A+ Swimmers: Evaluating The Extent to Which High School Competitive-Based Swimming Influences Academic Intelligence

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Abstract

The pressure has exponentially increased for high schools to improve test scores and continue to rise every year. Schools across the country are investigating ways to deal with the severe bdgest cuts while finding a way to improve student performance. Many schools have already started to decrease funding for certain extracurricular activities like swimming. This study explored the correlation between high school competitive-based swimming and how it impacts academic intelligence. The study focused on the influence of competitive-based swimming on GPAs, standardized test scores, and advanced classes as well as the 3 academic intelligence types: logical/mathematical, verbal/linguistic, and visual/spatial. In order to answer the research question, the study was conducted through a quantitative survey and the results of the data were analyzed using a 2-Sample t-test. The study found that high school students who participated in competitive swimming have slightly higher GPAs, standardized test scores, took more advanced classes, and overall had increased academic caliber compared to their non-swimming peers. Although the small sample size and possibility of cheating created some margins of error, this study and future research could help students increase their grades and could also be used as a therapy to help students with learning disabilities. Further research could look at the causal relationship between swimming and academic intelligence which could then be used to investigate the relationship between swimming and other intelligence types.

A+ Swimmers: Evaluating The Extent to Which High School Competitive-Based Swimming Influences Academic Intelligence.

Table of Contents

A+ Swimmers: Evaluating The Extent to Which High School Competitive-Based Swimming Influences Academic Intelligence.

Figures

Appendices Figures

A+ Swimmers: Evaluating The Extent to Which High School Competitive-Based Swimming Influences Academic Intelligence.

Introduction

John F. Kennedy believed that, "children are the world's most valuable resource and its best hope for the future." Throughout his presidency, JFK emphasized the importance of academic success for children and how it affects the future. Now, JFK's beliefs are still evident in the many studies being conducted on how academic success and student intelligence can be further facilitated through extracurricular activities like clubs and sports. This is especially relevant since nearly 9 million high school students participate in extracurricular activities each year in the United States (U.S. Census Bureau, 2014). The widespread participation in school sports has led to significant academic attention as many researchers have investigated the correlation between student engagement in school activities and academic achievement. Previous studies have consistently found that extracurricular activities have a positive correlation with academic performance in students. Specifically, one study indicated that students had significantly higher GPAs when involved in community-based and athletic-based extracurricular activities (Morris, 2019). Although substantial research focusing on general extracurriculars and academic intelligence have been studied in detail, insufficient attention has been paid to specific sports like competitive-based swimming and its association with academic intelligence in high school students. This paper sets out to address this research gap by investigating the extent to which high school competitive-based swimming influences the academic intelligence types (e.g. logical/mathematical, verbal/linguistic, and visual/spatial).

A+ Swimmers: Evaluating The Extent to Which High School Competitive-Based Swimming Influences Academic Intelligence.

Literature Review

Evaluating whether extracurricular activities and sports affect academic performance and education is not a new concept. Previous research has explored the influences of academic intelligence and the effects of extracurriculars and sports on academic achievement.

Influences of Academic Intelligence

In 2005, a study done by Feldman and Matjasko investigated the role of school-based activities on adolescent development. This included academic achievement, participation, substance abuse, delinquency, psychological adjustment, sexual anxiety, and young adult outcomes. No previous credible research had been done on how extracurriculars (EAs) affect adolescents, so this was a turning point in the relationship between extracurriculars and students. The study found that there was a positive association between school-based activities and the outcomes of adolescent development. Among these outcomes, academic achievement showed great positive correlation alongside extracurriculars, but there were many gaps in the research that needed to be filled like what *specifically* influences academic achievement.

Ten years later, a study done by researcher Rani from the Journal on Educational Psychology filled some of the gaps by looking specifically at what affects high school students' intelligence. This narrowed the area of what the researchers were investigating; instead of looking at all aspects of adolescent development, it focused on one: academic intelligence. The study defined intelligence by stating that it involved “the ability to think, solve problems, analyze situations, and understand social values, customs, and norms, [...] reason, plan, think abstractly, comprehend ideas and language, and learn.” Rani conducted a survey to determine the intelligence of high school students. A t-test using mean and standard deviation was used to

analyze the data and the results showed that there is significant difference in intelligence test scores of high school students in terms of "area of study, gender, medium of instruction and board of school." This new information introduced new concepts that were essential to the completion of this study.

Effects of Extracurriculars on Academic Intelligence

Upon discovering that extracurricular activities affect academic intelligence, the researcher decided to dive more into the topic. In 1997, Silliker and Quirk investigated the academic improvement of male and female high school students who participated in extracurricular activities. This study was one of the first to truly explore the effects of extracurriculars and other school activities on student academic performance. Along with behavioral improvements, they found that students who participated in extracurricular activities had higher GPAs. Therefore, it can be concluded that involvement in extracurriculars in high school enhances academic performance.

15 years later, Craft found similar results in a study on the impact of extracurriculars on student achievement as the pressure for high schools to expand test scores increased. This study done with the University of Southern Mississippi looked at the effects of specific extracurriculars like sports, music programs, and clubs and concluded that involvement in athletics in high school enhanced academic performance (i.e. grade point average, SAT scores, absentee rates, etc.).

Fast forward 5 years, Tanner's review similarly looks at the correlation between academic success and participation in extracurricular activities and examines the positive *and* negative effects that such participation has on academic achievement. The review found that such activities have a positive effect on student academics aligning with the results of previous

studies, but an overload of extracurricular activities may not always produce the same results as it would pull students away from managing time for academics. Specifically, if one extracurricular activity is done, the study suggests that it can potentially produce positive academic outcomes.

Each of these studies researched the effects of extracurricular activities on academic achievement and briefly discussed specific extracurricular activities like sports. This prompted the researcher to continue further into the topic to see if any studies existed on the effects of sports specifically affecting academic performance.

Effects of Sports on Academic Intelligence

Angela Lumpkin, professor and department chair of sport management at Texas Tech University, did a study comparing the academic performance of high school athletes vs non-athletes in 2009. Lumpkin focused on comparing GPAs, graduation rates, ACT test scores, and state assessments to assess the academic intelligence of the high school students and found that high school athletes graduated at a higher rate, earned higher grades, and scored higher on state assessments. 4 years later, a study was conducted on the effects of organized sports on academic achievement which suggested that children participating in organized sports gained benefits to their academic achievement. Finally, two years later, a similar study was done by Aslan which contrasted the multiple intelligence types of athletic students. The study specifically focused on the 8 different intelligence types and how sports affect the areas of intelligence. This study holds great significance in the research process as it was the first study to look at student intelligence in terms of various intelligence types.

Each of these studies yielded similar results to the previously mentioned studies about extracurriculars and academic intelligence, but these studies led the researcher to the last step in finding a gap in research by providing more specific parameters to be studied. Lastly, the research investigated studies done on how *specific* sports impacted academic intelligence. The researcher chose to further investigate and study swimming as the specific sport since the researcher is a swimmer themself.

Influences of Swimming on Academic Intelligence

Having focused on a particular sport, a 2013 study was the first official study to explore the relationship between swimming and academic intelligence. The study evaluated the effects of swimming on early childhood cognitive and physical abilities. According to this groundbreaking research, early childhood swimmers have many advantages over their non-swimming peers when starting primary school, such as better visual-motor skills and oral expression, as well as in the general areas of literacy and numeracy.. The broader idea of this study shows that swimming helps increase intelligence compared to non-swimmers. A dissertation from 4 years later confirms this hypothesis yet again by analyzing the impact of competitive swimming training on cognitive function in adolescents (ages 10-14). Professor Cumming, chairman of Swim England's Swimming and Health Commission, concluded that there is an overwhelming beneficial connection between chronic exercise on academic achievement, memory, and learning. Through this it can be hypothesized that competitive swimming amongst high school students also has benefits in cognitive function and can further support the data that this will positively influence academic intelligence and performance.

A+ Swimmers: Evaluating The Extent to Which High School Competitive-Based Swimming Influences Academic Intelligence.

Topic of Inquiry

While there has been significant research done on the effects of general extracurricular activities on student educational achievement, very few studies have taken a specific sport and type of intelligence into consideration. Furthermore, there has been no research conducted on the effects of swimming on academic intelligence in high school students. Each study included in the literature review focused the research one step closer to addressing a gap in this field. From the initial broad topic of academic intelligence to the effects of swimming on academic intelligence, a specific gap was finally discerned. This study continues the work done by Griffith University by evaluating another, previously uninvestigated, age group of swimmers who have shown to have an improvement of academic performance in past research like Silliker and Craft's studies: high school students. By combining the extracurricular activity of swimming from Griffith University's study with high schooler's intelligence from Siliker and Crafts studies, a gap was addressed by determining whether swimming influences high school students' academic intelligence.

A+ Swimmers: Evaluating The Extent to Which High School Competitive-Based Swimming Influences Academic Intelligence.

Methodology

The aim of this study is to investigate the extent to which high school competitive based swimming influences the academic intelligence types in students and possibly increases intelligence above their non-swimming peers. It was hypothesized that competitive swimming plays a key role in how students achieve their academic goals in high school. The purpose is to bring more specific and in depth knowledge into the already researched realm of how extracurriculars and other more widely known sports like soccer and football impact academic performance. The following research questions were used to guide the study:

1. Does competitive swimming increase high school students' intelligence more than their non-swimming peers?
2. How does competitive swimming influence high school students' intelligences and possibly increase intelligence than their non-swimming peers?
3. To what extent does competitive swimming influence high school students' intelligences (e.g. logical/mathematical, spatial, linguistic) and possibly increase intelligence than their non-swimming peers?

The final research question fully encompasses everything included in the study from the sport to the type of students to the type of intelligences being assessed. Because the research is testing the academic intelligence of high school students, the types of intelligence assessed were all related to high school academics. The research is a quantitative study using correlational research, characterized by the process of gathering and analyzing numerical data. A quantitative approach was used to gather as much data from as large a group as possible, modelled after Craft's quantitative approach when applying his methods.

Sample/Participants

In the research study, there are two types of high school students being proportionately assessed: competitive swimmers who have been swimming for 2 or more years and non-swimmers (preferably not in any other competitive sports because the overall study does not take into account how other sports affect the academic intelligence types). The participants were high school students from any high school in Henry County, Georgia since these students are provided with similar education opportunities and resources, providing a constant in the data. Accessibility of students was also taken into account as the research study is being conducted during the Covid-19 pandemic. Henry County students are more accessible to the researcher as they are closer in proximity than any other students.

Instrumentation and Application

The instrumentation used in this study consisted of a seventy-seven question survey, made by the researcher with a survey-making platform called SoGoSurvey, that assesses the academic intelligence of the students using previous grades and standardized test scores along with intelligence questions (Appendix A). The platform SoGoSurvey was used due to its easy accessibility as well as its capacity to hold a large number of survey questions, compared to others that limited questions to 30. In the survey, participants answered general, school-related, and academic intelligence questions. In the general questions portion of the survey, students identified gender, grade level, years of competitive swimming (if applicable), the high school they attend, and high school location. In the school-related questionnaire, students provided their unweighted and weighted GPA (grade point average), any existing standardized test scores (PreACT, ACT, PSAT, and/or SAT), the total number of any advanced or gifted courses taken or

taking (Honors, AP, and/or IB), and lastly, any other sports or clubs that the subject is participating in. Finally, in the academic intelligence-based section, students answered questions pertaining to the logical/mathematical, verbal/linguistic, and visual/spatial intelligence types. The academic questions provided in the study were used from the Psychology Today intelligence questions to accurately measure academic intelligence. In order to assess the subjects mathematical and logical skills, questions about patterns, sequences, problem-solving, and critical thinking were included. An example from the logical/mathematical questionnaire is: John is three times as old as Greg, and Greg is half the age of Bob. Steve is two times the age of John and Bob combined. If Steve's age is 60, how old is Greg's older cousin Jane, who is 2 years older than Greg? To test their verbal/linguistic skills, students were tested using their understanding of vocabulary and reading comprehension. An example from the verbal/linguistic questions includes: Choose the most fitting definition for the word that is underlined. It is important that you adhere to the curfew set by your parents. If you stay out too late, they may become worried and call the police. In the visual/spatial portion of the study, subjects were tested on their ability to perceive, assess, and understand the visual information given to them, essentially how well they can picture concepts in their minds. Examples of all of the academic intelligence questions can be found in Appendix A.

The research study was approved by the IRB to collect data from high school students with consent. Subjects were informed about the anonymity of the study and were given an option to proceed with the survey or opt out of the study. The survey was 100% anonymous as it did not collect any personal information stated by the HIPAA identifiers. The study needs 50-80 *total* responses to accurately provide results for the wider population, as stated by other similar studies

like Craft's study on the impact of extracurricular activities on student achievement at the high school level. To collect the data, subjects were contacted through recruitment emails sent to all Henry County high school swim coaches and various students across Henry County. Contacting the swim coaches was the most effective way to reach *all* Henry County high school swimmers that have been competitively swimming for two or more years. The standard recruitment email (Appendix C) provided information about the study and survey along with the subject requirements. High school students were also contacted through social media networking as this is an efficient way to communicate with the majority of the high school population.

Data Collection and Analysis

To gather the survey data, an excel spreadsheet was created to compare the answers given by each participant (Appendix B). Because this is only a correlational quantitative research study, once all the data was collected, the GPAs, standardized test scores, advanced courses, and academic intelligence responses were analyzed by comparing responses and averaging the final scores of the survey to determine whether high school competitive-based swimming influenced academic intelligence types of students, possibly enabling them to be more intelligent than their non-swimming peers. To bring statistical value to the findings, once the GPAs, standardized test scores, and advanced classes were averaged and analyzed, a 2-Sample t-test was used to statistically analyze the data from the academic intelligence questions. Craft and Rani similarly both used t-tests when analyzing their survey responses because it is commonly used to test whether the average difference between two groups is significant or due to random chance. More specifically, a right-tailed t-test was used because they were determining whether or not

academic intelligence is *greater* in two groups: competitive-based swimmers than non-swimmers.

Findings and Discussion

As stated in the previous methodology section, the data for this study was collected by using student surveys that were given to competitive-based swimming and non-swimming high school students in Henry County, Georgia. The researcher received 19 completed survey responses, 11 of which were non-swimmers and 8 swimmers. Prior to the discussion of the intelligence type portion of the survey, it is important to look at the academic GPA, test scores, and overall academic performance of the students in school to facilitate the determination of whether high school competitive-based swimming influences academic intelligence. Looking at the academic caliber of the participants before the statistical data helps to preface the results of the t-test as well as facilitates the ending results.

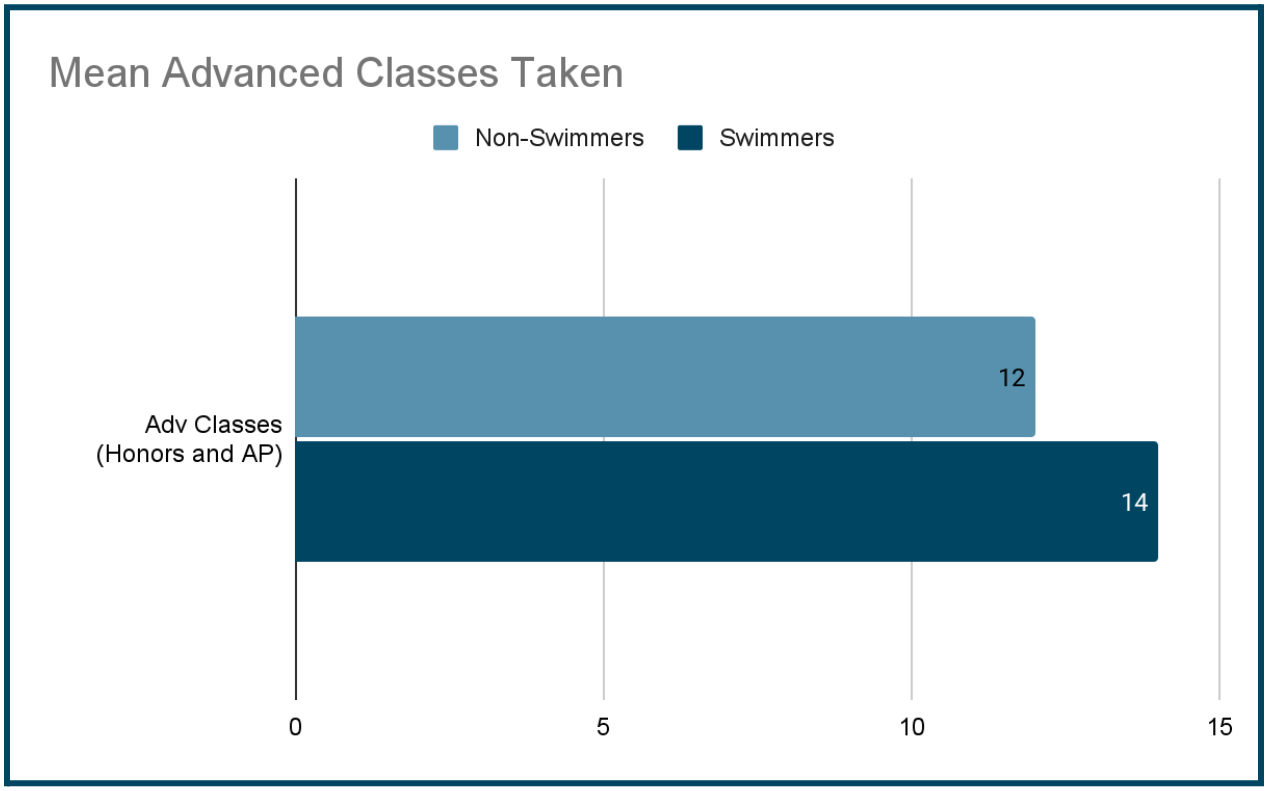

Figure 1. Comparison of the average number of advanced classes taken by swimmers and non-swimmers in Henry County schools.

As seen in Figure 1, swimmers who took the survey have taken an average of 14 advanced classes in high school so far whereas non-swimmers have taken 12 advanced classes. These advanced classes include Honors classes and Advanced Placement courses. Although it carries no *statistical* significance, the researcher observed that swimmers took, on average, a higher number of advanced classes than non-swimmers. This could potentially mean that competitive-based swimming has a positive effect on academic performance in high school.

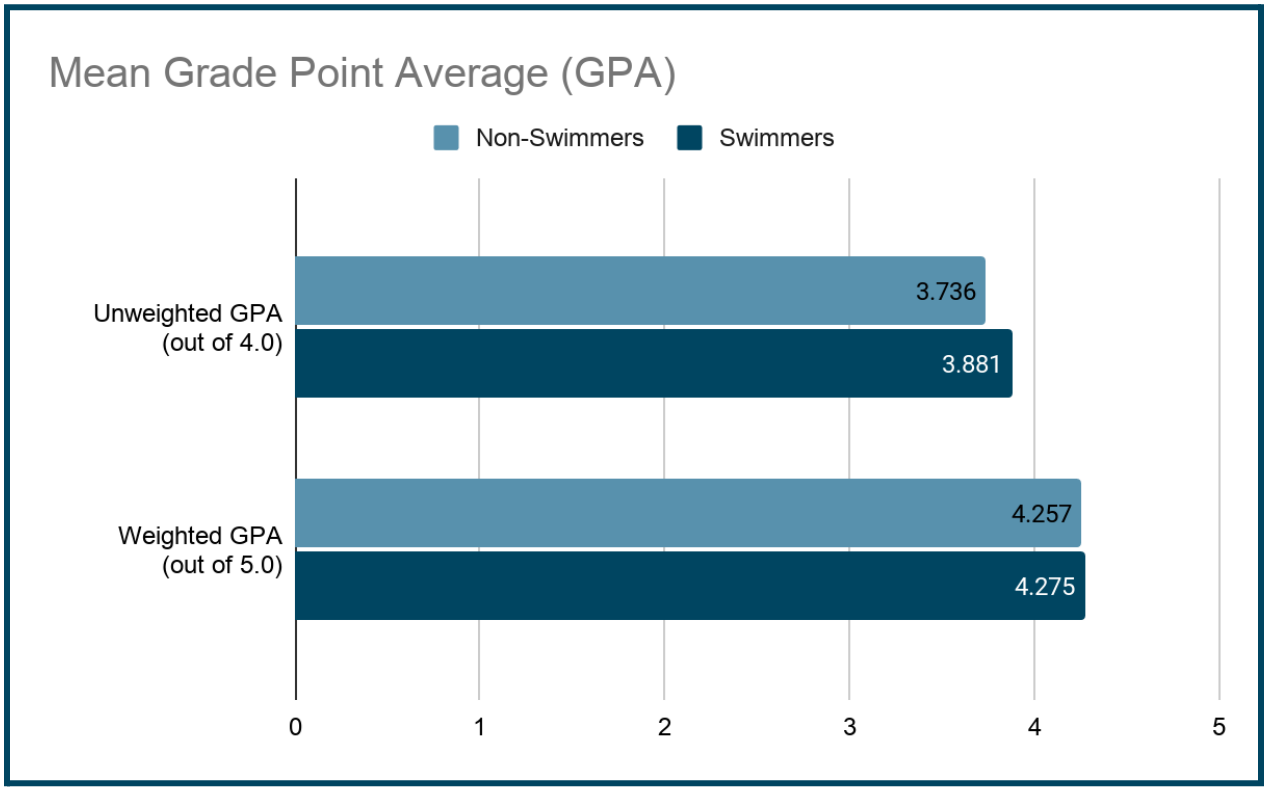

Figure 2. Comparison of the average unweighted and weighted GPAs of swimmers and non-swimmers in Henry County School. Weighted GPAs include added points from advanced classes.

Figure 2 shows that non-swimmers have *slightly* lower grade point averages than swimmers. Swimmers had an average unweighted GPA which was .145 points higher than the non-swimmers. Swimmers had an average weighted GPA which was only .018 points higher than non-swimmers. It is difficult to determine whether this data carries any significance as the number of surveys from each group is unequal as well as small compared to the population of Henry County Schools.

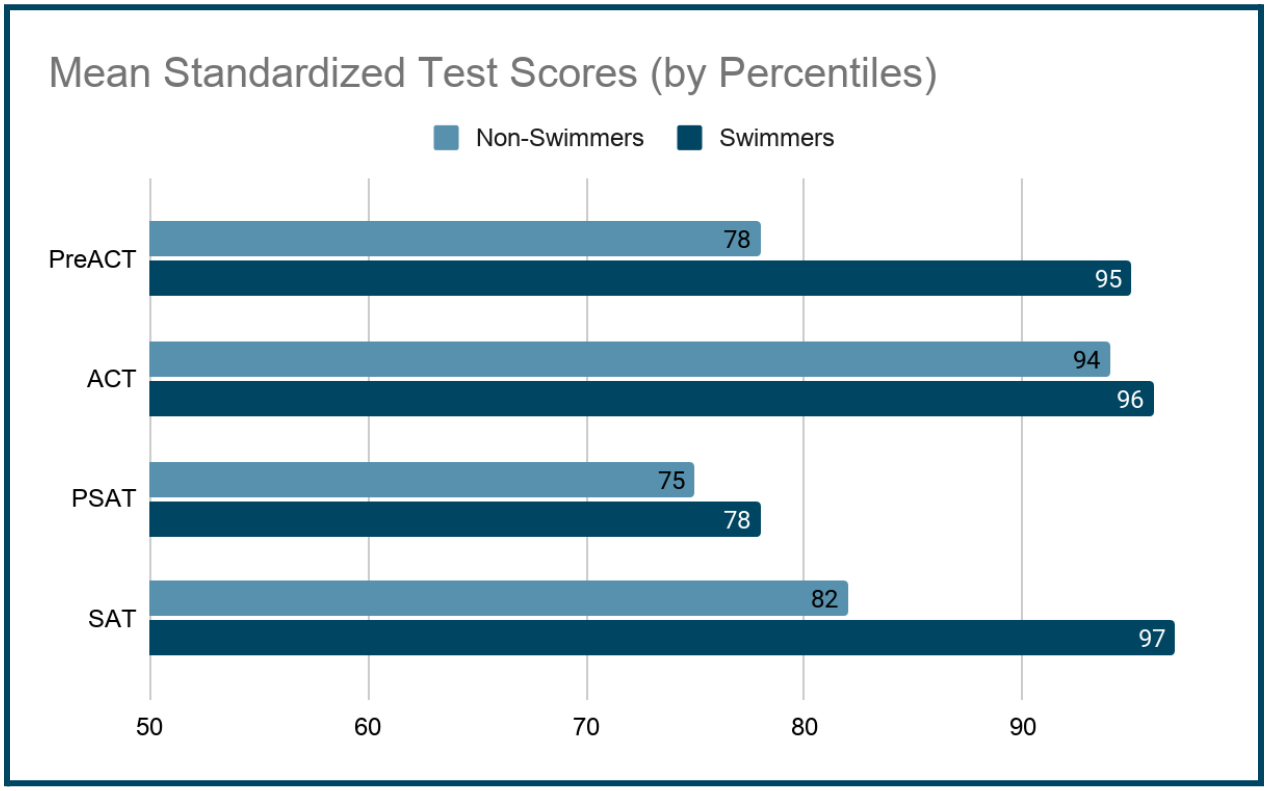

Figure 3. Comparison between the average standardized test scores of swimmers and non-swimmers, compared on a scale of composite score national percentiles.

Figure 3 shows that swimmers did relatively better than non-swimmers on standardized tests compared to the national average. Swimmers scored higher than 95% of the national population on the PreACT whereas non-swimmers scored higher than 78% of the nation's PreACT test-takers. On the ACT, non-swimmers scored higher than 94% of the population whereas swimmers scored higher than 96% of the national population of ACT test-takers. Similarly, on the PSAT, swimmers scored higher than 78% and non-swimmers scored higher than 75%. Lastly, swimmers scored, on average, higher than 97% of the SAT test-takers in the nation compared to non-swimmers who scored higher than 82%. On all standardized tests combined, swimmers, on average, score about 92% higher than the national population of standardized test-takers whereas non-swimmers scored about 82% higher. Swimmers scored about 10% higher

than non-swimmers on standardized test scores, possibly hinting at the hypothesis that competitive-based swimming could positively influence academic intelligence. Finally, before the researcher introduces t-test results of the survey data, the researcher first analyzed the mean results of the intelligence questions on the survey.

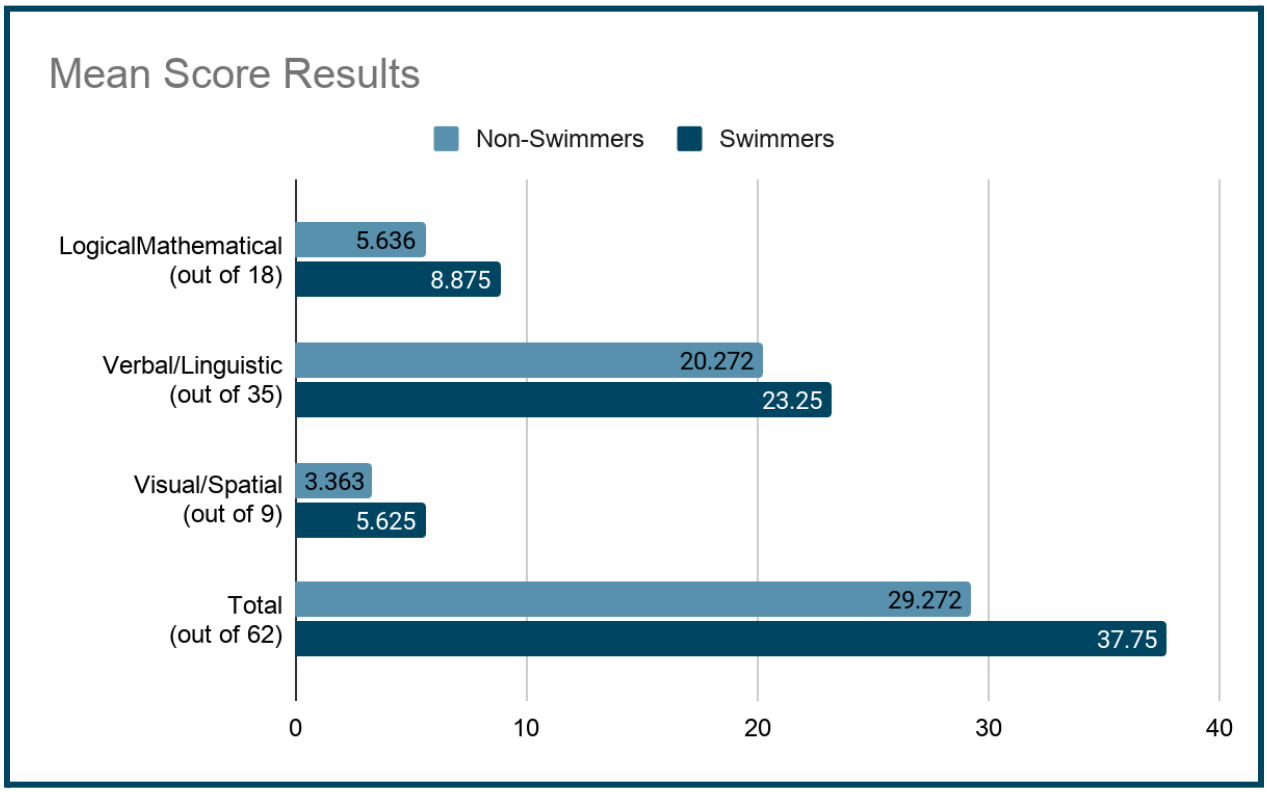

Figure 4. Mean score results of the intelligence questions on the survey broken down by each intelligence type.

Figure 4 shows the average results of the intelligence type questions pertaining to academic intelligences (logical/mathematical, verbal/linguistics, and visual/spatial). On average, the researcher discovered that swimmers earned a score that was approximately 8.5 points higher than non-swimmers meaning swimmers got about 8 more questions correct than the non-swimmers. Specifically, looking at the differences between the test scores, the researcher determined that swimmers got about 3 more verbal/linguistic questions correct, 3 more logical/mathematical questions correct, and 2 more visual/spatial questions correct than the

non-swimmers. After observing this data, the researchers assumed that there is a positive correlation between competitive-based swimming and academic intelligence. With the 2 Sample t-test, the researcher will be able to confirm or deny this assumption and will be able to determine whether the hypothesis that competitive-based swimming influences and possibly increases academic intelligence is correct. This test compared whether the average differences between the swimmers and non-swimmers was significant (alternative hypothesis) or due to random chance (null hypothesis). A Right-tailed 2-Sample t-test was used ($\mu 1 > \mu 2$)for all components of the intelligence test because the researcher was determining whether or not academic intelligence is greater in competitive-based swimmers than non-swimmers. The researcher used an alpha value of 0.05 for all statistical tests in the study.

Logical/Mathematical (out of 18)	
	Right-Tailed ($\mu 1 > \mu 2$)
P-value	0.0317365669
T statistic	2.022101823
Degree of Freedom	13.48179093

Figure 5. T-test results of the logical/mathematical questions on the A+ swimmers survey.

Figure 5 contains the results of the t-test conducted for the logical/mathematical questions in the A+ swimmers survey. The p-value is less than the significance level ($\rho \approx 0.03 < \alpha = 0.05$) meaning that the data is significant. The T statistic shows whether the whole t-test has statistical significance, the closer it is to 0, the less statistical significance. The T statistic in this case is approximately 2. The results indicated that there is a statistical significance between the results of the logical/mathematical averages between the swimmers and non-swimmers showing evidence against the null hypothesis.

Verbal/Linguistic (out of 35)	
	Right-Tailed ($\mu 1 > \mu 2$)
P-value	0.1482372099
T statistic	1.077997135
Degree of Freedom	16.5748505

Figure 6. T-test results of the verbal/linguistic questions on the A+ swimmers survey.

Figure 6 contains the results of the t-test conducted for the verbal/linguistic questions in the A+ swimmers survey. The p-value is greater than the significance level ($\rho \approx 0.14 > \alpha = 0.05$) meaning that the data is not significant. The T statistic in this case is approximately 1. The results indicated that it is inconclusive whether there is statistical significance between the results of the verbal/linguistic averages between the swimmers and non-swimmers showing evidence that it might fail to reject the null hypothesis.

Visual/Spatial (out of 9)	
	Right-Tailed ($\mu 1 > \mu 2$)
P-value	0.0051704827
T statistic	2.885078903
Degree of Freedom	16.87220409

Figure 7. T-test results of the visual/spatial questions on the A+ swimmers survey.

Figure 7 contains the results of the t-test conducted for the visual/spatial questions in the A+ swimmers survey. The p-value is less than the significance level ($\rho \approx 0.005 < \alpha = 0.05$) meaning that the data is significant. The T statistic in this case is approximately 3. The results indicated that there is great statistical significance between the results of the visual/spatial

averages between the swimmers and non-swimmers showing evidence that it rejects the null hypothesis.

Total (out of 62)	
	Right-Tailed ($\mu 1 > \mu 2$)
P-value	0.0363058143
T statistic	1.925610693
Degree of Freedom	15.57358023

Figure 8. T-test results of the total intelligence questions on the A+ swimmers survey.

Figure 8 contains the results of the t-test conducted for all of the academic intelligence questions in the A+ swimmers survey. This figure shows the most important set of data results as it analyzes all of the intelligence questions helping to answer the research question. The p-value is less than the significance level ($\rho \approx 0.04 < \alpha = 0.05$) meaning that the data is significant. The T statistic in this case is approximately 2. The results indicated that there is statistical significance between the results of all of the academic intelligence question averages between the swimmers and non-swimmers showing evidence that it rejects the null hypothesis.

The researcher received 19 survey responses from the 12 high schools in Henry County. Out of the total number of responses, 11 responses were from non-swimmers and 8 responses were from competitive swimmers. Figures 1-3 show the mean results for school measurements of academic caliber (GPA, standardized tests, and adv. classes). Although it carries no *statistical* significance, it was seen from Figure 1-3 that swimmers had higher mean measurements of academic caliber than non-swimmers. This does not answer the research question, but it facilitates future data from Figures 5-8 which discuss the t-test results of the academic intelligence questions on the survey. Figure 4 shows the number of questions correctly answered

by the 2 groups in each intelligence category. While this does not hold any statistical value on its own, paired with the results from Figure 5-8, the researcher was able to determine that, overall, swimmers tend to have *increased* academic caliber than their non-swimming peers.

This conclusion can also be supported by the three previous studies mentioned earlier. Siliker's and Crafts' study both concluded that extracurricular activities have a positive effect on high school academic performance and Griffith University's study gathered that swimming improves cognitive intelligence in early-aged swimmers. Now with the contributions of this previously unaddressed study, researchers may have a better grasp on how swimming affects students' academic intelligence.

Limitations

There were three major limitations that proved challenging in this research study. The first limitation was the sample size and location of the study. Despite numerous attempts by the researcher to collect responses, there were only 19 respondents, and accuracy of the data may have been limited by this. The location of the study is also a limitation as the results of the study only pertain to a small scale county rather than representing the national and/or world population. A high sample size and more widespread sample of participants would have a substantial impact on the statistical significance of the t-test results if applied again in the future.

The second limitation was that the survey responses provided on the questionnaire were based on the student's truthfulness and knowledge of their GPA, standardized test scores, advanced classes, participation in other sports and school clubs as well as their honesty in answering the intelligence questions without the help of outside resources. While there was no motive for a student to not be truthful with their answers, the survey did allow for the

opportunity for students to not answer with complete honesty. The academic intelligence questions came from a Psychology Today test, similar to the one used in Craft's study, mentioned above, and although participants couldn't access the answers to the questions, it is possible that other outside resources like calculators and the internet were used to facilitate the survey responses.

A final possible limitation could be that students who completed the survey were more academically inclined and confident in their ability to fill out the survey. Students who are more gifted in academics are found to be more confident in their abilities to complete tasks than other students so it is advised that future researchers encourage students from all backgrounds to complete the survey and emphasize that there is not just one type of student being considered.

Implications

Despite the limitations, expanding on this topic would be significantly beneficial for many students. The researcher believes that school districts should continue to allocate funding towards extracurriculars, specifically swimming. The literature review and this study showed that students involved in swimming are more likely to achieve higher results than students not involved in swimming in high school. These findings can be beneficial to school boards across the country to help determine where to allocate funding, especially when financial matters often demand that schools cut funding in certain departments. Along with continuing to fund competitive swimming, if further research confirms that swimming has a positive impact on academic intelligence, it could help solve problems and be a therapy to facilitate kids with learning disabilities. It could also be a way to help kids bring their grades up in school. It is often assumed that students with lower grades shouldn't participate in sports and other extracurriculars

as it takes time away from applying themselves to school. In fact, according to a Pew Research study, 60% of parents think extracurriculars negatively impact school performance. But with this study and continued research in the future, this myth could be discredited, helping students in the future. Further research could truly help determine which sports and extracurricular activities to heavily support based on their long term academic success rate.

Future Directions

It is highly advised that future studies work to confirm these results. Testing with a larger and more widespread sample size is used to get more accurate results with smaller margins of error. This way, the results can represent the national and/or world population. Following Griffith University's study and this study, for future research, the researcher also advises to continue this research on a new age group of students, like college athletes, to truly understand the extent to how this impacts students of all ages. Next, the researcher believes that it is important to investigate what causes these results in swimmiers. What causes swimmers to have increased academic performance? The researcher predicts this could be a result of hidden curriculum in participating in swimming like teamwork, dedication, success, failure, time management, and the building of positive relationships with teammates and coaches. Future research about the causes of swimming impacting academic intelligence could confirm this hypothesis. Researching the cause could help not only to facilitate academic intelligences but also personal intelligences like intrapersonal and interpersonal intelligences which could be beneficial in all aspects of life, not just school.

Conclusion

Studies have shown that swimming is highly beneficial for your mental and physical health, truly making it what some may call the perfect sport. This study explored the impact of competitive based swimming on high school student academic intelligence types. It focused on the impact that participation in swimming had on logical/mathematical, verbal/linguistic, and visual/spatial academic intelligences. The results of this study and the review of literature support a positive and increased impact created by participation in swimming on academic intelligence. With the results of this study and future research studies, fundings could be allocated to more impactful extracurriculars like swimming and students of all ages can be helped academically and potentially personally. It's not too late to gain from the benefits of swimming.

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A+ Swimmers: Evaluating The Extent to Which High School Competitive-Based Swimming Influences Academic Intelligence.

Appendices

Appendix A: Survey/Questionnaire

A+ Swimmer Survey

The purpose of this study is to determine **to what extent high school competitive swimming influences academic intelligence types**. This survey is designed for academic research purposes only. This survey is **100% ANONYMOUS** and **VOLUNTARY** and only anonymous research data will be released. Please answer the questions as honestly as possible. (Survey should take about **25-45 mins MAX**)

If you have any doubts or questions about the study, please contact me at [redacted] and/or [redacted] before taking the study.

1. **I have read and I understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I voluntarily agree to take part in this anonymous study about the extent to which high school competitive swimming can influence academic intelligence.**

- ☐ Yes, I agree to take this completely anonymous and voluntary questionnaire.
- ☐ No, I do not agree to take this completely anonymous and voluntary questionnaire. (If you do not agree to complete this survey, you may withdraw at this time.)

A+ Swimmers: Evaluating The Extent to Which High School Competitive-Based Swimming Influences Academic Intelligence.

✱ Required Information

General Questions

2. Gender

- [ ] Female
- [ ] Male
- [ ] Other

✱ 3. Grade Level?

- [ ] 9th
- [ ] 10th
- [ ] 11th
- [ ] 12th

✱ 4. Are you a COMPETITVE swimmer?

- [ ] Yes
- [ ] No

✱ 5. If so, how many years have you been competitively swimming?

Characters Remaining: 100

✱ 6. What high school do you attend?

Characters Remaining: 100

✱ 7. What county is your high school located in?

- [ ] Henry
- [ ] Other

✱ 8. What state is your high school located in?

- [ ] Georgia
- [ ] Other

A+ Swimmers: Evaluating The Extent to Which High School Competitive-Based Swimming Influences Academic Intelligence.

* Required Information

School-Related Questions

* 9. What is your current high school UNWEIGHTED GPA?

Characters Remaining: 100

* 10. What is your current high school WEIGHTED GPA?

Characters Remaining: 100

* 11. Have you taken the PSAT, PreACT, SAT, and/or ACT?

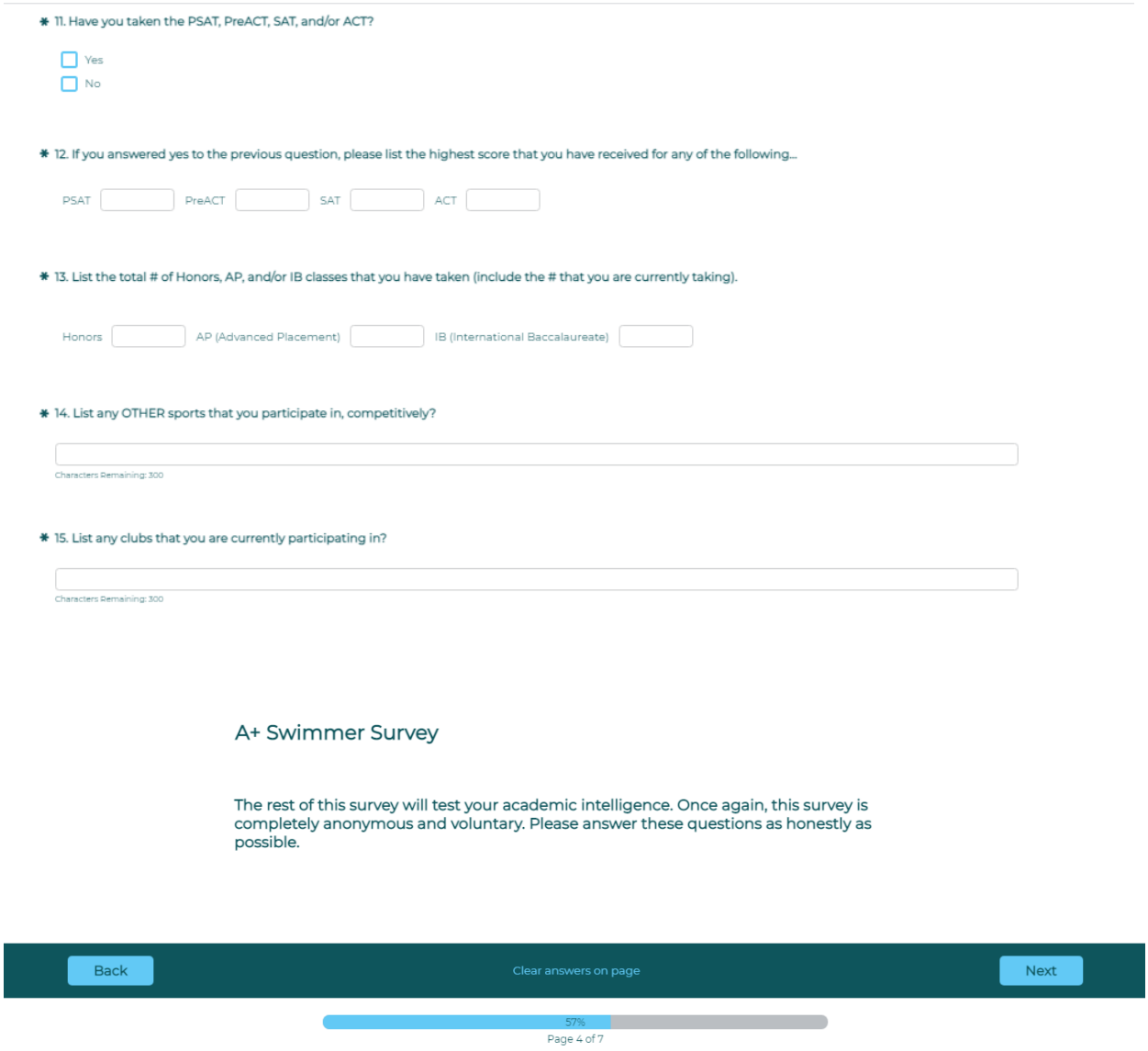
- [ ] Yes
- [ ] No

* 12. If you answered yes to the previous question, please list the highest score that you have received for any of the following...

PSAT | PreACT | SAT | ACT

* 13. List the total # of Honors, AP, and/or IB classes that you have taken (include the # that you are currently taking).

Honors | AP (Advanced Placement) | IB (International Baccalaureate)



* 11. Have you taken the PSAT, PreACT, SAT, and/or ACT?

Yes
No

* 12. If you answered yes to the previous question, please list the highest score that you have received for any of the following...

PSAT PreACT SAT ACT

* 13. List the total # of Honors, AP, and/or IB classes that you have taken (include the # that you are currently taking).

Honors AP (Advanced Placement) IB (International Baccalaureate)

* 14. List any OTHER sports that you participate in, competitively?

Characters Remaining: 300

* 15. List any clubs that you are currently participating in?

Characters Remaining: 300

A+ Swimmer Survey

The rest of this survey will test your academic intelligence. Once again, this survey is completely anonymous and voluntary. Please answer these questions as honestly as possible.

Back Clear answers on page Next

57%

Page 4 of 7

A+ Swimmers: Evaluating The Extent to Which High School Competitive-Based Swimming Influences Academic Intelligence.

A+ Swimmer Survey

* Required Information

Logical/Mathematical Intelligence

Logical/Mathematical Intelligence is the ability to analyze situations or problems logically, to identify solutions, to conduct scientific research, and to solve logical/mathematical operations easily.

Select the number that best completes the analogy.
For example, 7 : 10 :: 6 : 9.

* 16. 10 : 6 :: 3 : ?

- [ ] 2
- [ ] 1
- [ ] -1
- [ ] 12
- [ ] 4
- [ ] I don't know

* 17. 20 : 12 :: 5 : ?

- [ ] 3
- [ ] 15/4
- [ ] 3.5
- [ ] 2
- [ ] 5/3
- [ ] I don't know

* 18. 4 : 256 :: 5 : ?

- [ ] 526
- [ ] 625
- [ ] 125
- [ ] 726
- [ ] 620
- [ ] I don't know

* 19. 48 : 610 :: 39 : ?

- [ ] 362
- [ ] 975
- [ ] 511
- [ ] 602
- [ ] 353
- [ ] I don't know

* 20. 322 : 12 :: 421 : ?

- [ ] 15
- [ ] 7
- [ ] 8
- [ ] 16
- [ ] 9
- [ ] I don't know

* 21. 91827 : 364554 :: 369 : ?

- [ ] 46835
- [ ] 151821
- [ ] 84962
- [ ] 121518
- [ ] 163472
- [ ] I don't know

Enter the number that should come next in the sequence.
For example, 2, 4, 6, 8, 10, 12 ... 14
(If you do not know the answer, please be sure to write "I don't know" in the textbox.)

* 22. 2, 5, 8, 11, 12, 15, 18, 21 ... ?

Characters Remaining: 100

* 23. 1, -4, 8, 3, -6, -11, 22, 17 ... ?

Characters Remaining: 100

* 24. 2, 6, 3, 1, 3, 0, 0, 0, -3, -1, -3, -6, -2 ... ?

Characters Remaining: 100

* 25. 225, 4, 196, 9, 169, 16, 144, 25 ... ?

* 26. 8, 1, 3, 9, 2, 4, 10, 3, 5, 11 ... ?

Characters Remaining: 100

* 27. 1, 2, 3, 7, 11, 20, 29, 45, 61 ... ?

Characters Remaining: 100

Enter or select the correct answer to each of the following questions.
(If you do not enter an answer, please be sure to write "I don't know" box.)

* 28. The three sides of a figure are in the ratio 1 : 3: 5. The perimeter of the three-sided figure is 72. Find the length of each of the three sides.

Characters Remaining: 100

* 29. John is three times as old as Greg, and Greg is half the age of Bob. Steve is two times the age of John and Bob combined. If Steve's age is 60, how old is Greg's older cousin Jane, who is 2 years older than Greg?

Characters Remaining: 100

* 30. There is a 10 x 10 x 10 cubical box with no lid. It is filled with cubes 1 x 1 x 1. How many of the cubes touch the sides of the box with at least one face?

Characters Remaining: 100

* 31. Draw five straight lines overlapping in any way you wish. What is the greatest number of enclosed spaces that can be formed by the overlapping lines?

Characters Remaining: 100

* 32. In the following arrangement, what would be the first number in the 100th line?
1 2 3
4 5 6 7
8 9 10 11 12
13 14 15 16 17 18

Characters Remaining: 100

* 33. There are three boxes of balls of different colors, each labeled accordingly. One lid is labeled "green and yellow", another lid is labeled "blue" and the other, "yellow". However, all of the lids have gotten mixed up, and none of them are now on the correct boxes. It is your job to determine which box holds which set of balls. You are allowed to open only one box, and, without looking, reach in a take out one ball. Which is the one box you should NOT open?

- [ ] The box with the lid labeled "green and yellow"
- [ ] The box with the lid labeled "blue"
- [ ] The box with the lid labeled "yellow"
- [ ] The box with the lid labeled "yellow" and the box labeled "blue"
- [ ] None of them - opening any of them would give you the correct answer

A+ Swimmer Survey

* Required Information

Verbal/Linguistic Intelligence

Verbal intelligence is the ability to understand and reason using concepts framed in words. More broadly, it is linked to problem-solving, abstract reasoning, and working memory.

Choose the word that best completes the sentence.

* 34. To be choleric is to be

- [ ] overweight
- [ ] bad-tempered
- [ ] pleasant
- [ ] sad
- [ ] I don't know

* 35. To have aplomb is to have

- [ ] a sense of humor
- [ ] insecurity
- [ ] excessive pride
- [ ] confidence
- [ ] I don't know

* 36. A fecund tree is

- [ ] bearing lots of fruit
- [ ] changing colors for fall
- [ ] bending in the wind
- [ ] dried out and dying
- [ ] I don't know

* 37. A repast is a(n)

- [ ] instant replay
- [ ] meal
- [ ] factory
- [ ] close relationship
- [ ] I don't know

* 38. A pedagogue has

- [ ] patients
- [ ] enemies
- [ ] students
- [ ] servants
- [ ] I don't know

* 39. To incarcerate someone is to

- [ ] imprison them
- [ ] convict them
- [ ] accuse them
- [ ] acquit them
- [ ] I don't know

* 40. To forgo something is to

- [ ] do it too much
- [ ] become bored with it
- [ ] seek it out
- [ ] do without it
- [ ] I don't know

* 41. A languid movement is

- [ ] slow-moving
- [ ] speedy
- [ ] awkward
- [ ] reckless
- [ ] I don't know

Choose the most fitting definition for the word that is underlined.

* 42.After many vicissitudes of fortune, he at last sunk into abject poverty and hopeless misery.

- [ ] hardships
- [ ] fluctuations
- [ ] slump
- [ ] trials
- [ ] I don't know

* 43.The students listened to the speaker's hortatory statements with ever-increasing excitement. Finally, they rushed out of the auditorium, determined to make a difference.

- [ ] inflated
- [ ] encouraging
- [ ] factitious
- [ ] mendacious
- [ ] I don't know

* 44.It is important that you adhere to the curfew set by your parents. If you stay out too late, they may become worried and call the police.

- [ ] ignore
- [ ] tolerate
- [ ] withstand
- [ ] stick
- [ ] I don't know

Choose the word or phrase that is most similar to the one given.

* 45. FIRMAMENT

- [ ] Hell
- [ ] Paradise
- [ ] Sky
- [ ] Earth
- [ ] I don't know

* 46. FAIR

- [ ] Judgemental
- [ ] Impartial
- [ ] Just
- [ ] Lawful
- [ ] I don't know

* 47. CONTUMACIOUS

- [ ] Willing
- [ ] Obstinate
- [ ] Jaded
- [ ] Obsequious
- [ ] I don't know

* 48. IMPEDE

- [ ] Insult
- [ ] Enrage
- [ ] Hinder
- [ ] Aid
- [ ] I don't know

* 49. FOIBLE

- [ ] Strength
- [ ] Mistake
- [ ] Slight fault
- [ ] Misunderstanding
- [ ] I don't know

* 50. ASK

- [ ] Seek
- [ ] Guess
- [ ] Demand
- [ ] Inquire
- [ ] I don't know

* 51. FACETIOUS

- [ ] Teasing
- [ ] Intimidating
- [ ] Condescending
- [ ] Insinuating
- [ ] I don't know

A+ Swimmers: Evaluating The Extent to Which High School Competitive-Based Swimming Influences Academic Intelligence.

You have been given a related pair of words, followed by a series of paired words. Choose the pair that best expresses a relationship similar to that reflected in the question.

* 52. VERTIGO : DIZZY

- [ ] temperature: virus
- [ ] influenza: feverish
- [ ] fear: heights
- [ ] illness: germs
- [ ] I don't know

* 53. INDIGENOUS: NATIVE

- [ ] new: used
- [ ] alien: foreign
- [ ] aged: wrinkle
- [ ] immigrate: exodus
- [ ] I don't know

* 54. PAINT : CANVAS

- [ ] brush: bucket
- [ ] peanut butter: bread
- [ ] clock: time
- [ ] art: life
- [ ] I don't know

* 55. SEEDY : ELEGANT

- [ ] posh: sumptuous
- [ ] luxurious: fancy
- [ ] moneyed: frugal
- [ ] poor: rich
- [ ] I don't know

* 56. BUNGALOW : DOMICILE

- [ ] castle: turret
- [ ] bathroom: sink
- [ ] chair: furniture
- [ ] apartment: rent
- [ ] I don't know

* 57. TENTACLE : OCTOPUS

- [ ] oak: tree
- [ ] tendril: vine
- [ ] rat: vermin
- [ ] meow: cat
- [ ] I don't know

* 58. BEAGLE : DOG

- [ ] Africa: continent
- [ ] meow: cat
- [ ] barnyard: farm
- [ ] picnic: basket
- [ ] I don't know

Choose the word(s) that best fit in the sentence.

* 59. He sat facing the fire, eyes glazed and unseeing, _____ and looking for a solution to this _____. All of his options in the given circumstances were exceedingly unpleasant.

- [ ] cogitating...dilemma
- [ ] dreaming...stalemate
- [ ] perusing...problem
- [ ] contemplating...delay
- [ ] I don't know

* 60. The city's feeble art scene involved a couple of _____ museums, poorly lit, badly designed, and stuffed with the amateurish paintings of dabblers and _____.

- [ ] grand...demagogues
- [ ] somniferous...dilettantes
- [ ] resonant...parsimonious fools
- [ ] vaulted...gastronomes
- [ ] I don't know

* 61. Since Tom had been working with people intensively all week, he craved a quiet weekend of _____ to give himself a chance to read, rest, and relax.

- [ ] alone
- [ ] solitude
- [ ] congregation
- [ ] enterprise
- [ ] I don't know

* 62. The _____ remarks of the mayor elicited hisses from an audience who had hoped to hear more than empty platitudes.

- [ ] seditious
- [ ] factious
- [ ] vacuous
- [ ] eloquent
- [ ] I don't know

* 63. Mozart is considered a child _____ since he was working on keyboard concertos when he was merely five years old.

- [ ] delinquent
- [ ] specialist
- [ ] expert
- [ ] prodigy
- [ ] I don't know

* 64. A vast expanse of luscious _____, of carefully tended gardens, rolling hayfields, and shady orchards surrounded the meticulous white farmhouse.

- [ ] fauna
- [ ] verdure
- [ ] wildlife
- [ ] ecosystem
- [ ] I don't know

Read the given text and answer the comprehension questions that follow

Groups perform better than the best individuals at solving complex problems.
Groups of three, four, or five perform better on complex problem solving than the best of an equivalent number of individuals, says a new study appearing in the April issue of the Journal of Personality and Social Psychology, published by the American Psychological Association (APA). This finding may transfer to scientific research teams and classroom problem solving and offer new ways for students to study and improve academic performance, according to the study authors.

In this study 760 students from the University of Illinois at Urbana- Champaign solved two letters-to-numbers coding problems as individuals or as groups of two, three, four, and five people. Previous research has shown that groups perform better than the average individual on a wide range of problems. However, this study tested the relationship between group size and performance as compared to that of an equivalent number of individuals by comparing the number of trials to solutions and answers given for complex problems. The groups of three, four, and five performed better than the best of an equivalent number of individuals on the letters-to-numbers problems.

"We found that groups of size three, four, and five outperformed the best individuals and attribute this performance to the ability of people to work together to generate and adopt correct responses, reject erroneous responses, and effectively process information," said lead author Patrick Laughlin, PhD., of the University of Illinois at Urbana-Champaign.

Moreover, groups of two performed at the same level as the best of two individuals, suggesting that this group size was too small to introduce the necessary dynamics for optimal problem-solving. However, since groups of three, four, and five were able to achieve the same results, the authors submit that groups of at least three are necessary and sufficient to perform better than the best of an equivalent number of individuals on complex problems that require an understanding of verbal, quantitative, or logical conceptual systems. Understanding these systems are necessary skills for scientific research teams, and the finding that groups of three or more perform better than the best of the same number of individuals may indicate that research teams perform better than their top members would perform alone.

"Problem-solving groups may also be a useful method for students to use in school," said Laughlin. Further research is necessary to determine if cooperative groups perform better than the best individuals in academic settings with different age groups and for other forms of problem-solving.

Laughlin, Patrick. "Groups Perform Better Than the Best Individuals at Solving Complex Problems." APA Online, April 23, 2006. Online. Internet. American Psychological Association. June 20, 2006. http://www.apa.org/releases/group042306.html

* 65. According to the article, who will likely perform best on a complex problem-solving task?

- [ ] The most intelligent member of a group, working alone.
- [ ] A group of three, four, or five individuals working together.
- [ ] A group of two individuals.
- [ ] The number of people working on a problem is not predictive of the success of the project.
- [ ] I don't know

* 66. How well did the researchers find that groups of two performed?

- [ ] They performed better than larger groups.
- [ ] They performed as well as larger groups.
- [ ] They performed as well as the most talented member of the pair would have done alone.
- [ ] They performed more poorly than one person would have working alone.
- [ ] I don't know

* 67. How did the researchers measure the problem-solving ability of different groups?

- [ ] Assigning two letters-to-numbers coding problems to individuals and groups of different sizes.
- [ ] Assigning different types of problems to groups of various sizes.
- [ ] Giving a survey to people to determine what they think is the best way to solve a problem.
- [ ] Looking at on-the-job problem-solving of different-sized groups.
- [ ] I don't know

* 68. Why did the researchers suggest that three, four, and five-person groups were more effective at solving problems?

- [ ] People working alone are more bored and therefore less productive.
- [ ] People in a group tend to police each other and prevent each other from goofing off.
- [ ] People working in a group situation tend to work faster and can therefore get more done.
- [ ] In a group, people can generate more possible responses and they are more effective at identifying incorrect responses.
- [ ] I don't know

A+ Swimmer Survey

* Required Information

Visual/Spatial Intelligence

Visual-Spatial Intelligence is the ability to generate, retain, retrieve, transform, and understand visual information like well-structured visual images.

* 69.
If you disassemble the block, which piece would be missing?

 ☐ 1.

 ☐ 2.

 ☐ 3.

 ☐ 4.

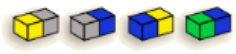
 ☐ 5.

☐ I don't know

A+ Swimmers: Evaluating The Extent to Which High School Competitive-Based Swimming Influences Academic Intelligence.

* 70. If you fold the image above on the dotted line, which shape will result?

- [ ] 1.
- [ ] 2.
- [ ] 3.
- [ ] 4.
- [ ] 5.
- [ ] I don't know



* 71. If you use the following four pieces to build a cube, which image would result?

- [ ] 1.
- [ ] 2.
- [ ] 3.
- [ ] 4.
- [ ] 5.
- [ ] I don't know

* 72. Which image is next in the sequence?

☐ 1.

☐ 2.

☐ 3.

☐ 4.

☐ 5.

☐ I don't know

* 73. Which image is next in the sequence?

 ☐ 1.

 ☐ 2.

 ☐ 3.

 ☐ 4.

 ☐ 5.

☐ I don't know

* 74. Which image is next in the sequence?

 ☐ 1.

 ☐ 2.

 ☐ 3.

 ☐ 4.

 ☐ 5.

☐ I don't know

* 75. Which 3-D shape corresponds to these 2-D representations?

 ☐ 1.

 ☐ 2.

 ☐ 3.

 ☐ 4.

 ☐ 5.

☐ I don't know

* 76. If you fold the sheet along the dotted line, which image would result?


1.


2.


3.


4.


5.

I don't know

* 77. If you continue to fold the image along the dotted lines, which shape would result?


1.


2.


3.


4.


5.

Appendix B: Data collection charts

Participant#	Swimmer?	Yrs of swim	Unweighted GPA	Weighted GPA	PSAT/ PreAct	SAT/ACT	Total # of Adv classes
1	**N**	N/A	3.9	4	1090	N/A	12 (8AP)
2	**N**	N/A	3.31	3.69	880/17	1000	12 (4AP)
3	**N**	N/A	3.04	IDK	N/A	N/A	2 (Honors)
4	**N**	N/A	3.5	3.9	1050/16	1130	14 (5AP)
5	**N**	N/A	3.47	3.78	1080	N/A	14 (6AP)
6	**Y**	9	4	4.68	N/A	34	20 (11AP)
7	**N**	N/A	4	4.55	1180	N/A	13 (6AP)
8	**Y**	3.5	4	4.37	1270	N/A	15 (2AP)
9	**Y**	9	4	4.65	1370/32	1560	16 (7AP)
10	**Y**	10	4.15	4.33	1150	1300/29	19 (5AP)
11	**Y**	8	3.8	4	1080	N/A	6 (1AP)
12	**N**	N/A	4	4.67	1250/29	1230	17 (7AP)
13	**Y**	10	3.1	3.25	850	N/A	2 (2AP)
14	**Y**	8	4	4.42	1180	N/A	9 (1AP)
15	**N**	N/A	3.88	4.4	1350/32	1290	17 (13AP)
16	**N**	N/A	4	4.62	1130/24	1230	16 (6AP)
17	**N**	N/A	4	4.66	1280/30	1410/31	16 (7AP)
18	**N**	N/A	4	4.3	1260	N/A	8 (1AP)
19	**Y**	10	4	4.5	1290/30	1510/32	25 (15AP)

Figure 1. Pre academic intelligence question responses

Participant #	Logical/Mathematical Correct of 18	Verbal/Linguistic Correct of 35	Visual/Spatial Correct of 9	Total Correct of 62
1	9	29	3	41
2	4	22	1	27
3	0	6	0	6
4	3	13	2	18
5	4	21	2	27
6	10	25	6	41
7	9	18	5	32
8	10	24	4	38
9	12	25	7	44
10	7	28	3	38
11	6	19	5	30
12	4	31	5	40
13	2	13	6	21
14	9	20	6	35
15	3	22	4	29
16	8	23	7	38
17	9	19	4	32
18	9	19	4	32
19	15	32	8	55

Figure 2. Academic intelligence responses

Appendix C: Emails to respondents

Good (Morning, Afternoon, or Evening),

My name is [redacted] and I am a junior at [redacted] I'm contacting you today because you have an opportunity to participate in a research study of mine for an Advanced Placement research class that may eventually be published in an academic journal. The purpose of my study is to determine to what extent competitive swimming among high school students influence academic intelligence types (i.e. logical/mathematical, verbal/linguistic, and visual/spatial).

I need your help to collect the data for this study so that I can analyze the results and determine whether there is an impact on academic intelligences through high school competitive swimming. Here the key details:

- I am seeking two types of high school students:
  - Students who have been competitively swimming for 2 or more years
  - Non-swimmer students, preferably ones that do not participate in other competitive sports or participate in only one other sport.
- Your part in the study will involve you to take a 77 question survey which will take anywhere between 25-45 mins approximately, to complete.
  - At the start of the survey, you will be asked to answer general questions like your grade level, the school you attend, whether you are a competitive swimmer etc. Then, you will be asked to answer school-related questions like your GPA, SAT scores, the # of Adv. classes taken, etc. Lastly, you will be asked to answer the academic intelligence questions pertaining to the 3 types of intelligence I am testing.
- The survey is completely ANONYMOUS. There are *no* questions to identify who you are (name, address, phone number, email address, etc.)
- If at any point you do not feel comfortable to continue with the study, you may certainly exercise the ability to withdraw yourself from the research, as this is purely voluntary.

If you have any questions, please contact me! Thank you for reading through this email, and please let me know if you have any further questions. Please note that requesting more information does not obligate you to participate in the survey.

The link to the survey:
https://survey.sogosurvey.com/Survey1.aspx?k=SsRPPWSTsQsPsPsP&lang=0

[redacted]
[redacted] High Swim Captain
AP Research Student
[redacted]

Figure 1. Email to students (non-swimmers and swimmers) to fill out the surveys

Good (Morning, Afternoon, Evening) Swim Coaches,

My name is [redacted], and I am a junior and swim captain at [redacted] I'm contacting you today because I need help to recruit subjects for a research study of mine for an Advanced Placement research class that may eventually be published in an academic journal. The purpose of my study is to determine to what extent competitive swimming among high school students influence academic intelligence types (i.e. logical/mathematical, verbal/linguistic, and visual/spatial).

I need the help of swimmers all across Henry County to collect the data for this study so that I can analyze the results and determine whether there is an impact on academic intelligences through high school competitive swimming. Here are the details:

- I am seeking two types of high school students:
  - Students who have been competitively swimming for 2 or more years
  - Non-swimmer students, preferably ones that do not participate in other competitive sports or participate in only one other sport.

In this case, I will need the help of coaches across Henry County to contact the first type of student (students who have been competitively swimming for 2 or more years). If you have any swimmers that meet this requirement on your swim team, please share the link below that includes a document with the information. I would greatly appreciate any responses that I could get from your swimmers so that I could evaluate the extent to which high school competitive swimming influences the academic intelligence types of students.

If you have any questions, please contact me! Thank you for reading through this email, and please let me know if you have any further questions.

The link to the information: https://rb.gy/puropv

[redacted]
AP Research student
[redacted] High Swim Captain

Figure 2. Email to coaches and teachers to send out the surveys