HIGH SCHOOL EDITION
Journal of Student Research
Volume 11 Issue 4 (2022)

Effects of a Growth Mindset Intervention on Ninth Grade Students' Self-Perception of AP Enrollment Likelihood

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ABSTRACT

Students of color and low-income students face external barriers that prevent them from reaching equal representation in Advanced Placement (AP) classes in the United States. Internal barriers, like self-doubt, however, may be just as effective at decreasing enrollment likelihood for these populations. This trend has been noticed even in regions of the U.S. that have very diverse high school populations. The purpose of this study was to determine the effects that a growth mindset can have on historically-underrepresented students' self-perceived AP enrollment likelihood. A growth mindset intervention was administered to five standard level freshman English classes via PowerPoint presentation. These classes were chosen based on a calculated diversity score to examine historically-underrepresented populations. Two surveys were completed by students before and after the intervention. The surveys collected information on students' self-perception of their likelihood of enrolling in an AP class in their future high school years. The analysis revealed that students who struggled to use a growth mindset had a significant increase in self-perceived AP enrollment likelihood. Based on the gap in research regarding growth mindset and AP enrollment, these analyses provide evidence that growth mindset interventions could potentially help more students overcome their internal barriers and have the confidence to enroll in AP classes.

Growth Mindset and Historically-Underrepresented Students' AP Enrollment

Advanced Placement (AP) classes can affect students' college options, learning enjoyment, and sense of place at school. According to the AP College Board (2021), the AP testing institution, the classes can offer rigorous college-level content designed to challenge high school students, and can "help students build confidence and learn the essential time management and study skills needed for college and career success" (ACS, 2021). As a student myself, I know that AP classes play a large role in many students' high school experiences. But not all students have access to or feel welcome in AP classes (A. Brown, lecture, January 13, 2021). Special programs like Equal Opportunity Schools (EOS) have been created to combat this inequality. EOS is an organization with a mission to "ensure that students of color and low-income students have equitable access to America's most academically intense high school programs and succeed at the highest levels" (EOS, 2021). In other words, EOS is addressing racial and income inequality that has become increasingly apparent in AP classes. The organization has partnered with 32 states in the US, over 700 schools, and over 200 school districts. The Anchorage School District (ASD) is one of these districts.

The ASD is home to the United States' top three most diverse high schools, and has been working with EOS to increase historically-underrepresented students of color and low-income students' enrollment and

success in AP classes (Tunseth, 2015). One high school in the district, although highly ranked on national diversity scales, hasn't reached the enrollment rates of historically-underrepresented students in AP classes that other ASD schools are attaining (A. Brown; Niche, n.d). A school-wide study showed that higher percentages of historically- underrepresented students face barriers when enrolling in AP classes than White, Asian, and middle-to-high-income students (A. Brown, presenter, 2020; ASD Student Survey, 2020).

External barriers include: self-perceived unwelcoming classroom environment, lack of general knowledge about AP courses, and little knowledge of the potential benefits to AP enrollment for students in the ASD (A. Brown, presenter, 2020). But external barriers are only half of the battle for these students. Historically-underrepresented students also face more internal barriers than other students. The greatest internal barrier was a lack of self-confidence and doubts that they could succeed in an AP class (A. Brown, presenter, 2020, ASD Student Survey, 2020). Compared to concerns about GPA and workload, students cited that they were much less likely to enroll in AP classes because they "didn't think they could be successful." A similar problem was present in a high school in Omaha, Nebraska (Sauders & Maloney, 2005). Despite a diverse student population, few minority students enrolled in AP or advanced classes. In an analysis of focus groups with minority students from the school, internal stigmas toward academic success were noted as a main reason that students chose not to enroll in AP classes, as well as social isolation and insufficient familial support. In other high schools around the country, Black students who had dropped out of advanced courses cited their lack of self-belief as a primary reason for their enrollment choices (Jefferies & Silvernail, 2017). These students also noted that lacking parent involvement and uninterested teachers deterred them from enrolling in AP and advanced classes (Jefferies & Silvernail). All of these examples show that historically-underrepresented students often grapple with internal turmoil about enrolling in AP classes. The goal of this project is to determine if the presence of a growth mindset, which could combat self-doubt, would increase historically-underrepresented students of color and low income students' enrollment rates in AP courses.

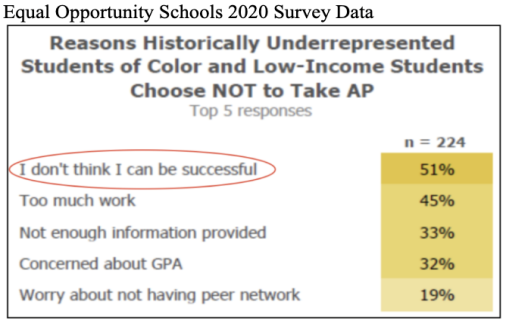
Literature Review

One area that has yet to be researched is the relation between historically-underrepresented students' mindset and their enrollment choices. Previous research has only compared growth mindset and students' academic performance. In order to understand and navigate the realm of growth mindset and AP inequality, some themes must be described and synthesized in detail.

Growth Mindset

As defined by Carol Dweck (2010), a growth mindset is the belief that one's brain can grow and develop. Attributes of this mentality include seeking challenges to grow one's brain and using failure as a chance to learn (Dweck, 2010). The opposite of a growth mindset is a fixed mindset. When a person has a fixed mindset, they believe that their abilities and intelligence are innate and incapable of growth, try to avoid challenges, and think of failure as a sign of unworthiness. Figure 1 illuminates that many historically- underrepresented students are grappling with self-doubt and fixed-mindset beliefs, as cited by the schoolwide study in Anchorage (A. Brown, presenter, 2020; EOS, 2020). A potential solution to inequality in AP classes could be a mindset shift for students of color and low-income students (A, Brown; Dweck, 2010, 2015).

Equal Opportunity Schools 2020 Survey Data



(ASD Student Survey, 2020)

Figure 1. This image highlights the idea that many students choose not to enroll in AP classes because they do not believe that they can be successful.

Benefits of a Growth Mindset

A growth mindset can provide its endorsers with many benefits, especially in a classroom setting. In an attempt to explore students' perceptions of college curriculums, researchers found that students who set academic goals that are learning and growth-mindset based are more likely to enjoy and succeed in their classes than students who set performance-based goals that are more representative of a fixed mindset (Martin et al., 2008). Not only do students in college level classes benefit from a growth mindset, but low achieving high school students have also shown to improve their academic performance by adopting a growth mindset (UT of A, 2019). A longitudinal study by three experts of growth mindset showed that students with growth mindsets had higher academic achievement, and began to show better test scores even two years after the initial questionnaire than their peers with fixed mindsets (Blackwell et al., 2007). While these studies focus on students' goals and achievement, Claro et al. (2018) introduced students' external situations to the realm of knowledge. A nationwide study in Chile showed that students of low-income backgrounds were more likely to display fixed mindsets than middle and high-income students. Most importantly, the low-income students with growth mindsets were shown to be extremely resilient and "buffered against the deleterious effects of poverty on achievement…" (Claro et al., 2018). This research presents an idea that students who face external challenges (like poverty or racial discrimination) may be better prepared for academic challenges if a growth mindset is aquired.

AP Classes: Benefits and Drawbacks

Taking AP classes in high school has shown to help students succeed in and out of academic settings during and after they graduate high school. According to a four year longitudinal study based in Texas, students who take on these challenging courses have been shown to graduate from college with a higher GPA and in a more timely manner than students who were not exposed to AP classes (Klein, 2007). In Klein's study, students were grouped by similar ACT scores, presenting a strong argument for the benefits of AP class enrollment by eliminating other intelligence factors and variables. Students who enrolled in AP classes in high school have also proven to be more likely to thrive after college, especially with potentially reduced student debt from AP test credit transfers or AP-based scholarships (Schneider, 2018). Students are also most likely to enjoy classes that challenge and interest them, which is a prominent component of many AP programs (Martin et al.). According to the study, students' favorite classes were the most stimulating and rewarding ones, which can provide evidence for all students' belonging in AP classes. However, AP classes can have drawbacks. A qualitative analysis of students in different AP programs showed that a stressful workload, judgement from non-AP enrolled students, and negative self-perceived stereotypes were prevalent in each of the AP programs (Foust et al., 2009). It is also important to note that studies have shown that students who perform poorly on the end-of-course AP exams may not reap the benefits that exam-passing students do (Adams, 2013; McKillip & Rawls, 2013). Students who take and succeed in AP classes may be more likely to be successful than students who do not enroll in high school AP classes. Even with the drawbacks of AP classes, students have proven to be more successful in their academic endeavors if they complete AP courses.

Growth Mindset Interventions

Many forms of growth mindset interventions have proven to be effective in changing interventees' mindsets, as attested to by many studies. Haimovitz and Dweck (2017) highlighted the ease at which students' mindsets could be altered and "artificially" fostered by an intervention in their analysis of the origins of childrens' mindsets. Even relatively short interventions have greatly benefited students (Yeager et al., 2016). Fraser (2018) confirms the work of Haimovitz, Dweck, and Yeager, but adds data that show greater effectivity of long-term interventions than one-time interventions for growth mindset. A study examined 9th graders' responses to two

25 minute online growth mindset learning sessions administered at the beginning of their school year (UT of Austin, 2019). Compared to the students who hadn't completed the intervention, the students had higher GPAs and failed fewer classes that year, with positive impacts that lasted into their sophomore years (UT of A, 2019). Nationwide research by Yeager et al. (2019) showed that students from around the United States experienced an improved GPA and growth mindset after an hour-long online growth mindset intervention. In a study of an online growth mindset intervention called "Brain Points," it was shown that students who played the video-game-like intervention were more likely to persevere when faced with challenges (O'Rourke, 2013). Brain Points encouraged players to use learning strategies and focus on effort and learning, instead of speed and answer correctness. The successes of growth mindset interventions leads to the conclusion that students can successfully adopt a growth mindset and use it to tackle their academic challenges.

Inequality and Diversity in the Classroom

The Equal Opportunity Schools organization has shown that a high school in Anchorage, Alaska, is lacking equality in its AP classes. Historically-underrepresented students of color and low-income students may face internal and external barriers to enroll in AP classes at the school (A. Brown, presenter, 2020). This isn't a problem in only Anchorage high schools, though. In a 15 year, longitudinal study in the Southeastern U.S., it was shown that African American, Latinx, and low-income students are significantly less likely to enroll in AP classes in high school, despite being equally likely to enroll in honors courses in middle/junior high schools (Ricciardi & Winsler, 2021). In 2020, it was estimated that if students at this school could overcome the noted internal barriers, 42 new students might enroll in the school's AP program, increasing diversity and equality in AP programs (A. Brown, presenter, 2020).

Increasing diversity in high school classes has proven to benefit both students and teachers. Tam and Basset (2004) executed a study to understand the correlation between high school diversity and college success and found that greater diversity in students' high school classes resulted in higher college GPAs during the first semester. Teachers who have more diverse classes have also shown to have a "higher teaching quality" than teachers with less diverse exposure (Beuckelaer et al., 2012).

A Path Forward

Not everyone in the education community thinks that students should be pushed out of their comfort zones by encouraging AP enrollment (Matthews, 2006). But after analyzing students' enjoyment of challenging classes and resilience a growth mindset can provide, it seems that many historically-underrepresented students could benefit from the challenge (Martin et al., 2008; Claro et al., 2018). Shifting to a growth mindset ideology could help these students have the confidence to enroll in challenging AP classes (Haimovitz & Dweck, 2017; UT of Austin, 2019; Yeager et al., 2019, p. 368). As shown, many studies have concluded that growth mindsets increase students' academic performance, but whether or not mindset influences students' class enrollment choices remains to be studied. As previously stated, this project aims to determine if a mindset oriented around growing and learning positively influences historically- underrepresented students of color and low income students' enrollment in AP classes. It is hypothesized that a growth mindset intervention will increase historically-underrepresented students' self-perceived likelihood of enrolling in AP classes.

Methods and Materials

This study aimed to determine the relationship between mindset and self-perceived likelihood of AP enrollment of historically-underrepresented students in the Anchorage School District. The question in consideration was

"How will a growth mindset intervention affect historically-underrepresented students' self-perceived likelihood of enrolling in AP classes?" Prior research has not examined mindset in relation to class enrollment, focusing only on student academic performance and GPA.

Participants

To ascertain whether a growth mindset intervention could help historically- underrepresented students enroll in AP classes, diverse populations of 9th grade students in standard level English classes were surveyed. For this project, standard level classes included courses that were not AP, Honors, school-within-a-school, or accelerated courses. These classes were selected because of their racial diversity and to increase the likelihood that students were not already enrolled in AP classes. Because the surveyed standard level freshmen classes were calculated with a diversity index to have more diverse populations than many AP classes, it was assumed that the data trends were consistent for all of the students in the classes, not just historically-underrepresented students. This population of students who were enrolled in standard level classes provided a control for the experiment, because students who were already enrolled in AP classes could have reasons other than a shifted mindset for likelihood of AP class enrollment.

Freshmen participants were chosen to eliminate other variables that could interfere with AP enrollment in future years, such as scheduling conflicts and graduation requirements that would arise more prominently for juniors and seniors. Freshmen students also had limited exposure to AP classes compared to other grades, which provided a mostly-controlled variable for the experiment.

Five standard level classes composed of only freshmen students were identified and given permission to participate in the study by the classroom teachers. These participants were informed of this study's purpose before any information was gathered. Consent was given from each student and their teachers. The Institutional Review Board also approved this research and confirmed the participants' safety during and after their involvement with the study.

Three teachers were contacted, who taught a total of nine standard level freshman English classes. Two teachers allowed time for the study and five classes were chosen to participate in the study. A total of 71 responses were collected for students who completed both pre- and post-intervention surveys.

Instruments

Absolute Diversity Index

Classes were labeled with "diversity scores" on a scale that was used in Tam and Bassett's 2004 study on the "Impact of high school diversity on freshman GPA." One diversity measure used was the Absolute Diversity Index (AbD), which measured the probability that "two students selected at random … have different ethnic backgrounds." The scale ranges from 0 to 1, with 0 being a single ethnic group and 0.75 being equal representation of each group. Five standard level freshmen classes were chosen that had a high absolute diversity. The classes with higher diversity indexes were chosen because they provided information about historically-underrepresented groups, particularly students of color, which could directly relate to a possible correlation between historically-underrepresented students' enrollment rates and their mindsets. Data were collected about students' ethnicities anonymously from the school.

Intervention

Many growth mindset interventions have been implemented and tested in classrooms around the world. However, many of these interventions were long-term, required school wide participation, teacher administration or took too much time to be feasible for this project (Mindset Works, 2021; PERTS, 2021). To create a growth mindset intervention that would be appropriate for this setting, a PowerPoint presentation was designed and

created using proven techniques from Yaeger et al.'s (2016) study: "Using Design Thinking to Improve Psychological Interventions: The Case of the Growth Mindset During the Transition to High School." The presentation also incorporated ideas from Shivek Narang's (2020) presentation on "Adolescent Brain Development And Growth Mindset."

The techniques used in the PowerPoint presentation applied from the aforementioned study included emphasis on prosocial behaviors, celebrity endorsements, learning strategies, scientific examples relating to teenagers, a downplayed importance of hard work, and a minimized focus on fixed mindset behaviors (Narang, 2020).

Surveys

Because no previous research has compared mindset to AP enrollment, a new survey needed to be designed. A 6-item pre-test survey was created and administered via Google Forms before the growth mindset intervention, and a similar 6-item post-test survey was administered directly after. The online format was used for ease of use and easy incorporation into the PowerPoint slideshow via a scannable QR code. Both surveys used Likert scales, short answer questions, and polar questions. Each of the classrooms' surveys were merged together to show population-wide trends before and after the growth mindset presentation, instead of keeping the individual classes' data as separate populations.

The surveys and growth mindset intervention were designed to be brief and quickly completed to ensure student engagement and to preserve teachers' class time. The surveys did not include questions about race or income, as not to trigger negative feelings in those regards and to preserve anonymity. However, anonymous data about students' ethnicities from each of the surveyed classes was collected from an administrator at the high school to calculate the Absolute Diversity Index, which gave a general idea about the demographics of the surveyed population.

Procedure

First, Absolute Diversity Indexes were calculated and averaged for the surveyed classes using the method cited by the aforementioned study by Tam and Basset (2004), which was originally published in a study by Meyer and McIntosh (1992). The classes with high absolute diversity were selected to provide data on historically-underrepresented students' AP enrollment likelihood. In generalized terms, the AbD is the probability that two students of different racial groups will come into contact with each other.

Then, the selected classes' teachers gave permission for the presentation and surveys to take place during their classes. Students who consented to the study were given five minutes to complete the pre-test survey mentioned above, which consisted of both multiple choice and short answer questions. The growth mindset intervention PowerPoint was then presented to the classroom of students, which took around ten minutes. The post-test survey was administered after the PowerPoint intervention and students were given five minutes to complete the survey questions.

Quantitative data from the Likert scale questions were coded and analyzed using a five point t-test to determine the statistical significance of the differences in the data sets. The multiple response questions were analyzed in relation to the students' likelihood factors using another t-test from the Likert scale questions. This was used to show differences in pre and post surveys for specific groups of students who face certain barriers to enroll in AP classes. These calculations analyzed students' self-perceived likelihood of enrolling in AP classes in relation to learning about growth mindset.

Results & Discussion

A null hypothesis was written: "a growth mindset intervention will have no impact on historically-underrepresented students' self-perceived likelihood of enrolling in AP classes" and tested for statistical significance using paired samples t-tests. In the pre-intervention survey, 186 responses were recorded. However, only 77 students completed the post-intervention survey. Six students only responded to the post-intervention survey. Thus, of the 263 survey results from pre- and post- tests, only 71 were able to be used as data.

Although the intervention was not tested by a growth mindset pre- and post- test, students were attentive during the presentation and 79% (n = 55) of students who answered both pre- and post- survey questions answered that they had learned something new from the presentation and provided an example of their new knowledge.

Diversity

Diversity scores were calculated with permission from researchers and authors of the paper "Does Diversity Matter? Measuring the Impact of High School Diversity on Freshman GPA" using the formula $P = 1 - (P^2_A + P^2_H + P^2_N + P^2_M + P^2_A + P^2_P + P^2_B)$.

Diversity of Surveyed Population

Ethnicity	Class 1	Class 2	Class 3	Class 4	Class 5	Total	P^2
W= White	9	4	14	10	12	49	0.09993756504
H= Hispanic	3	7	0	3	6	19	0.01502601457
N= Alaska Native	3	3	3	4	1	14	0.008158168574
M= Multi-ethnic	4	6	4	5	8	27	0.0303433923
A= Asian	7	6	7	7	4	31	0.04
P= Native Hawaiian or Pacific Islander	6	2	1	0	0	9	0.003371488033
B= Black	0	2		3	1	6	0.001498439126
Total	32	30	29	32	32	155	0.1983350676

Figure 2. This figure shows raw values for diversity in the surveyed ninth grade classes. It also shows the squared probability for each ethnic group being selected that is used to calculate the Absolute Diversity Score.

$P = 1 - 0.1983350676$

$P = 0.8016649324$

The diversity score of 0.80 shows a high level of absolute diversity for the surveyed student population on the scale of 0 to 1, where 0.75 is when "the student body has equal proportion among the four groups" [$P = 0.80 > 0.75$] (Tam & Basset, 2004). Historically under-represented students for the surveyed population, as defined by Equal Opportunity Schools, are students of color or low-income students. This relates the data directly to historically-underrepresented students, gives value to the study, and connects to the original research question.

Calculations

Before calculations were run, data from students who did not complete both pre- and post- survey questions were removed. A paired samples t-test was conducted on the entire usable data set (n = 71) to determine the effects of a growth mindset intervention on the overall self-perceived likelihood of AP class enrollment. Responses were coded to fit the surveys' Likert scales, with a value of five as *"very likely,"* and a value of one for *"very unlikely."* The results of the test on the overall population indicated an insignificant difference for likelihood of AP enrollment before and after the intervention; [$p = .89 > \alpha = .05$]. This could be an effect of combining students who are not interested in AP classes before the intervention with students who are already planning on enrolling in the future. This was further explored by running a second paired samples t-test on the responses from students who noted *"None, I want to take AP classes"* on the pre-intervention survey (n = 21). The results of this t-test also indicated an insignificant change in the enrollment likelihood of students who did not have any barriers to AP enrollment [$p = .33 > \alpha = .05$]. The null hypothesis failed to be rejected, which suggests that only students who face specific barriers have a greater probability of experiencing a statistical change.

In addition, the AP enrollment barriers noted by students, such as "*The classes seem too difficult., I do not have enough information about the classes., I do not feel like I can succeed."* did not change significantly before and after the intervention, as shown by the Figures 3 and 4 below.

Pre-intervention Barriers Noted By Students

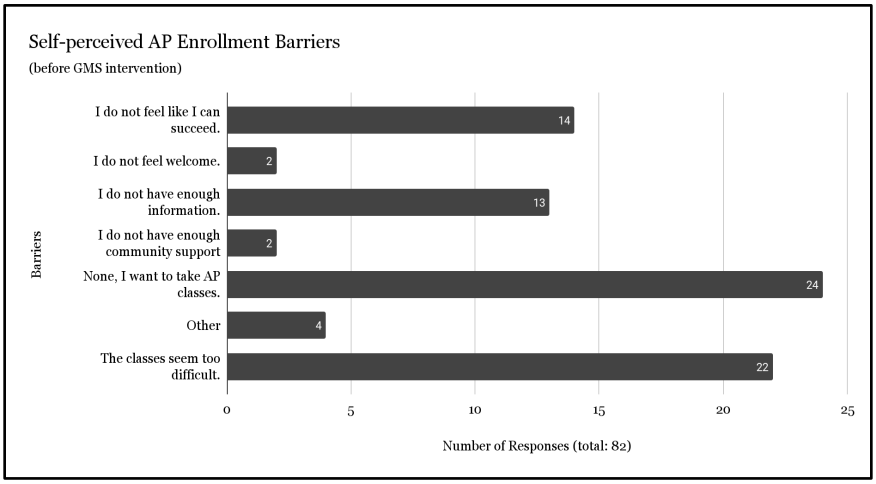


Figure 3. This figure shows students' responses to survey questions about AP class enrollment barriers that they experienced before the growth mindset intervention.

Post-intervention Barriers Noted By Students

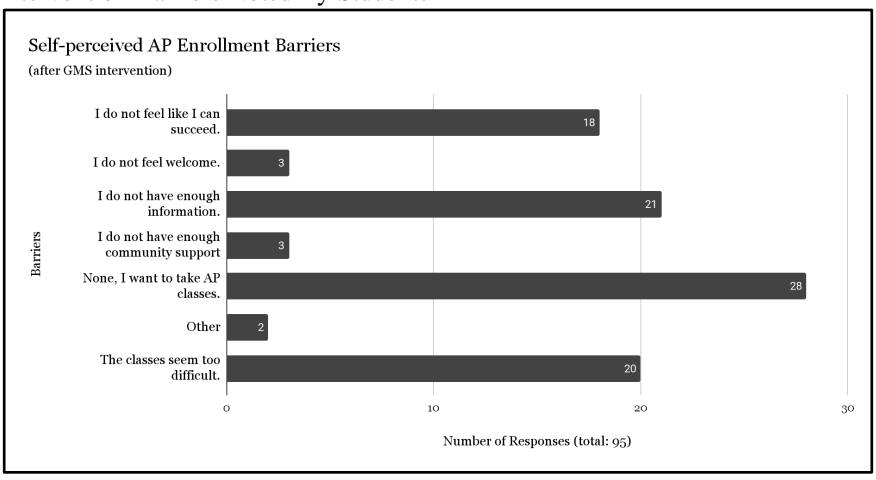


Figure 4. This figure shows students' responses to survey questions about AP class enrollment barriers that they experienced after the growth mindset intervention.

A paired samples t-test was conducted on the population who noted self-doubt by responding *"I don't feel like I can succeed"* on either the pre- or post-intervention survey. This was used to determine how a GMS intervention affected self-doubting students' self-perceived likelihood of AP class enrollment of the population. The test indicated a significant difference for likelihood of AP enrollment before and after the intervention; [$p = .019 < \alpha = .05$]. Two more categorical variables were isolated from the survey question about barriers that most students experienced: *"classes seem too difficult,"* and *"not enough information."* Both of these variables showed a statistically significant increase in self-perceived likelihood [$p = .0015$, $p = .020 < \alpha = .05$ respectively] and the null hypothesis was rejected. This could potentially show that students who have trouble using a growth mindset (*"don't feel like I can succeed"* and *"classes seem too difficult"*) or want to learn more about the workload (*"not enough information"*) could benefit from an intervention like this one. This suggests that an intervention could influence students' AP enrollment likelihood and set them up for success in college and beyond.

Conclusions, Limitations, and Implications

To conclude the findings of this study, it is noted that a growth mindset intervention increases historically-underrepresented students' self-perceived likelihood of enrolling in AP classes who experience external enrollment barriers. Students who did not feel that they could find success in AP classes because they were *"too difficult"* were most positively affected by the growth mindset intervention, followed by students who responded *"I don't feel like I can succeed."* These findings are consistent with past research on growth mindset interventions and their success in helping students embrace challenges (Claro et al., 2018; Martin et al., 2008). Students who faced self-doubt seemed to benefit from the growth mindset presentation the most.

The intervention was unsuccessful in removing external barriers that students perceived when considering AP enrollment. This shows a complicated relationship and difference between "overcoming" or "solving" the self-perceived barriers and accepting them as a challenge as a student. Because students who faced self-doubt and who worried about the difficulty of the curriculum showed a significantly increased likelihood of enrollment, it seems that the intervention may have been successful in instilling a challenge-oriented mindset. An outlook that focuses on learning, rather than an end goal, has been shown to increase enjoyment in the classroom and better academic performance (Martin et al., 2008). Although the intervention did not seem to decrease students' perceptions of external AP enrollment barriers, it did appear to instill a growth-oriented mindset, which was enough to change students' perceptions even as they experienced barriers.

This project did not come without complications. The most problematic issue with data collection were students who did not complete both surveys. In the future, incentivizing students to take part in the entire process would allow for more data and a more accurate analysis of the population. Survey questions should also be revised to include specific examples of the barriers that students face to eliminate ambiguity. For example, it was unclear whether students who answered *"I do not have enough information about the classes"* were uninformed about the curriculum, difficulty of classes, did not understand how to enroll, etc. Because of the study's time frame and sample size, students' "actual" AP enrollment in future years was not studied. Instead, self-perceived likelihood of enrolling was studied. In a longer-term study with a much larger sample size, students' actual enrollment after a growth mindset intervention could be studied compared to a control group of students who were not given a growth mindset intervention. This method could be problematic because of different schools' relationships to AP programs, ie. schools that offer fewer AP classes compared to others, but could add to the lacking knowledge related to AP classes and growth mindset if correctly explored. In addition, stu-

dents were not surveyed for race or income, so true "historically-underrepresented" status could not be measured. Assumptions had to be made that students who noted that they faced barriers to enrollment on the survey were mostly historically-underrepresented. However, even if the assumptions were wrong, the literature shows that all students belong in AP, so helping any student find courage to enroll is likely to benefit them. In the future, studies that gather more complete demographic data should be conducted for better methodological alignment.

Implications for the surveyed high school and the Anchorage School District could include administering a growth mindset intervention for ninth grade students, as well as working with Equal Opportunity Schools (EOS) at a higher level. A growth mindset lesson plan could be included in the school's monthly homeroom schedules. Integrating a growth mindset section into EOS's surveys to improve AP classroom environments and historically-underrepresented students' enrollment could provide further information about its significance in students enrollment likelihood.

The null hypothesis "A growth mindset intervention will have no impact on historically-underrepresented students' self-perceived likelihood of enrolling in AP classes" has been rejected until further research. Overall, this project was successful in determining whether or not a growth mindset intervention influences students' self-perceived AP enrollment likelihood. However, an exclusive perspective on historically-underrepresented students was not incorporated effectively.

Acknowledgments

I would like to thank my advisor for the valuable insight provided to me on this topic.

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