (Lui et al., 2018). The writing assessment asks students to summarize their SRL survey results, identify specific strategies for improving their SRL, and commit to using
them. LightSide, an open source, automated essay scoring program, scores the writing assessments on nine criteria related to effective college-level writing and provides students with feedback in one minute. The mathematics and reading assessments are computer-adaptive tests with 18 to 24 multiple-choice items adapted from state-mandated high school English language arts and mathematics exams that are useful for identifying college readiness. The self-directed learning component involves students getting immediate feedback upon completion of the diagnostic assessments, and links to Online Educational Resources (OERs) related to their results (Bryer et al., 2019).

**Data Analysis Methods**

The first research question asks whether the combination of treatment group assignment and sex significantly predict post-secondary outcomes. Sex is represented as a dichotomous independent variable. The sex variable reflects self-identified gender, but the choice options were binary (male or female). The information on student sex was collected by WGU according to the reporting requirements for the Integrated Postsecondary Education Data System (IPEDS) web-based data collection system. The reporting requirements for IPEDS offer no guidance on how to define gender: The interpretation is left to the reporting entities (IPEDS Technical Review Panel #51: Gender, 2016). This means that each reporting entity may be identifying and recording student sex differently. This is a notable limitation of the data collection method for this study. The dependent variables include on-time progress for the first and second terms, term-to-term retention, and success rate for the first and second terms. On-time progress for the first term is defined as student completion of 12 credits within the first six months of enrollment. On-time progress for the second term is defined as student completion of 12 credits between seven and twelve months of enrollment. On-time progress is coded as 0 or 1, with zero indicating the
student did not achieve the outcome and one indicating success. Term-to-term retention is defined as whether a student remained enrolled from their first to second term. Term-to-term retention is coded as 0 or 1, with zero indicating the student did not remain enrolled and one indicating continuing enrollment. Success rate is defined as the ratio of credits earned to credits attempted for the first term and then those for the second term. The values for success rate range from 0% to 100% and these results are then recoded into a categorical variable with five categories: (1) .0 to .19, (2) 20 to .39, (3) .40 to .59, (4) .60 to .79, and (5) .80 thru 1.0. The intended statistical analyses include log-linear analyses with treatment condition and sex as the independent variables and the measures of post-secondary success (on-time progress for the first and second terms and term-to-term retention, success at term 1, success at term 2) as dependent variables (Table 5).

The second research question asks whether the combination of treatment group assignment and race significantly predict post-secondary outcomes. To address the second research question, the analyses will involve race/ethnicity as a categorical independent variable and will include on-time progress, term-to-term retention and success rate for the first and second terms as the dependent variables. If the combination of treatment group assignment and race significantly predict post-secondary outcomes further analyses will be conducted to determine whether first-generation status or income act as significant covariates in these relationships.

The second research question will be addressed with the same statistical approach used to address the first question: log-linear analyses with treatment condition and race/ethnicity as the independent variables and all measures of post-secondary success (on-time progress for the first and second terms and term-to-term retention, success at term 1, success at term 2) as dependent
variables (Table 5). Race/ethnicity will include three mutually exclusive categories: (1) White (n = 8,768), (2) Black (n = 1,307), and (3) Hispanic (n = 1,373). If the combination of treatment group assignment and race significantly predict post-secondary outcomes then further analyses will be conducted to see if first-generation status or income act as significant covariates in these relationships.

Table 5. *Data Sources and Analytic Procedures for Research Questions 1 and 2*

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Variables</th>
<th>Analytic Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Does the combination of treatment group assignment and sex significantly predict post-secondary outcomes?</td>
<td>2 Dichotomous independent variables: Treatment Sex</td>
<td>3 Dichotomous outcomes: On-time Term 1 On-time Term 2 Retention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Categorical outcomes: Success Term 1 Success Term 2</td>
</tr>
<tr>
<td>2. Does the combination of treatment group assignment and race significantly predict post-secondary outcomes?</td>
<td>2 Dichotomous independent variables: Treatment Race/Ethnicity</td>
<td>3 Dichotomous outcomes: On-time Term 1 On-time Term 2 Retention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Categorical outcomes: Success Term 1 Success Term 2</td>
</tr>
</tbody>
</table>

If one or more of the analyses find a significant interaction showing post-secondary outcomes are dependent on the combination of treatment assignment and sex or race, then the third and fourth research questions will be addressed using moderation analyses to determine what aspects of the DAACS (e.g. scores, feedback usage, etc.) increase or decrease post-secondary success.

Moderation occurs when a third variable influences the strength of the relationship between an independent and dependent variable. In other words, at different levels of a moderator, the relationship between an independent and dependent variable can become weaker
or stronger; absence of the moderator altogether can completely negate the relationship between the independent and dependent variable.

In order to determine if differences in post-secondary success, dependent on either sex or race/ethnicity, are moderated by performance on or use of specific components of the DAACS question, the content will be separated into analyzable components. The variables intended to be tested for moderating effects between sex or race/ethnicity and post-secondary outcomes include DAACS scores and DAACS usage data. DAACS scores will include the four overall DAACS scores for math, reading, writing, and SRL as well as six SRL sub-measures: (1) mindset, (2) anxiety, (3) mastery-motivation, (4) metacognition, (5) managing time and environment, and (6) understanding strategies. The DAACS usage variable is a single composite score representing how often students completed DAACS assessments, viewed the results pages, and visited the recommended resources. The individual relationships to be tested for moderating variables are included in Table 6. The analyses will be conducted using IBM SPSS version 25 (IBM Corporation, 2017) with the added PROCESS macro (Hayes, 2019).

Table 6. Moderation Analyses

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Moderator Variables</th>
<th>Dependent Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>DAACS scores</td>
<td>On-time progress at term 1</td>
</tr>
<tr>
<td></td>
<td>DAACS usage</td>
<td>On-time progress at term 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Term-to-term retention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Success rate at term 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Success rate at term 2</td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td>DAACS scores</td>
<td>On-time progress at term 1</td>
</tr>
<tr>
<td></td>
<td>DAACS usage</td>
<td>On-time progress at term 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Term-to-term retention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Success rate at term 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Success rate at term 2</td>
</tr>
</tbody>
</table>

Summary
The intent of this study is to determine if participation in the DAACS intervention results in differences in academic success dependent on student sex or race/ethnicity. The first research question asks whether the combination of treatment group assignment and sex significantly predict post-secondary outcomes. The second research question asks whether the combination of treatment group assignment and race significantly predict post-secondary outcomes. The intended statistical procedure to test these questions is log-linear analysis. If one or more of the log-linear analyses find a significant interaction showing post-secondary outcomes are dependent on the combination of treatment assignment and sex or race, then the third and fourth research questions will be addressed using moderation analyses to determine what aspects of the DAACS (e.g. scores, usage, etc.) increase or decrease post-secondary success.
Chapter 4: Findings

The final analyses included ten individual three-way log-linear analyses. The data were assessed to determine if the test assumptions for the log-linear analyses were met (Field, 2009). The assumptions for the log-linear analyses were met in all instances: (1) the data was categorical; (2) the observations were all independent; and (3) the expected frequencies were greater than 1 and not more than 20% were less than 5 (Field, 2009). Descriptive statistics for each of the assessed variables are included in Tables 7 and 8 in Appendix B.

Statistical Results

The first research question asked whether the combination of treatment group assignment and sex significantly predicted any of the five post-secondary outcomes (on-time first term, on-time second term, retention, success first term, success second term). Five log-linear analyses were run. None of the three-way log-linear analyses produced a final model that retained the highest order effects.

For the first post-secondary outcome analysis, the highest order interaction (treatment x sex x on-time first term) was not significant, $\chi^2(1) = 2.43, p = .119$. The second highest order effect was significant $\chi^2(4) = 29.66, p < .001$. The (sex x on-time first term) was the significant partial association effect $\chi^2(1) = 20.56, p < .001$. To break down this effect, a chi-square test was performed. The results showed that a higher percentage of male than female students were on-time for the first term (71.9% versus 68.2%), $\chi^2(1) = 20.24, p < .001$.

For the second post-secondary outcome analysis, the highest order interaction (treatment x sex x on-time second term) was not significant, $\chi^2(1) = .711, p = .399$. The second highest order effect was significant $\chi^2(4) = 9.43, p = .051$. The (treatment x on-time second term) was the significant partial association effect $\chi^2(1) = 7.368, p = .007$. To break down this effect, a chi-
square test was performed. The results showed that students that did not participate in the DAACS were on-time more in the second term than those that participated in the DAACS intervention (40.9% versus 38.5%), \( \chi^2(1) = 7.372, p = .007 \).

For the third post-secondary outcome, the highest order interaction (treatment x sex x retention) was not significant, \( \chi^2(1) = 1.299, p = .254 \). No second highest order interactions were significant.

For the fourth post-secondary outcome analysis, the highest order interaction (treatment x sex x success first term) was not significant \( \chi^2(4) = 3.82, p = .432 \). The second highest order effect was significant \( \chi^2(13) = 23.75, p = .034 \). The (sex x success first term) was the significant partial association effect \( \chi^2(1) = 15.402, p = .004 \). To break down this effect, a chi-square test was performed. The results showed that the male students were more successful than female students in the first term \( \chi^2(4) = 15.24, p = .004 \).

For the fifth post-secondary outcome analysis, the highest order interaction (treatment x sex x success second term) was not significant \( \chi^2(4) = 2.85, p = .583 \). No second highest order interactions were significant.

The second research question asked whether the combination of treatment group assignment and race significantly predicted the five assessed post-secondary outcomes (on-time first term, on-time second term, retention, success first term, success second term). None of the three-way log-linear analyses produced a final model that retained the highest order effects.

For the first post-secondary outcome analysis, the highest order interaction (treatment x race x on-time first term) was not significant, \( \chi^2(2) = 3.15, p = .207 \). The second highest order effect was significant \( \chi^2(7) = 370.35, p < .001 \). The (race x on-time first term) was the significant partial association effect \( \chi^2(1) = 355.366, p < .001 \). To break down this effect, a chi-
square test was performed. The results showed that white students were on-time (74.2%) more than both black (49%) and Hispanic (63.1%) students and that Hispanic students were on-time more than black students $\chi^2(2) = 380.176, p < .001$.

For the second post-secondary outcome analysis, the highest order interaction (treatment x race x on-time second term) was not significant, $\chi^2(2) = 2.24, p = .326$. The second highest order effect was significant $\chi^2(7) = 225.73, p < .001$. Both the (race x on-time second term) and (treatment x on-time second term) were significant partial association effects $\chi^2(1) = 208.559, p < .001$ and $\chi^2(1) = 6.437, p = .011$, respectively. To break down these effects, chi-square tests were performed. The results showed that white students were on-time (43.4%) more than both black (24.6%) and Hispanic (32.7%) students and that Hispanic students were on-time more than black students $\chi^2(2) = 201.468, p < .001$. The results also showed that students that did not participate in the DAACS were on-time in the second term more than those that did participate in the DAACS (52.2% versus 47.8%, respectively), $\chi^2(1) = 7.372, p = .007$.

For the third post-secondary outcome analysis, the highest order interaction (treatment x race x retention) was not significant, $\chi^2(2) = 2.15, p = .341$. The second highest order effect was significant $\chi^2(7) = 84.487, p < .001$. The (race x retention) was the significant partial association effect $\chi^2(2) = 73.543, p < .001$. To break down the effect, a chi-square test was performed. The results showed that white students were retained (73.4%) more than both black (62.9%) and Hispanic (66.8%) students, $\chi^2(2) = 76.496, p < .001$. Black and Hispanic students did not differ in their rates of retention.

For the fourth post-secondary outcome analysis, the highest order interaction (treatment x race x success first term) was not significant $\chi^2(8) = 11.61, p = .169$. The second highest order effect was significant $\chi^2(22) = 440.45, p < .001$. The (race x success first term) was the
significant partial association effect $\chi^2(8) = 418.237, p < .001$. To break down this effect, a chi-square test was performed. The results showed that white students earned more of their attempted credits in the first term compared to both black and Hispanic students. In example, 71% of white students earned 79% - 100% of their attempted credits, compared to 45% of black and 58% of Hispanic students $\chi^2(8) = 458.25, p < .001$.

For the fifth post-secondary outcome analysis, the highest order interaction (treatment x race x success second term) was not significant $\chi^2(8) = 12.48, p = .131$. The second highest order effect was significant $\chi^2(22) = 242.26, p < .001$. The (race x success second term) was the significant partial association effect $\chi^2(8) = 215.271, p < .001$. To break down this effect, a chi-square test was performed. The results showed that white students earned more of their attempted credits in the second term compared to both black and Hispanic students. Sixty-three percent of white students earned 79% - 100% of their attempted credits, compared to 39% of black and 52% of Hispanic students $\chi^2(8) = 227.502, p < .001$.

**Power Analysis**

To determine whether the non-significant results were due to a lack of statistical power, post hoc power analyses were conducted using GPower (Faul, Erdfelder, Lang, & Buchner, 2007). The purpose was to determine if the sample sizes were large enough to detect an effect with the log-linear statistics. The sample size was 12,707 for the analyses with sex as an independent variable and 11,448 for those with race/ethnicity as an independent variable. The results indicated that the power to detect an effect with each the log-linear analyses was 1.0. Thus, it is unlikely that our negative findings can be attributed to a limited sample size.

**Summary**
The first research question asked whether the combination of participation in the DAACS intervention and sex significantly predicted any of the five post-secondary outcomes (on-time first term, on-time second term, retention, success first term, success second term). The second research question asked whether the combination of participation in the DAACS intervention and race/ethnicity significantly predicted the same five assessed post-secondary outcomes. The analyses each resulted in non-significant findings of the three way interactions between treatment, subgroup membership, and post-secondary outcomes. Meaning, the results showed that the combination of participation in the DAACS and sex or race/ethnicity did not predict any of the assessed post-secondary outcomes. The results of each of the performed statistical tests are summarized in Table 9.

Table 9. Summary of Highest Order Interaction Results by Subgroup and Outcome

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Treatment x Sex</th>
<th>p</th>
<th>Treatment x Race/Ethnicity</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>test-statistic</td>
<td></td>
<td>test-statistic</td>
<td></td>
</tr>
<tr>
<td>On-time Term 1</td>
<td>$\chi^2 = 2.43$</td>
<td>.119</td>
<td>$\chi^2 = 3.15$</td>
<td>.207</td>
</tr>
<tr>
<td>On-time Term 2</td>
<td>$\chi^2 = .711$</td>
<td>.339</td>
<td>$\chi^2 = 2.24$</td>
<td>.326</td>
</tr>
<tr>
<td>Retention</td>
<td>$\chi^2 = 1.299$</td>
<td>.254</td>
<td>$\chi^2 = 2.15$</td>
<td>.341</td>
</tr>
<tr>
<td>Success Term 1</td>
<td>$\chi^2 = 3.82$</td>
<td>.432</td>
<td>$\chi^2 = 11.61$</td>
<td>.169</td>
</tr>
<tr>
<td>Success Term 2</td>
<td>$\chi^2 = 2.85$</td>
<td>.583</td>
<td>$\chi^2 = 12.48$</td>
<td>.131</td>
</tr>
</tbody>
</table>

While none of the highest order effects were significant, a number of second order effects were. The results showed that male students were on-time and more successful in the first term than were female students. The results also showed that white students were on-time in the first and second terms and retained significantly more than both black and Hispanic students. In
addition, white students earned more of their attempted credits in the first and second terms compared to both black and Hispanic students.

Since none of the analyses indicated that the DAACS intervention combined with race significantly predicted post-secondary outcomes, no further analyses were done to see if first-generation status or income act as significant covariates. Analyses to address the third and fourth research questions were not conducted since none of the results showed evidence to indicate that measures of post-secondary success differed dependent on participation in the DAACS combined with either sex or race/ethnicity.
CHAPTER 5: Discussion

Lack of academic preparation for college has been and continues to be a common problem in the United States (National Assessment of Educational Progress, 2019). For this reason, there are multiple national interventions to increase college readiness. However, the research on post-secondary outcomes associated with participation in traditional college readiness programs is severely limited (Kolbe et al., 2018). The few studies assessing the post-secondary outcomes associated with participation in college readiness programs have numerous methodological issues that limit the credibility of the results. In short, there is minimal research of questionable quality showing if these programs work to increase post-secondary outcomes.

The intent of the current study was to add meaningful information to the body of research on post-secondary outcomes following participation in college readiness programs and to determine if outcomes differed depending on either sex or race/ethnicity. The DAACS offers an alternative, non-traditional college readiness intervention to offer newly enrolled college students the opportunity to assess their level of readiness and strategies to increase their skills independently. Based upon related research that shows different sex and racial/ethnic dependent reactions to feedback on academic performance, there was concern that participation in the DAACS intervention might result in unequal and possibly negative post-secondary outcomes (Voyer & Voyer, 2014; Aud et al., 2010).

No Significant Differences Due to DAACS Combined with Sex or Race/Ethnicity

The first and second research questions asked whether the combination of treatment group assignment and sex or race/ethnicity significantly predicted any of the five post-secondary outcomes. The research in the literature review suggested that the outcomes of this study would show significant differences in how men and women, as well as different racial/ethnic groups,
tend to respond to evaluative feedback (Roberts & Nolen-Hoeksema, 1989; Roberts & Nolen-Hoeksema, 1994). The presumption was that sex and/or race/ethnicity would influence how individuals reacted to their performance on the DAACS and might influence whether they interacted with and benefitted from the feedback and suggestions for skill building.

There were some significant differences in terms of both sex and race/ethnicity and post-secondary outcomes (i.e., second order effects) independent of the DAACS intervention: Male students were on-time and more successful in the first term compared to female students, and white students had higher rates of retention, earned more attempted credits, and were on-time in the first and second terms significantly more than both black and Hispanic students. However, no statistically significant interaction was found for the DAACS intervention combined with sex or race/ethnicity and any of the assessed post-secondary outcomes. These results suggest the DAACS intervention may not elicit differential responses between the sexes or between the assessed race/ethnicities.

To determine if men and women or students of different race/ethnicities did differ in terms of the use of feedback, an exploratory investigation was conducted. Feedback usage differed by sex but not by race/ethnicity. An independent samples t-test showed that, as predicted, the female students ($M = 17.48$, $SE = .243$) accessed the feedback more than the male students ($M = 15.95$, $SE = .277$). This difference was significant $t(6256) = -4.12$, $p < .001$. The finding that the female students accessed the feedback on their DAACS performance significantly more than male students coincides with social role theory and the research discussed in the literature review, which showed that women tend to use performance feedback more than men do. However, the effect size was very small, $d = 0.05$, which might explain the
lack of impact of the feedback on achievement. Descriptive statistics for DAACS feedback usage by sex and race/ethnicity can be seen in Tables 10 and 11 in Appendix C.

Another possible explanation for the absence of significant differences may relate to the type of feedback provided by the DAACS intervention. The body of research showing sex and racial/ethnic differences in reaction to feedback focuses on evaluative feedback. However, the DAACS utilizes diagnostic feedback (i.e., the feedback is intended for personal use for self-improvement and not for grading or other evaluative outcomes). This may explain why the study did not find differences in reaction to feedback within the assessed subgroups. Since the DAACS is diagnostic and not evaluative, any perceived negative feedback on performance may not result in the same adverse reactions students have to evaluative testing intended to determine high stake outcomes such as placement or academic advancement (Cornell, Krosnick, & Chang, 2006).

Limitations and Delimitations

Some limitations may affect the interpretation of the results of the current study. First, the generalizability of the results is limited, as the sample for the original study was drawn from a single, online university and included primarily older, nontraditional students who often had prior college experience. Secondly, it is unknown whether anyone in the original sample had prior experience participating in other college readiness interventions. In addition, the study did not include data from participants who identified as a race/ethnicity other than White, Hispanic, or Black. The data for these participants was not included due to very small sample sizes.

Significance of Study and Suggestions for Future Research

The literature review identified minimal research on whether the main large-scale college readiness programs are effective across different populations. The current study adds valuable information to the sparse body of research on post-secondary outcomes following participation in
college readiness interventions, but questions remain (e.g., are the results applicable to in person or online interventions or different samples). Future research is needed to see if the results are replicable and applicable in other sample populations.

**Conclusion**

The primary aim of this study was to determine whether participation in the DAACS intervention resulted in different post-secondary outcomes dependent on sex or race/ethnicity. The results indicated that post-secondary outcomes do not differ dependent on sex or race/ethnicity combined with participation in the DAACS intervention. The outcomes provide support for the notion that participation in the DAACS does not result in better or worse post-secondary outcomes for men versus women nor students belonging to different racial/ethnic groups. This suggests that participation in the DAACS may offer equal benefits to students regardless of sex or the assessed race/ethnicities.
References


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Appendix A

Results of Randomized Control Trial of DAACS Intervention

Table 1. *Chi-square analyses of on-time progress (OTP) and term-to-term retention, and t-tests of ratio of credits earned to credits attempted (CE-A).*

<table>
<thead>
<tr>
<th>Outcome</th>
<th>EC</th>
<th>WGU</th>
<th>p</th>
<th>WGU</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Treatment (n = 5141)</td>
<td>Control (n = 5144)</td>
<td>test-statistic</td>
<td>Treatment (n = 6542)</td>
<td>Control (n = 6658)</td>
</tr>
<tr>
<td>OTP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Term 1</td>
<td>Pass</td>
<td>56.2%</td>
<td>55.7%</td>
<td>$\chi^2 = 0.240$</td>
<td>0.624</td>
</tr>
<tr>
<td></td>
<td>Fail</td>
<td>43.8%</td>
<td>44.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OTP</td>
<td>Pass</td>
<td>34.8%</td>
<td>34.2%</td>
<td>$\chi^2 = 0.414$</td>
<td>0.520</td>
</tr>
<tr>
<td>Term 2</td>
<td>Fail</td>
<td>65.2%</td>
<td>65.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retained</td>
<td>Yes</td>
<td>39.5%</td>
<td>38.6%</td>
<td>$\chi^2 = 0.797$</td>
<td>0.372</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>60.5%</td>
<td>61.4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE-A</td>
<td>Term 1</td>
<td>M = .598</td>
<td>M = .595</td>
<td>$t_{10283} = 0.301$</td>
<td>0.764</td>
</tr>
<tr>
<td>CE-A</td>
<td>Term 2</td>
<td>M = .346</td>
<td>M = .343</td>
<td>$t_{10283} = 0.235$</td>
<td>0.815</td>
</tr>
</tbody>
</table>

*p <.05*
Appendix B

Descriptive Statistics for Analyzed Variables

Table 7. Post-secondary Outcome Percentages by Treatment Group and Sex

<table>
<thead>
<tr>
<th>Post-secondary Outcome</th>
<th>NO DAACS Male</th>
<th>NO DAACS Female</th>
<th>DAACS Male</th>
<th>DAACS Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-time First Term</td>
<td>73.6%</td>
<td>68.6%</td>
<td>70.2%</td>
<td>67.7%</td>
</tr>
<tr>
<td>On-time Second Term</td>
<td>40.4%</td>
<td>41.2%</td>
<td>38.9%</td>
<td>38.2%</td>
</tr>
<tr>
<td>Retained</td>
<td>70.6%</td>
<td>72.5%</td>
<td>70.5%</td>
<td>70.6%</td>
</tr>
</tbody>
</table>

Success First Term

- 0 thru 19% of Attempted Credits Earned: 5.3% (Male), 5.6% (Female), 6.4% (Male), 6.8% (Female)
- 20 thru 39% of Attempted Credits Earned: 7.6% (Male), 7.8% (Female), 8.2% (Male), 8.3% (Female)
- 40 thru 59% of Attempted Credits Earned: 7.6% (Male), 7.2% (Female), 8.3% (Male), 8.4% (Female)
- 60 thru 79% of Attempted Credits Earned: 11.3% (Male), 13.4% (Female), 11.7% (Male), 11.6% (Female)
- 80 thru 100% of Attempted Credits Earned: 68.3% (Male), 66.0% (Female), 65.3% (Male), 64.9% (Female)

Success Second Term

- 0 thru 19% of Attempted Credits Earned: 9.1% (Male), 8.8% (Female), 9.5% (Male), 8.8% (Female)
- 20 thru 39% of Attempted Credits Earned: 7.9% (Male), 9.4% (Female), 10.4% (Male), 9.9% (Female)
- 40 thru 59% of Attempted Credits Earned: 8.9% (Male), 9.7% (Female), 9.2% (Male), 10.8% (Female)
- 60 thru 79% of Attempted Credits Earned: 12.7% (Male), 12.1% (Female), 12.5% (Male), 12.4% (Female)
- 80 thru 100% of Attempted Credits Earned: 61.5% (Male), 60.1% (Female), 58.5% (Male), 58.1% (Female)

Table 8. Post-secondary Outcome Percentages by Treatment Group and Race/Ethnicity

<table>
<thead>
<tr>
<th>Post-secondary Outcome</th>
<th>NO DAACS White</th>
<th>NO DAACS Black</th>
<th>NO DAACS Hispanic</th>
<th>DAACS White</th>
<th>DAACS Black</th>
<th>DAACS Hispanic</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-time First Term</td>
<td>75.1%</td>
<td>47.7%</td>
<td>65.2%</td>
<td>73.3%</td>
<td>50.1%</td>
<td>61.2%</td>
</tr>
<tr>
<td>On-time Second Term</td>
<td>44.9%</td>
<td>23.9%</td>
<td>33.5%</td>
<td>41.9%</td>
<td>25.3%</td>
<td>31.9%</td>
</tr>
<tr>
<td>Retained</td>
<td>73.9%</td>
<td>61.9%</td>
<td>68.4%</td>
<td>72.9%</td>
<td>63.9%</td>
<td>65.2%</td>
</tr>
</tbody>
</table>

Success First Term

- 0 - 19% Attempted Credits Earned: 4.3% (White), 15.9% (Black), 7.9% (Hispanic), 4.8% (White), 12.7% (Black), 8.8% (Hispanic)
- 20 - 39% Attempted Credits Earned: 6.6% (White), 14.7% (Black), 9.6% (Hispanic), 6.9% (White), 12.7% (Black), 10.9% (Hispanic)
- 40 - 59% Attempted Credits Earned: 7.4% (White), 9.4% (Black), 9.3% (Hispanic), 6.7% (White), 12.7% (Black), 9.9% (Hispanic)
- 60 - 79% Attempted Credits Earned: 10.4% (White), 16.2% (Black), 13.5% (Hispanic), 11.4% (White), 16.2% (Black), 13.9% (Hispanic)
- 80 - 100% Attempted Credits Earned: 71.3% (White), 43.9% (Black), 59.6% (Hispanic), 70.2% (White), 45.9% (Black), 56.5% (Hispanic)

Success Second Term

- 0 - 19% Attempted Credits Earned: 7.4% (White), 17.4% (Black), 11.9% (Hispanic), 8.4% (White), 14.1% (Black), 8.8% (Hispanic)
- 20 - 39% Attempted Credits Earned: 7.8% (White), 14.6% (Black), 11.0% (Hispanic), 8.3% (White), 18.9% (Black), 13.8% (Hispanic)
- 40 - 59% Attempted Credits Earned: 8.2% (White), 12.2% (Black), 13.4% (Hispanic), 9.6% (White), 13.7% (Black), 10.3% (Hispanic)
- 60 - 79% Attempted Credits Earned: 11.8% (White), 16.1% (Black), 12.6% (Hispanic), 11.9% (White), 14.1% (Black), 14.3% (Hispanic)
- 80 - 100% Attempted Credits Earned: 64.7% (White), 39.6% (Black), 51.1% (Hispanic), 61.8% (White), 39.2% (Black), 52.7% (Hispanic)
Appendix C

Descriptive Statistics for DAACS Feedback

Table 10. Descriptive Statistics for DAACS Scores and Feedback Usage by Sex

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th></th>
<th>Female</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>M</td>
<td>SD</td>
<td>N</td>
</tr>
<tr>
<td>DAACS Feedback Views</td>
<td>2,613</td>
<td>15.95</td>
<td>14.18</td>
<td>3,645</td>
</tr>
</tbody>
</table>

Table 11. Descriptive Statistics for DAACS Scores and Feedback Usage by Race/Ethnicity

<table>
<thead>
<tr>
<th></th>
<th>White</th>
<th></th>
<th>Black</th>
<th></th>
<th>Hispanic</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>M</td>
<td>SD</td>
<td>N</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>DAACS Feedback Views</td>
<td>4294</td>
<td>16.58</td>
<td>14.33</td>
<td>686</td>
<td>16.17</td>
<td>13.47</td>
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