Athletes to Mathletes: Factors Influencing Student-Athletes Mathematical Experiences

Lee Roberson, David Caples, and Wafa Yacoub

University of Northern Colorado

Abstract

Currently, there exists a deficiency in research promoting the attitude and actions of student-athletes in regards to their mathematical success. This quantitative research involves a cross-sectional survey of 369 student-athletes at a division one university in the Rocky Mountain region to determine if sport, gender, major and depth of mathematical experience influences student-athletes' attitudes towards mathematics. The analysis of the survey also examines the connection between student-athletes' support system, authority figures, career goals, and educational experiences as they relate to student-athletes' attitudes toward and value of mathematics. Using ANOVA's we determined that there was no significant relationship between student-athletes' sport and their mathematical perceptions. Similarly, there was no significant relationship between survey responses and the student's sport and math experience. The result of this study will bring the student-athletes' scholastic identity back into focus and will assist educators in providing student-athletes the opportunities and resources to learn mathematics.

Introduction

The phrase, "Success breeds success" holds true for both athletics and mathematics, yet while there is research promoting the attitude and actions of student-athletes' in regards to their athletics' success (Huffmon & Doyle, 2008; Papenikolaou, et al., 2003), there is no research promoting the attitudes and actions of student athletes in regards to their mathematic success. Myles Brand, the president of the National Collegiate Athletic Association (NCAA), commented that academic departments' lack of research concerning athletics at the college level reflects their opinion of athletics. R. Scott Kretchmar, a professor of exercise and sport science at Pennsylvania State University, expressed his desire to see an increase in student-athlete research involving a variety of disciplines to fill the current deficiency of investigations (Powers, 2008). This research is an attempt to initiate such research inquiries.

It is important for academia to answer this call to action and conduct research to bring the student-athletes' scholastic identity back into focus. This will assist educators in fulfilling their responsibility to provide all students equal opportunities and resources necessary to learn mathematics (NCTM, 2000). The results of such a study may help determine the best course of action to address these relationships, leading to the diversification and improvement of the student-athletes' overall education.

Throughout this paper, we will consider a student-athlete as a member of an intercollegiate team affiliated with an institution's athletic department. Through our discussions with experts in the field and from reviewing literature on student-athletes and influencing factors in mathematical achievement, we determined that there are four categories; authority figures, career goals, education experiences and support systems, that affect student-athletes' relationship with mathematics. A student-athlete's *authority figures* include their coaches, parents and teachers (Johnson, 1985; Papanikolauo, et al, 2003; Simons, et al, 2007). Their *career goals* relate to their desired career upon graduation (*Life After Sports*, 2007). *Educational experiences* involve their successes and tribulations while taking mathematics courses (Hannula, 2002; Middleton & Spanias, 1999; Schiefele & Csikszentmihalyi, 1995). A student-athletes' *support system* includes influence from their peers, teammates and sport as it relates to mathematics (Koller, Baumert, & Schnabel, 2001; Marx, Huffmon, & Doyle, 2008; Whitner, 1986). The number of mathematics courses taken determines their level of *mathematical experience*. We consider student-athletes who progress past Calculus IV to have a *high* level of experience, and student-athletes who have had no mathematics higher than college-algebra to have a *low* level of experience. We define all other participants as having a *medium* level of experience.

In this study, we will determine if sport, gender, major, and depth of mathematical experience influences student-athletes' attitudes toward mathematics. In addition, we will investigate the connection between student-athletes' support system, authority figures, career goals, and educational experiences as they relate to student-athletes' attitude toward and value of mathematics.

Literature Review

Since there is a deficiency in literature concerning student-athletes' mathematical achievement, interests, and perceptions, we synthesized research from two areas of focus: student-athletes' overall educational experience and factors relating to students' attitude, motivation, interest, and achievement in mathematics. During this process, we observed that currently there is no connection between these two fields. Based on this current gap in the literature, we developed our survey consisting of four primary constructs: Authority, Career, Education, and Support.

A student-athlete is a member of an intercollegiate team affiliated with an institution's athletic department. Student-athletes have a unique role within their college community, and this role presents them with many obstacles during their transition to college and overall college experience that the general student population will rarely face. Recently the focus of the student-athletes' athletic identity has intensified due to the progression of the media's coverage of intercollegiate athletics, resulting in their academic identity becoming ignored or disregarded. It is important that educators not allow this to affect their responsibility to provide student-athletes with a proper education. This means ensuring student-athletes possess the primary skills necessary to enter a highly competitive job market. Since mathematics is part of this fundamental knowledge it is essential that student-athletes acquire a strong mathematical background. To make certain student-athletes enroll in courses that provide high quality mathematical experiences, it is critical to understand why they would not enroll in such classes. Before research can take place to address this concern, it is necessary to obtain an understanding of both the student-athlete and the factors that influence their mathematical experience.

To gain an understanding of collegiate student-athletes' mindset it is necessary to understand how they construct their identity. Marx, Huffmon, and Doyle report in their 2008 quantitative study *The Student-Athlete Model and the Socialization of Intercollegiate Athletics* that student-athletes' parents, peers, and coaches significantly influence how student-athletes construct their academic and athletic identities. Parents tend to focus on scholastic success while peers and coaches focus on student-athletes' athletic achievement. At the collegiate level, the influence of peers generally overshadows the effects of parental guidance. Unfortunately, these peers can negatively affect a student-athlete's identity by coercing them to fall in line with perceived athlete stereotypes, such as lack of concern for academics, display of little intellect, and expectation of special treatment (Papanikolaou, 2008; Simons, 2007). These mixed messages can make it difficult for student-athletes to assess their collegiate responsibilities and discern their roles at their institution. These perceptions can be influenced by the student-athletes' experiences at their previous schools. To understand how these viewpoints developed it is critical to analyze student-athletes' academic and athletic background.

Whitner's and Myers's 1986 qualitative research article *Academics and an Athlete: A Case Study* outlines an educational profile of Mike Jones, a freshman student-athlete at the University of Toledo in 1984 who was identified as an academic high risk by the university's

Athletes Educational Planning Program (AEPP). To develop an understanding of the student-athlete's educational background and establish academic goals, they held an academic consultation session. Mike divulged that throughout his high school education, his sister completed his class work and his teachers were lenient. These factors allowed Mike to pass high school. Unfortunately, Mike's high school academic experience is common; many student-athletes arrive to college underprepared for the scholastic rigors they face due to colleges' admission of academically unqualified and underprepared students, eligibility standards, and the time constraints of their athletic requirements (Maloney & McCormick, 1993; Papanikolaou & Alexooulos, 2003). The National Collegiate Athletic Association (NCAA) is currently attempting to address this issue by increasing the number of high school core courses required for incoming freshmen student-athletes from 14 to 16 starting August 2008 (NCAA Eligibility Center, 2007). Thurston Banks (2008) stresses in *Integrated Mathematics Courses and the NCAA Core Course System* the need for intensive mathematics courses to be included in the NCAA core course requirements, since many college programs demand that students complete at least one mathematics course beyond a developmental or remedial mathematic course. However, the number or type of courses the NCAA requires is meaningless unless the teachers evaluate athletes and non-athletes fairly.

Papanikolaou and Alexooulos (2003) express concerns in their article, *The Freshman Experience: High Stress – Low Grades,* that student-athletes generally lack encouragement to foster their academic identity until they reach college, creating many problems for student-athletes as they transition to their collegiate career. Since the student-athletes are unfamiliar with their role as a student, they arrive at college with little motivation or interest in their academics. This obligation to fulfill scholastic demands to maintain athletic eligibility frustrates many first year student-athletes. Student-athletes experience high levels of stress learning to manage their academic responsibilities within an intensive athletic schedule that consumes both their energy and time (up to 40 hours a week) (Simons, 2007). Unfortunately, many incoming freshman have underdeveloped time management and coping skills, which may lead to added difficulties with their coursework. These problems potentially generate further stress for the student-athletes, which can hinder their ability to complete rational or organized mental tasks making it even more challenging to maintain academic goals (Papanikolaou & Alexooulos, 2003).

Student-athletes not only have to cope with their new collegiate identity, they must learn to cope with the change of perception from being highly revered in high school to being viewed as academically inferior (Papanikolaou & Alexooulos, 2003). Simons, Bosworth, Fujita and Jensen surveyed 538 student-athletes at a university, in their 2002 quantitative study *The Athlete Stigma in Higher Education*, to discover how the faculty members and the general student population perceived student-athletes. This study reported that 33% of the athletes’ professors viewed them in a negative manner, and only 15% of the athletes’ professors thought of them positively. Furthermore, the surveyed reported that almost 70% of the student-athletes experienced direct negative stereotypical remarks from faculty members. Surprisingly, a larger percentage of the general student population regarded the student-athletes more negatively than the faculty at the university. This negativity may be stemming from the perceived stereotype that student-athletes do not possess the mental capacity of non-athletes. However, early research (Carter & Shannon, 1940; Snoddy & Shannon, 1939) suggested that there were no statistically significant difference between the mental-ability of student-athletes and non-athletes. These studies indicated that participating in sports actually improved student-athletes bonds to their school, but it was not reported whether these connections were beneficial to student-athletes' academic achievement.

In addition to adjusting to their academic role, student-athletes must adapt to their athletic role within their college and team. Many of the students participating in collegiate sports transition from an elite athlete among their high school competition to an average or below-average athlete among their collegiate competition. This can be very difficult for a student-athlete to cope with since such a large part of their identity stems from their athletic achievement. This feeling of inadequacy further intensifies due to the lack of personal relationship between the athlete and coach at the collegiate level, and can result in loneliness, self-doubt, and a general sense that no one cares about them (Papanikolaou & Alexooulos, 2003). To combat these feelings it is important to provide a system of guidance and support to nurture the student-athlete's academic and athletic growth.

Whitner and Myers (1986) research provides an excellent example of how a plan of support can benefit the educational development of a student-athlete. In a consultation meeting Mike, the student-athlete participating in the study, voiced his frustrations with his courses, and discussed the possibility of quitting school despite the fact that he, while struggling greatly, was academically surviving his classes. This is not a problem unique only to the student-athlete community, various student-counseling services, such as Getting Ready for College; list this frustration as one of the main reasons college students struggle (*10 Reasons College Students* Struggle). Mike's aggravation with school lead to his avoidance of a series of consultation sessions, and when Mike finally returned he voiced his desire to drop out and his concerns for the consequences that would follow. Without the support from these meetings, it is not hard to imagine that Mike would have ended his collegiate career much earlier (Whitner & Myers, 1986). When a student-athlete chooses to withdraw from school, they are also withdrawing from their athletic commitment. Johnson (1985) claims, in his article *Educating Misguided Student Athletes: An Application of Contract Theory*, that schools have a contractual obligation to their student-athletes to assist in their educational progress. Thus, it is in the interest of the entire university, not just the coaching staff and athletic department, to provide their student-athletes with support for all aspects of their collegiate experience. Lack of a coordinated college program and professional standards fail to support the individual needs of the student athlete.

Often, the actions of well-intentioned people and institutions set up the student athlete for a troubled college career. To ensure student-athletes maintain their academic eligibility, some coaches and advisers persuade student-athletes to register for irrelevant courses that offer little academic challenge. Many times this means avoiding basic subjects such as math and writing. While some feel they are protecting the student-athletes by managing the courses in which they enroll; they are in fact, depriving the student-athletes of their education (Johnson, 1985). Pascaraella, Bohr, Nora, and Terenzini (1995) elaborate on this issue, reporting that male student-athletes participating in football and basketball enrolled in more courses involving applied and pre-professional curriculums, such as physical education, speech pathology, or child and family studies, than the general student population. These classes offer little assistance in improving reading comprehension or mathematics. Pascaraella, et al.'s (1999) expanded their research in *Cognitive Impacts of Intercollegiate Athletic Participation: Some Further Evidence* by studying the negative relationship between student-athletes and their college experience, career maturity, educational and occupational plans, and moral judgment. However, they concluded that the student-athletes participating in non-revenue sports college experiences differed little from non-athletes. The nature of athletic competition in higher education creates many obstacles for student-athletes during their academic experience. The psychological and physical toll of their sports leave only limited amount of energy left to devote to their academic progress, and student-athletes also have fewer hours of the day to invest in their coursework due to their athletic obligations. In addition to these responsibilities, the athletic culture does not necessarily place a high value on academic achievement, and the segregation of student-athletes from non-athletes hinders their intellectual growth (Papanikolaou & Alexooulos, 2003). It is important to continue this type of research to further student-athletes' educational achievement since less than 5% of all student-athletes compete professionally in their respective sports and they need fundamental skills to survive in the current highly competitive job market (*Life After Sports*, 2007). It may be ambitious and unreasonable to overhaul the academic structure of the student-athlete, but improving one facet of their education at a time is certainly a more realistic goal. Pascaraella et al. (1995) discuss that student-athletes tend to score lower in mathematics and reading comprehension than non-athletes. Focusing on the advancement of student-athletes in one of these areas could yield benefits to the student-athletes' overall education. Promoting the enrollment of student-athletes in mathematics related classes is the first step in addressing their mathematical deficiencies. To advocate the pursuit of mathematics education properly, it is necessary to first gain an understanding of students' attitudes towards mathematics.

A student's attitudes and emotions towards mathematics play an influential role in determining the level of mathematics pursued. Markku Hannula's examines this notion in his 2002 qualitative research article *Attitude Towards Mathematics: Emotions, Expectations and Values* in which he focuses on Rita's, a female Finnish student, developing attitudes towards mathematics as she progresses through elementary school and on to her early secondary education. Hannula's definition of attitude is broken down into four categories: the student's emotions during activities related to mathematics, the student's emotions connected to the topic of mathematics, the evaluation of how a student responds to confronting a mathematical setting, and how a student values their goals linked to mathematics in relation to their overall educational goals. The researcher analyzed these aspects of Rita's attitude through interviews with her authority figures and peers, and by observing her behavior in the classroom. Collecting this data over a number of years provided the information needed to recognize and understand the changes in her attitudes towards mathematics. The student explains that her dislike for mathematics stemmed from the negative emotions that she associated with the subject, and that these emotions affected her confidence in understanding mathematics. As Rita's confidence declined, her expectations for success declined as well. Working mathematical problems with fellow students did little to improve her perception of mathematics. Rita became annoyed during the task, she felt the difference in abilities between herself and others made her an "outsider" in the group. She sensed that the group viewed her as a hindrance, which furthered her irritation. Rita's petitions for help went unnoticed; in response, she refrained from positively participating with the others, and declared the task useless. This type of flight response is normal; to preserve one's self-image, the student will denounce, avoid, and attempt to distort their academic standing (Papanikoloau, 2008; Middleton & Spanias 1999). Repeated failure prompts student dropout. Lack of designs to detect individual weaknesses and provide support comprise an inefficient college program.

Middleton and Spanias (1999) point to a deficiency in encouragement and classroom atmosphere for the deterioration in student attitudes and motivations towards mathematics. As students' perceptions of mathematics become more negative, they learn to dislike mathematics. Students begin to form the notion that mathematics is a subject were only the capable succeed and everyone else struggles or fails. Students that explain their failure in mathematics by citing their personal intellect and ability generally have an aversion to mathematic related courses and majors. On the other hand, students that direct their success in mathematics to their skills and effort tend to gravitate more toward mathematics related fields. Students believe their success in mathematics is completely dependent on their natural mathematical abilities. This type of attitude provides students with little motivation to apply themselves in the field of mathematics.

Achievement is a large influence on a student's motivation to succeed. A student's prior accomplishments in mathematics significantly affect their motivation to engage in higher levels of mathematics with the expectation to do well. However, students' understanding of the importance of mathematics has not affected the decline in students enrolling in mathematic related courses (Middleton & Spanias, 1999). Stage and Kloosterman explain in their 1995 quantitative research article *Gender, Beliefs, and Achievement in Remedial College-Level Mathematics* that students view mathematics courses as obstructions that prevent them from pursuing certain careers, due to their inability to overcome their emotional or cognitive challenges in mathematics. On the other hand, some students' interests provide them with the motivation necessary to confront and conquer their deficiencies.

A student's interests play a critical role in determining their level of engagement within a course. Koller and Baumert report on the effects of interest in academic engagement and success in their 2001 research article *Does Interest Matter? The Relationship between Academic Interest and Achievement in Mathematics*, explaining students seek knowledge and endeavors that gives them a sense of adequacy and self-control. There are numerous avenues of interest a student can pursue in attempt to attain these goals, and these paths are in direct competition with another to hold the student's interest; selecting one generally requires neglecting others. Providing the student a high quality mathematical education experience in school is critical to maintain the student's mathematical interest. Schiefele and Csikszentmihalyi stress, in their 1995 article *Motivation and Ability in Mathematics Experiences and Achievement*, that students' interest in mathematics reliably determines the student's experiences, grades, and level of achievement and understanding in mathematics. The converse of this statement is also true; student's mathematical performance and success generally directly influences his or her interest in the subject. Therefore, a student-athlete's awareness of mathematical aspects within their particular sport may influence their interest in mathematics.

The connections between mathematics and athletic competition are prominently displayed through measurable data, such as score, time, distance, etc. However, the level and types of mathematics that also exist within sports can sometimes be difficult to perceive and understand. Mathematics allows for the depictions of different models of physical motions, such as running and jumping, while considering the effects of air resistance, fatigue, duration, grade of surface, etc., by utilizing various geometric and real analysis theories (Davey, Hayes, & Norman, 1994; Ladany & Singh, 1978; Mathis, 1989; Norman, 2004; Pritchard, 1993). Modeling physical movements is not the only aspect of sports that mathematics can represent, it is also possible to optimize in-game strategies (Wright & Hirotsu, 2003) and compare athletic performance (Grubb, 1998) with the assistance of mathematics. In addition to mathematics role within actual sports, mathematics facilitates the development of schedules for athletic competition among many colleges using highly constrained linear programming (van Voorhis, 2002).

These studies served to inform us on the perceived roles and responsibilities student-athletes undertake within their schools, and provided insight into possible determining factors for students' mathematical experiences, achievement, and perceptions. Our research is an early attempt at establishing an understanding of the relationship between student-athletes' and their attitudes, motivations, interests, and achievements related to mathematics.

Methodology

In the methodology section, we will discuss the demographics of the sample and sampling method, the theoretical framework. Subsections include discussions of the instrument and of the role of the researcher. The instrument subsection relates to the constructs found in the survey, the validity, and reliability of the survey. In the role of the researcher subsection discusses our potential biases as mathematicians researching student-athletes.

The site of this study was a public university in the Rocky Mountain region of the United States having a student population of about 12,000 students. Of this population, our focus is restricted to 369 student-athletes participating in inter-collegiate sports. Of the participants, about 40% are female. Regarding their progress through school, about 33% of the participants are freshman, 24% are sophomores, 31% are juniors, and 12% are seniors. The participants had the following distribution for their mathematical background: 3.5% had a high background, 35.3% had a medium background and 61.3% of the participants had a low mathematical background.

The participants in our study share common athletic and academic experiences. Athletically, these student-athletes participate in sports requiring similar physical and time demands that can sometimes hinder their educational progress. Academically, the student-athletes have satisfied the NCAA's core course requirements during their secondary education career or have completed the necessary coursework at a prep school to participate in athletics at the collegiate level. In addition to these requisites, the participants of this study must complete a minimum mathematic requirement to receive a degree from their institution; which ranges from completing one course of *mathematics for liberal arts majors* to completing a sequence of *college algebra* and *topics in calculus* courses, depending on their major area of study.

The theoretical framework for this research is quantitative with a survey strategy. We conducted a cross sectional survey of all student-athletes in the spring semester during an academic advising meeting held for each individual team. Of the 369 student-athletes, 235 completed the survey giving us a response rate of almost 64%. The athletic department staff administered the surveys to provide participant anonymity. We did not receive data from the women's volleyball team or wrestling team. Participants from the other 15 teams contributed to our data.

Survey Instrument

Since the survey is quantitative, we used a post-positivist approach of creating and testing hypothesis statements for statistical significance. Current research in student-athletes perceptions and attitudes towards mathematics is lacking, and currently there are no in-depth quantitative studies in this area. We designed the Mathematics Experience Questionnaire (appendix A) to disambiguate student perceptions of mathematics within Authority, Career, Education, and Support. We developed our survey based on the synthesis of the literature. By creating a new questionnaire, we are able to align the survey statements with our four constructs to gain a greater understanding between the student-athletes background and their mathematical perceptions (Creswell, 2009). However, due to the absence of previous studies, we are unable to compare aspects of our survey with previously established quantitative research. Since this is this study represents the initial test of our instrument, we are unable to benefit from the outcomes of previous tests of our survey. Thus, we lack the historical data with which to test our survey for predictive validity (Huck, 2008).

Throughout the development of our survey (appendix A), we sought expert consultation from the head of the athletics department, the assistant athletic director, and statistician who was a former athletic director. This served to validate the four constructs within our survey, allowing us to investigate the correlation between student-athletes' educational experiences, desired career, and the support they receive from peers, coaches, parents, teachers, and from participation in their selected sport. We listed the relation between the items and constructs, as well as the positive versus negative aspects of the items in a table in appendix B. Each construct contains between 6 and 10 positively and negatively phrased statements to determine the student-athletes mathematical perspective towards each construct. The survey reflects these four constructs using a six-value Likert scale similar to the model used by Harding-DeKam (2005), to eliminate neutral responses from our participants. We felt that an even number of responses would engage participants with the survey rather than presenting an easier neutral selection. Our survey responses have a Crombach's Alpha score of 0.908, which reflects a high reliability (Huck 2008).

Role of Researcher

As researchers, we desire to be aware of and acknowledge any bias that may influence our study. Undue and unspoken bias could potentially undermine the statistical approach, and validity of the analysis (Gall, Gall & Borg, 2003). We, the researchers, each possess strong mathematical backgrounds and value mathematics highly within our lives. This value system directly affected the construction of our mathematical experience explanatory variable. It is our belief that the completion of mathematics courses at or below the level of college algebra constitutes a low level of mathematical experience, since it is the minimal requirement to fulfill the mathematical requirement for graduation at the surveyed institution. We define a medium level of mathematics as completing mathematical courses above college algebra, but no greater than calculus IV since this provides a solid practical mathematical background, and occurs prior to the stage involving abstract mathematical concepts. A high mathematical background involves the completion of proof based mathematical courses. Our definitions of low, medium and high may not be consistent with the general mathematical requirements of individuals with a non-mathematical emphasis nor that of the participants in this study.

Data Analysis and Results

Members of athletic department staff surveyed all intercollegiate student-athletes as they discussed registration during a team meeting. At the time of the data analysis, we did not have responses from either the wrestling or women's volleyball teams. Of the completed surveys, eight student-athletes participated in two sports, and one student-athlete had a double major. Due to the sample size, rather than discard these entries, we duplicated each student response to represent each of the individual sports and/or majors that they represented.

We gathered data using a 30-statement survey, collecting data over four different constructs: Authority, Career, Education, and Support. Of the constructs, six items relate to statements about Career and Support, eight items address Authority, and ten statements pertain to Education. Each construct had an equal number of positively and negatively phrased statements. We entered the responses to each survey in Microsoft Excel, and adjusted the negatively phrased items to reflect a positive phrase. When we were finished with all data gathering and input, we imported the data into SPSS for statistical analysis.

We ported the survey data to SPSS for our statistical analysis of the surveys. To investigate significance between the survey responses, we performed multiple ANOVAs using participants' responses for Gender, Major, Sport, and Math Experience as our explanatory

Table I

ANOVA Testing Effects of Gender, Major, Sport, and Experience

Source	Type III SS	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	106521.130[a]	144	739.730	2.640	.000	.809
Intercept	867425.526	1	867425.526	3096.108	.000	.972
Gender	1239.312	1	1239.312	4.423	.038	.047
Major	15633.850	29	539.098	1.924	.010	.383
Sport	1148.140	9	127.571	.455	.900	.044
Experience	3762.534	2	1881.267	6.715	.002	.130
Gender*Major	6931.94	8	866.493	3.093	.004	.216
Gender*Sport	11390.750	2	5695.375	20.329	.000	.311
Gender*Experience	36.000	1	36.00	.128	.721	.001
Major*Sport	22488.402	50	449.768	1.605	.026	.471
Major*Experience	2085.080	10	208.508	.744	.681	.076
Sport*Experience	1421.674	6	236.946	.846	.538	.053
Error	25214.981	90	280.166			
Total	3312018.00	235				
Corrected Total	131736.111	234				

a. R Squared = .809 (Adjusted R Squared = .502) variables, while looking for a significant relation with the total survey score and each of the four constructs. The SPSS univariate analysis checked for interactions between each of the explanatory variables, to find significant interactions, as shown in table 1. We found a highly significant relationship between student-athletes major (p=0.010, Eta squared=0.383) and mathematical experience (p=0.002, Eta squared=0.013) with their responses to the Mathematical Experience Questionnaire. We expected this significance since students with more mathematically intensive majors and high levels of mathematics experience are more likely to have a positive view of mathematics. We also found a significant relation between gender and the responses to the Mathematical Experience Questionnaire (p=0.038, Eta squared=0.047). However, we did not find a significant relation between the students sport, and their survey responses (p=0.90, Eta squared=0.044). The sport in which a student-athlete participates has no effect on the student's responses to the questionnaire, however interactions between student responses and sport*gender (p=0.000, Eta squared=0.311), and sport*major (p=0.026, Eta squared=0.471) are highly significant. The Eta squared values reflect the practicality of the results. According to Huck (2008), Eta square values below 0.06 demonstrate small practical significance, between 0.6 and 0.14 moderate practical significance, and any values above 0.14 demonstrate large practical significance.

To follow up with this, we compressed the sports data to indicate whether each student-athlete participated on a team sport, or an individual sport. Broh's (2002) research indicates that team sports build greater social networks, while individual sports build a stronger work ethic. We then analyzed whether the student-athletes' participation in a team sport had a significant relation towards their perception of mathematics. Based on our data gathered, there is not a significant difference between whether a student-athlete participates in a team or an individual sport ($t(236)=-1.413$, $p=0.0159$).

To address the connection between student-athletes' support system, authority figures, career goals, and educational experiences as they relate to student-athletes' attitude toward and value of mathematics, we attempted to predict a relation between student responses to the Mathematical Experience Questionnaire (appendix A) and their respective sport, sport type, and mathematical experience. This allowed us to compare categorical explanatory constructs with categorical responses. Since there were six possible responses to each statement, ranging from strongly (=1) disagree to strongly agree (=6), we defined a positive response to be any response from vaguely agree to strongly agree (>3). To test for significance, we counted the number of positive responses for each construct and evaluated them against each of the three variables indicated above. We evaluated the data using a Pearson Chi-Squared distribution, and found no statistically significant difference between student-athlete responses, and the sport ($\chi^2(27)=3.191$, $p=1.000$) or sport type ($\chi^2(3)=0.048$, $p=0.997$) in which they participated. Similarly, there was no statistically significant difference between the student-athlete and their level of mathematical experience ($\chi^2(6)=1.107$, $p=0.981$). According to Huck (2008), there is little practical significance to each of the chi-squared tests since the Cramer's V for each test was below 0.04.

Table II

Positive Responses to Construct Statements by Mathematics Experience

Math Experience	Authority	Career	Education	Support	Total
Low	122 (15%)	91 (11%)	123 (15%)	129 (16%)	465 (57%)
Medium	81 (10%)	69 (9%)	84 (10%)	82 (10%)	316 (39%)
High	8 (1%)	8 (1%)	8 (1%)	8 (1%)	32 (4%)
Total	211 (26%)	168 (21%)	215 (26%)	219 (27%)	813

a. Cramer's V Value of .026, with Approximate Significance of .981

Positive Responses to Construct Statements by Sport Type

Sport Type	Authority	Career	Education	Support	Total
Team	132 (16%)	105 (13%)	134 (16%)	135 (17%)	506 (62%)
Individual	79 (10%)	63 (8%)	81 (10%)	84 (10%)	307 (38%)
Total	211 (26%)	168 (21%)	215 (26%)	219 (27%)	813

a. Cramer's V Value of .008, with Approximate Significance of .997

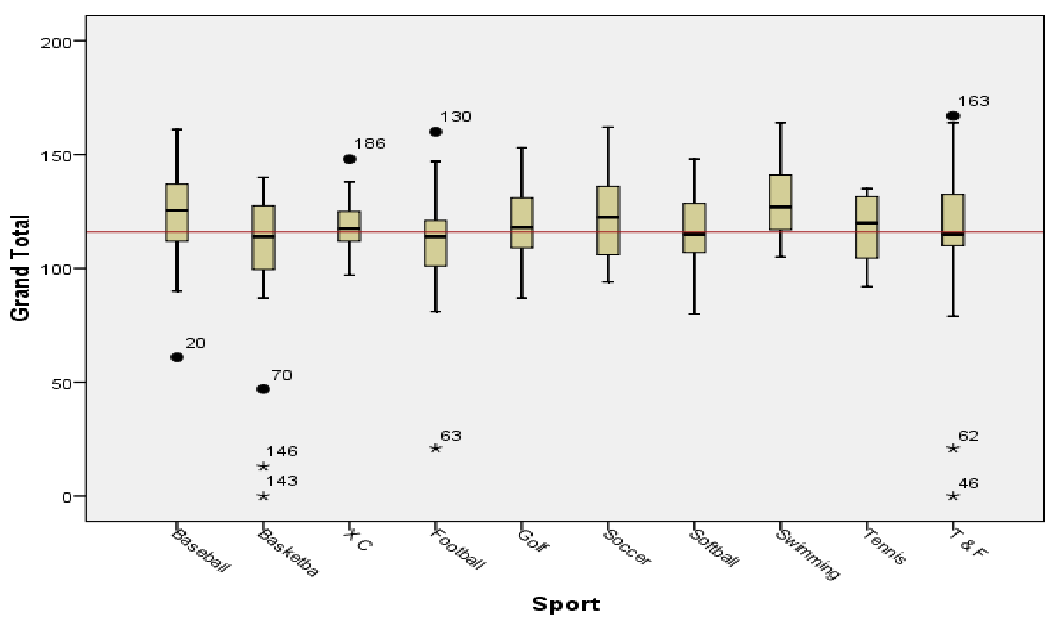
Table II continued

Positive Responses to Construct Statements by Sport

Sport	Authority	Career	Education	Support	Total
Baseball	28 (3%)	25 (3%)	30 (4%)	30 (4%)	113 (14%)
Basketball	19 (2%)	12 (1%)	18 (2%)	20 (2%)	69 (9%)
Cross Country	10 (1%)	7 (1%)	10 (1%)	10 (1%)	37 (5%)
Football	58 (7%)	49 (6%)	62 (8%)	61 (1%)	230 (28%)
Golf	7 (1%)	6 (1%)	8 (1%)	9 (1%)	30 (4%)
Soccer	12 (1%)	9 (1%)	11 (1%)	12 (1%)	44 (5%)
Softball	15 (2%)	10 (1%)	13 (2%)	12 (1%)	50 (6%)
Swimming	12 (1%)	12 (1%)	13 (2%)	13 (2%)	50 (6%)
Tennis	12 (1%)	6 (1%)	12 (1%)	12 (1%)	42 (5%)
Track and Field	38 (5%)	32 (4%)	38 (5%)	40 (5%)	148 (18%)
Total	211 (26%)	168 (21%)	215 (26%)	219 (27%)	813

a. Cramer's V Value of .036, with Approximate Significance of 1.000

Box Plot Depicting Positive Responses to Construct Statements by Sport



Horizontal line indicates overall mean positive response score.

Our participant's major area of study and amount of mathematical experience had statistically significant effects on their attitudes towards mathematics. One would expect this type of result from any segment of the student population. This outcome coincides with the research (Hannula, 2002; Koller, Baumert, & Schnabel, 2001; Middleton & Spanias, 1999) that students with a higher mathematical experience are more likely to have positive mathematical experiences, and students with negative mathematical experiences may be less likely to continue taking mathematics classes. Likewise, participants who chose a mathematically intensive major expressed a greater percentage of positive responses on the survey. The choice of a major may reflect students', and student-athletes' academic preferences and abilities.

Contrary to the literature (Pascaraella, et al. 1995, 1999), our study found no statistical difference between the participants' perceived attitudes towards mathematics based on their participation in particular sports. Therefore, it appears that student-athlete's teammates have neither a positive nor a negative influence on an individual's perceptions of mathematics. This conclusion does not support the research (Koller, Baumert, & Schnabel, 2001; Marx, Huffmon, & Doyle, 2008; Whitner, 1986) that peers and teammates play an influential role in student-athletes' attitudes and perceptions. However, Broh (2002) indicated that student-athletes participating in team sports have a greater peer support system, so team sports potentially influences participants' mathematical attitudes. We found no significant difference between the numbers of students with overall positive responses to the statements on the Mathematical Experience Questionnaire (appendix A) based on whether or not they participated in a team or individual sport.

Our study indicates there is not any predictive value in determining participants' level of mathematical experience, sport, or sport type through the analysis of their attitudes towards mathematics within our four constructs: authority, career, education, and support. Student-athletes attitudes towards mathematics have no influence when choosing a sport, which contradicts Pascarella, et al.'s (1995, 1999) findings that men's basketball and football participants tend to avoid mathematics courses. This supports the previous results between student-athletes sport or sport type, and their attitudes toward mathematics. We expected to find a positive relation between a student-athletes attitude and their mathematical experience, however there was no relationship. This result is surprising and warrants further attention in a future study to determine the nature of this relationship.

Discussion

Since our study found no significant difference in the effects that sport or sport type had on our participants' attitudes toward mathematics, other questions have begun to develop. We now would want to consider if there exists a significant difference in the perception of mathematics between athletes and non-athletes within the student population or if the significant difference only exists between the students' major and experience with mathematics as our current research has shown. We would accomplish this quantitatively by refining past research (Pascarellera, et al., 1995; Pascarellera, et al., 1999) to focus specifically on athletes' and non-athletes' achievement in mathematics. Another interesting aspect of such a study would be to analyze the breakdown by percentage of majors within the non-athlete student population in comparison to the student-athlete population to determine if there exists a difference in the type of academic paths selected.

Our study found no connection between the participants' attitudes towards mathematics and their involvement with mathematics. Therefore, it appears that motivating student-athletes to enroll in mathematics courses will take more than just improving student-athletes' attitudes towards mathematics. Currently, the NCAA (Banks, 2008; NCAA, 2007) requires the completion of a certain number of courses to receive athletic eligibility. The NCAA's method for encouraging student-athletes to increase their level of mathematics exposure appears to be more effective in improving student-athletes' mathematical experiences than positively influencing their mathematical attitudes.

A qualitative follow-up to our research may produce further insight into the nature of the relationship between student-athletes and mathematics. By conducting interviews with the student-athletes in our study, we may be able to get a rich, thick description of student-athletes' perceptions towards mathematics. Analyzing these interviews would allow us to triangulate themes and patterns in the data (Creswell, 2009). The result of such a study could offer many benefits to both the athlete and the athlete's school. Understanding student-athletes' perception of mathematics can provide education institutions an outline to actively engage student-athletes to enrich their mathematical experiences. The process of the student-athlete discussing their academic concerns may serve as a stress reliever. This discussion also serves to increase the students' interest and investment into their own education (Whitner & Meyers, 1986). Such a dialogue may also help the student address their academic and athletic demands

The most important results of any study involving student-athletes' education, is to encourage future research into student-athletes' perspectives on other subjects besides mathematics to increase the educational diversity and strengthen the overall education of the student-athlete population.

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Appendix A

Directions: For each of the following statements circle one of the following:
Strongly Disagree = SD, Disagree = D, Vaguely Disagree = VD, Vaguely Agree = VA, Agree = A, and Strongly Agree = SA.

Statement						
1. Math will help me advance in my career.	SD	D	VD	VA	A	SA
2. My high-school teachers thought I could do well in math.	SD	D	VD	VA	A	SA
3. Math is not important to my sport.	SD	D	VD	VA	A	SA
4. I do not need mathematics for my education.	SD	D	VD	VA	A	SA
5. My coaches do not encourage me to study additional math courses.	SD	D	VD	VA	A	SA
6. Math has prevented me from participating in my sport.	SD	D	VD	VA	A	SA
7. Math is not important to my career goals.	SD	D	VD	VA	A	SA
8. My coach encourages me to take challenging courses.	SD	D	VD	VA	A	SA
9. I perform poorest in math.	SD	D	VD	VA	A	SA
10. My teammates think I am good at math.	SD	D	VD	VA	A	SA
11. I need mathematics in my education.	SD	D	VD	VA	A	SA
12. I plan to pursue a career that requires little math.	SD	D	VD	VA	A	SA
13. I am aware of the mathematics in my sport.	SD	D	VD	VA	A	SA
14. I was successful in high school math classes.	SD	D	VD	VA	A	SA
15. Math classes have not affected my choice in my major area of study.	SD	D	VD	VA	A	SA
16. I see mathematics as something I will not use very often in my job.	SD	D	VD	VA	A	SA
17. I am interested in math.	SD	D	VD	VA	A	SA
18. My teachers encourage me to study additional math courses.	SD	D	VD	VA	A	SA
19. I will use mathematics in my future career.	SD	D	VD	VA	A	SA
20. I cannot learn mathematics.	SD	D	VD	VA	A	SA
21. Math teachers showed little interest in me.	SD	D	VD	VA	A	SA
22. I will pursue a job involving mathematics.	SD	D	VD	VA	A	SA
23. I seek additional help when learning math.	SD	D	VD	VA	A	SA
24. My parents see little need for mathematics.	SD	D	VD	VA	A	SA
25. The involvement of mathematical content influences my aspirations in a field of study.	SD	D	VD	VA	A	SA
26. My peers do not value math courses.	SD	D	VD	VA	A	SA
27. I have not been successful in college math classes.	SD	D	VD	VA	A	SA
28. The demands of my sport do not affect the courses I take.	SD	D	VD	VA	A	SA
29. My teachers do not think I am good at mathematics.	SD	D	VD	VA	A	SA
30. My parents encourage me to study more mathematics.	SD	D	VD	VA	A	SA

Appendix B

Construct Breakdown Table

Authority Statements	Response Type
2. My high-school teachers thought I could do well in math.	Positive
5. My coaches do not encourage me to study additional math courses.	Negative
8. My coach encourages me to take challenging courses.	Positive
18. My teachers encourage me to study additional math courses.	Positive
21. Math teachers showed little interest in me.	Negative
24. My parents see little need for mathematics.	Negative
29. My teachers do not think I am good at mathematics.	Negative
30. My parents encourage me to study more mathematics.	Positive
Career Statements	
1. Math will help me advance in my career.	Positive
7. Math is not important to my career goals.	Negative
12. I plan to pursue a career that requires little math.	Negative
16. I see mathematics as something I will not use very often in my job.	Negative
19. I will use mathematics in my future career.	Positive
22. I will pursue a job involving mathematics.	Positive

Education Statements	
4. I do not need mathematics for my education.	Negative
9. I perform poorest in math.	Negative
11. I need mathematics in my education.	Positive
14. I was successful in high school math classes.	Positive
15. Math classes have not affected my choice in my major area of study.	Negative
17. I am interested in math.	Positive
20. I cannot learn mathematics.	
23. I seek additional help when learning math.	Positive
25. The involvement of mathematical content influences my aspirations in a field of study.	Positive
27. I have not been successful in college math classes.	Negative

Support Statements	
3. Math is not important to my sport.	Negative
6. Math has prevented me from participating in my sport.	Negative
10. My teammates think I am good at math.	Positive
13. I am aware of the mathematics in my sport.	Positive
26. My peers do not value math courses.	Negative
28. The demands of my sport do not affect the courses I take.	Positive