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GENDER AND MOTIVATION IN CONCUSSION SYMPTOMS

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Abstract

There is an apparent divergence between genders in their reports of concussion symptoms in that women tend to report fewer symptoms than men. In an effort to uncover the underlying causes of gender differences in reports of concussion symptoms, the present study examined the role of motivation in affecting this variation. Archival data of participants who have had a concussion were used, and I evaluated three scales. The Examiner Motivation Scale assesses the athletes' motivation according to the perception of the person giving the test. The Subject Motivation Scale examines the athletes' self-rated motivation. Lastly, the Post Concussion Symptom Scale assesses the athletes' self-report of symptoms. It was predicted that gender would be associated with differences in motivation that, in turn, would be associated with self-reports of concussion symptoms. In other words, the theory and research presented in this thesis examined the possibility that gender differences in motivation help to explain the well-documented gender differences in the reports of post-concussion symptoms. The main effect of motivation was found to be significant, but only when rated by the examiner. Additionally, the interaction between gender and motivation to affect Post Concussion Symptom Scale scores was significant, but again, only when the motivated was examiner-rated.

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Gender and Motivation in Concussion Symptoms

Concussions are becoming more commonly reported among athletes, especially adolescent athletes, which has led to stricter guidelines and more conservative decisions about when athletes are able to return to play. Collins et al. (1999) defined concussions as “a traumatically induced alteration in mental status not necessarily resulting in loss of consciousness”. Many pathophysiological changes occur after a concussion. Specifically, glutamate, a neurotransmitter, binds to its receptor in the brain leading to an “efflux of potassium and influx of calcium” (Giza & Hovda, 2001). In order to restore the previous balance, an energy dependent mechanism is required. The sodium/potassium pump works to counter the efflux of potassium through the use of adenosine triphosphate (ATP), an energy rich molecule. This depletion of ATP requires the body to metabolize more glucose in order to meet the demands of the sodium/potassium pump. “The resulting energy crisis is a likely mechanism for postconcussive vulnerability, making the brain less able to respond adequately to a second injury and potentially leading to longer-lasting deficits” (Giza & Hovda, 2001).

The symptoms of a concussion are variable, but usually include headaches and dizziness (Dupuis et al., 2000). The unfortunate truth in some of these instances of brain trauma is that many athletes may be dishonest when reporting symptoms. The number of reported sport induced concussions is greatly underestimated, but still reaches a staggering 300,000 each year (Dupuis et al., 2000). The severe effects of one concussion, let alone multiple concussions, have driven research in this field. Disregarding concussions can lead to serious future medical issues for athletes because repeated brain injury can be life threatening.

The goal of the present study is to consider the interactive role of both subject and examiner rated motivation and gender on reports of concussion symptoms. To explain the focus

of the present work and to derive testable hypotheses, I first review relevant theory and research documenting gender differences in severity of concussion, gender differences in gender socialization, and gender differences in motivation. I then turn to prior research examining linkages between gender, motivation, and post-concussion reports of symptoms.

Gender Differences in Concussion Severity

Ample research has found that women experience more severe concussions than males. Dick (2009) found in his study on concussion outcomes that females displayed a worse outcome than males on most measured variables. Specifically, he noted that “females may be more frequently cognitively impaired than males following concussions” (Dick, 2009). This finding was supported by Broshek et al. (2005) who found that compared to males, female athletes displayed greater declines from preseason baseline levels on reaction time tasks and also reported more post-concussion symptoms. Women have also been shown to perform worse on visual memory tasks after a concussion than males (Covassin et al., 2007). Thus, there appears to be some support of the notion that women show a greater impact from concussions than men. Examining gender in relation to concussion severity is thus important.

The Socialization of Gender

Researchers have examined the effects of socialization of gender roles on adolescents’ behaviors. Differences between genders on amounts of nurturance, obedience, responsibility, achievement, and self-reliance have all been documented. For instance, Barry, Bacon, and Child (1973) found that young girls are most often socialized to be nurturing, obedient, and responsible, “whereas pressure toward achievement and self-reliance is most often stronger for boys.”

Those cultures that tend to favor strength in young boys also tend to favor masculinization of young boys (Barry et al., 1973). It is also not surprising that those cultures that have traditionally large, conventional families also support gender socialization (Barry et al., 1973). Barry et al. (1973) found correlations between “large family group with high cooperative interaction” and sex differences in socialization. This suggests that the larger the family, the greater the cooperative dynamic, and therefore, the greater the socialization of gender differences. Large families are the ones that teach the girls how to cook, clean, and take care of children, while the boys are taught to be strong and to support the family. This can be contrasted with small, nuclear families where socialization of gender differences is much smaller. In these cases, if the male or female became unable to be present, the roles of that person would fall on the rest of the family. With less people available, there is less room for specialization in the sense that each person needs to be able to express, in a sense, both genders. The continuation of these traditional gender roles is natural if this is what the parents teach the children. The higher rate of socialization of gender roles for children of large families may play a role in the gender differences of reports of concussion symptoms.

So what is it about this socialization that could cause gender differences in post-concussion symptom ratings? Boys are taught to be self-reliant and strong. In fact, masculinity is comprised of three separate components that are taught to young boys (Vescio, Schlenker, & Lienes, 2010). First, masculinity requires power and status. At a very early age, boys are taught that “real men” are powerful, high status people. Real men influence others rather than be influenced by others, lead rather than be led, and protect and physically care for others rather than be protected and physically cared for themselves. Second, to be masculine is to be tough – physically, emotionally, and mentally tough. To be a real man requires a tolerance of pain,

regardless of whether it is physical or mental. Anti-femininity, the last component of masculinity means avoiding all things deemed feminine, for example, displaying the typical feminine, communal traits such as being caring, nurturing, and gentle. Post-concussion, the reason men are less willing to report symptoms may be due to the fact that they have a need to be powerful, tough, and to also avoid femininity.

Reporting concussion symptoms, then, may involve a threat to masculinity, requiring men to admit physical pain and the need for care, blurring the lines between what it means to be male and female. Vescio and her colleagues (2010) noted, “Masculinity demands avoiding or fleeing from any activities, traits, or behaviors that others could interpret as feminine or ‘sissy’.” Men and women are socialized from a young age about their social roles and what types of behaviors accompany this distinction. Going against these social norms of gender roles could lead to ridicule and humiliation, which may explain men’s general lack of willingness to report symptoms.

Conversely, if girls are being taught to be obedient and responsible, this may explain their reasoning for wanting to be more specific and thorough in their report of post-concussion symptoms. Traditionally, girls are taught to be reliant on their fathers or husbands, the critical men in their life, so being reliant and subservient comes naturally. The idea of being tough and independent is not projected on girls as it is on boys.

Gender Differences in Motivation

Prior studies have also explored variance in motivation between genders. There are multiple explanations for a divergence in motivation of genders. Men just might be more motivated to succeed. Dyke and Murphy (2006) conducted open-ended interviews with forty successful men and women. They found that “gender differences do exist. Women highlight the

importance of balance and relationships. Men focus more on material success.” Dyke and Murphy found that around fifty percent of women cited balance and forty-five percent of women cited relationships as the keys to their success. Even more surprising is that only fifteen percent noted money as important to their success (Dyke & Murphy, 2006). This can be starkly contrasted with men who primarily emphasized monetary gains as important to their success. This can be translated into post-concussion symptom rating in that men may be more willing to complete the necessary testing to the best of their ability. This could be due to internal pressures to succeed in general, or specifically for potential monetary gains (i.e. scholarships).

Another explanation for why men may have greater motivation may be that men have a great desire to return to play, which can be labeled as intrinsic motivation. Having intrinsic motivation is the idea that one completes the task, or in this case plays the sport, due to personal reasons such as enjoyment and feelings of accomplishment. A multi-variable study examined the interaction between gender and intrinsic motivational factors in athletes (Amorose & Horn, 1999) to examine the possibility that the higher reports of concussions in women than men may result from women’s smaller intrinsic motivation to return to the game post-concussion.

To examine whether there were gender differences in intrinsic motivation to return to their sport, Amorose & Horn (1999) asked 199 men and 187 women Division I collegiate athletes to complete two surveys. First, participants completed the Intrinsic Motivation Inventory, which is a 16-item questionnaire that is comprised of four subscales. These subscales are (1) interest enjoyment, which is how much the athletes reports the sport being interesting and fun, (2) perceived competence, which is how the athlete views their own abilities to play the sport, (3) effort-importance, which is how important the athlete thinks it is to try their best, and (4) tension-pressure, which is how much pressure the athlete experiences while playing the sport

(Amorose & Horn, 1999). Second, participants completed a four-option multiple-choice question that asked the athletes what they felt their perceived choice to play the sport was. This was included as a supplement to add another aspect of motivation.

Amorose and Horn (1999) found gender differences on some of the four subscales of the Intrinsic Motivation Inventory. First, female athletes scored higher on the effort-importance subscale, which measures how much effort athletes deem necessary for them to exert in order to succeed. Second, female athletes also scored higher than male athletes on tension-pressure, a scale that explored how much pressure the athlete experiences in regard to their sport. Men, though, scored higher on the perceived choice subscale. The gender main effect found for tension pressure was .39 and was -.39 for perceived choice. While women were shown to be more intrinsically motivated based on these subscales, the effect size of the gender difference was small.

In the present study, I expect gender and motivation to interact to affect reports of concussion symptoms. For example, if men have the inherent impetus to play whatever sport they play, they have high motivation, and will be less willing to report symptoms for fear that the doctors and trainers will tell them they cannot return. If they report symptoms of concussion, there is less of a chance they will be able to return to play than if they ignore or deny their symptoms. Women who have little desire to return to play have low motivation and will report the highest number of concussion symptoms.

Research has also explored possible gender differences in motivational orientation. Motivational orientation relates to the type and how much motivation a person experiences. Boggiano, Main, & Katz (1991) examined this issue in a sample of 107 girls and 106 boys. The fourth-through-sixth graders completed a five-subscale survey that evaluated levels of

motivational orientation (Boggiano et al., 1991). Three of the five subscales directly assessed motivational orientation, while two of the subscales looked at cognition (Boggiano et al., 1991). The motivational subscales were a preference for challenge versus easiness, working for oneself versus working for someone else, and attempting to solve a problem independently versus asking for assistance (Boggiano et al., 1991). Although the authors predicted females would be higher in extrinsic motivation, that is motivated by external factors, than males, the results showed that females reported lower motivational orientation scores than males in both the high extrinsic motivational orientation and the moderate extrinsic motivational orientation.

Having extrinsic motivation is the idea that one completes the task, or in this case plays the sport, due to external factors such as scholarships or monetary gains. High levels of extrinsic motivation in athletes would be indicative of a high need to return to the game, and in turn, a high need to return to the game might motivate a minimization of symptom reports. Therefore, according to the research done by Boggiano et al. (1991), if females are found to be less extrinsically motivated, they may feel less of a need to return to the game, and therefore less of a need to minimize symptoms on the Post-Concussion Symptom Scale. This may explain why males seem to experience lower levels of concussion symptoms in that they may simply minimize their symptom report in order to satisfy their extrinsic motivations.

Hypotheses

It has been proposed that males experience less severe concussions than females in that males tend to report fewer symptoms and recover faster after brain trauma. There are many explanations for why this may be, but research has failed to examine the role of both the motivation to accurately and fully complete neuropsychological testing as a method of measuring severity of the concussion, as well as decreased reports of concussion symptoms among males. If patients are highly motivated do their best on the testing, they will be perceived as less affected by their concussion. This can be compared to those who are simply going through the motions and are thus perceived as more affected by their concussion. Also, males may be less likely to report their symptoms of concussions for a variety of reasons, one being that males are often socialized to be masculine (tough, tolerant to pain, and powerful). Given these considerations, in the proposed research, I examined the effects of gender (male, female) and both subject-rated motivation (high subject-rated motivation, low subject-rated motivation) and examiner-rated motivation (high examiner-rated motivation, low examiner-rated motivation) on the number of reported concussion symptom reports. This research addressed three hypotheses.

Hypothesis 1: Main Effect for Motivation

I predict a main effect of motivation on reports of concussion symptoms. Participants who have high motivation will have lower Post Concussion Symptom Scale scores than those who have low motivation. The reason for this relationship may be due to the fact that if someone is more motivated for testing, they will have a greater desire to be regarded as healthy (perhaps in order to have an earlier return to play decision) and thus may be less likely to report their symptoms.

Hypothesis 2: Main Effect for Gender

I predict a main effect of gender on reports of concussion symptoms. Male participants will have lower Post Concussion Symptom Scale scores than females. The reason for this relationship may be due to the fact that men are socialized to be masculine and not show pain and thus may be less likely to report their symptoms. Such a prediction is also consistent with most prior research.

Hypothesis 3: Motivation x Gender Interactions

I predict an interaction between gender and motivation on Post Concussion Symptom Scale scores. I predict that women who have low motivation during testing will have the highest Post Concussion Symptom Scale scores while men who have high motivation during testing will have the lowest Post Concussion Symptom Scale scores.

Method

Participants

120 Pennsylvania State University student athletes who experienced a concussion were examined. Of the 120 participants, 89 were male and 31 were female. The average age of the participants was 18.91 years old.

Materials and Procedure

Male and female collegiate athletes were tested in the Penn State Concussion Lab after experiencing a concussion. The athletes were given an array of tests, and among these tests, I examined their responses on three scales. The first was the Examiner-Rated Motivation Scale (see Appendix A) aimed to measure motivation from the perspective of the person giving the test. After testing was completed, the scale was rated by the examiner in terms of their perception of the participant's effort on testing on a scale of 1 to 7. The second scale, also developed for use in the Penn State Concussion Lab, was the Subject-Rated Motivation Scale (see Appendix B) aimed to measure motivation from the perspective of the participant. After testing was complete, the scale was placed in front of the participant. They were asked to rate themselves in terms of their effort on testing on a scale of 1 to 7.

The third scale completed by the concussed athletes was the Post-Concussion Symptom Scale (see Appendix C), measured the severity of concussion symptoms in comparison to prior to the concussion (Heck & Rosa, 2000). A total of 21 specific common concussion symptoms are listed with one space left for additional symptoms (Heck & Rosa, 2000).

Examiner- and Subject-Rated Motivation Scales. Examiner and subject motivations were determined on a 7-point scale that is used to assess the extent to which the participant is

trying (1 = *not trying at all* and 7 = *trying very hard*). Based on an examination of the distribution scores, participants who scored 6 and below were placed in the “low motivation” group and those scoring 7 were placed in the “high motivation” group.

Post Concussion Symptom Scale (PCSS) ratings. The severity of post-concussion symptoms was determined by means of a 7-point scale that assessed the extent to which the athlete experienced that symptom (0 = *not experiencing at all* and 6 = *a severe problem*). The mean score for the present sample was 9.63. The dependent variable was the total PCSS score.

Results

The number of reported concussion symptoms was submitted to a 2 (men, women) x 2 (high motivation, low motivation) between-subjects Analysis of Variance (ANOVA). The analysis was expected to produce three significant effects. Main effects of motivation and gender on the Post Concussion Symptom Scale were expected. Specifically, participants in the high motivation group were expected to have lower Post-Concussion Symptom Scale scores compared to those in the low motivation group. Regarding the second main effect, males were predicted to have lower Post Concussion Symptom Scale scores compared to females. Finally, it was predicted that motivation and gender would interact to affect Post-Concussion Symptom Scale scores, with high motivation group males expected to have the lowest PCSS scores and low motivation group females expected to have the highest scores.

An outlier was found in the PCSS score data. This outlier was more than five standard deviations away from the mean and was thus removed. The average PCSS score after the removal of the outlier was 9.63.

Hypothesis 1: Main Effect for Motivation

As shown in Table 1, high motivation group subjects on the Subject-Rated Motivation Scale were not significantly different from the low motivation group on the PCSS, $F(1,115) = 0.038, p = 0.845$. In contrast, as shown in Table 1, and consistent with predictions, high motivation group subjects on the Examiner-Rated Motivation Scale scored significantly lower than low motivation group subjects, $F(1,115) = 7.80, p = 0.06$.

Hypothesis 2: Main Effect for Gender

As shown in Table 2, males scored lower ($M = 7.74$, $SD = 1.27$) on the Post-Concussion Symptom Scale than females ($M = 11.66$, $SD = 2.38$), but this effect was not statistically significant, $F(1,115) = 2.11$, $p = 0.15$.

Also shown in Table 2, males on the Examiner-Rated Motivation Scale scored lower ($M = 7.63$, $SD = 1.303$) on the Post-Concussion Symptom Scale than females ($M = 11.278$, $SD = 2.166$). However, this main effect was also not statistically significant, $F(1,115) = 2.08$, $p = 0.15$.

Hypothesis 3: Motivation x Gender Interactions

As shown in Table 3 and Figure 1, and contrary to predictions, the interaction between gender and Subject-Rated Motivation of the athlete on PCSS scores was not statistically significant, $F(1,115) = 1.86$, $p = 0.175$.

Also shown in Table 3 and Figure 2, and consistent with predictions, the interaction between gender and Examiner-Rated Motivation of the athlete on PCSS was statistically significant, $F(1,115) = 4.18$, $p = 0.04$.

Discussion

The purpose of this study was to examine the effects of gender and motivation on reports of concussion symptoms. Reports of concussion symptoms have been proven to vary depending on gender so this research set out to provide a potential explanation. This study looked at differing motivation levels among genders in hopes of explaining this apparent divergence.

The first hypothesis predicted a main effect of motivation on reports of post-concussion symptoms. It was predicted that those who have high motivation scale scores (Subject-Rated Motivation Scale and Examiner-Rated Motivation Scale) would have low Post-Concussion Symptom Scale scores while those who had low motivation scale scores (Subject-Rated Motivation Scale and Examiner-Rated Motivation Scale) would have high Post-Concussion Symptom Scale scores. This finding was not significant in the case of the Subject-Rated Motivation Scale, but was significant in the case of the Examiner-Rated Motivation Scale. Thus, motivation only appears to be related to post-concussion symptom reporting when rated by the examiner.

The second hypothesis predicted a main effect of gender on reports of post-concussion symptoms. It was predicted that males would have lower Post-Concussion Symptom Scale scores than females. When examining the mean PCSS score values, males did report fewer symptoms, but this finding was not statistically significant for either the Subject-Rated Motivation Scale or Examiner-Rated Motivation Scale. Thus, gender was not significantly associated with post-concussion symptom reporting.

The third hypothesis predicted an interaction of motivation on reports of post-concussion symptoms. It was predicted that males who have high motivation scale scores (Subject-Rated Motivation Scale and Examiner-Rated Motivation Scale) would have the lowest Post-Concussion

Symptom Scale scores. It was also predicted that females who have low motivation scale scores (Subject-Rated Motivation Scale and Examiner-Rated Motivation Scale) would have the highest Post-Concussion Symptom Scale scores. This finding was not significant for Subject-Rated Motivation Scale, but was significant for Examiner-Rated Motivation Scale.

The nature of the interaction was such that males and females in the high motivation groups did not differ in PCSS reports and reported low levels of symptoms. In contrast, however, females in the low motivation group reported substantially higher PCSS symptoms compared with low motivation males. As predicted, low motivation females had the highest PCSS reports; however, high motivation male and female groups were low and nearly identical in their symptom report. I had expected that men in the high motivation group would have lower PCSS scores than low motivation group females. In fact, the two groups were nearly identical.

Limitations

One major limitation to this research lies in the small pool of participants. Due to the nature of the research, a large number of subjects requires more time. In the Penn State Sports Concussion Program, athletes are given baseline testing and if they experience a concussion, they are sent back for another round of testing. Since this research focused solely on post-concussion data, the sample size was somewhat reduced. A total of 120 subjects' data were used in this research.

A related limitation to this research is the small pool of female participants. Again, since this data focuses on testing from athletes who experienced a concussion, there is a disproportionate representation of genders. Typically, males participate in more contact sports than females (i.e. football) so more males are sent to the lab after a concussion. This was

especially limiting when examining the main effect of gender on reports of concussion symptoms.

Another limitation to this research is the generality of both the Subject-Rated Motivation Scale and the Examiner-Rated Motivation Scale. Both of these tests are based on a 7-point scale. Thus, obtaining results with great validity is difficult. The Examiner-Rated Motivation Scale provided more significant results than the Subject-Rated Motivation Scale. This could be due to the fact that motivation ratings are more reliable and valid when completed by the examiner than when completed by the subject.

Gender Differences in Sports Played

A potential explanation for the difference between genders on reports of concussion symptoms may have to do with the gender-specific sports played. In a study on male athletes and how their sports seem to function as a precipitator of masculinization, Messner (1990) discussed why men seem to participate in so-called “male sports”. Messner interviewed former (five years retired) middle-aged male athletes of common sports such as football and basketball (Messner, 1990). Four major issues were discussed during each interview: early experiences with sports, athletic career, retirement from athletic career, and life after athletic career (Messner, 1990). A major reason noted by most of the participants for participating in their sport was said to be the role of persuasion and idealization of their fathers. The fathers of these athletes seemed to play a central role in the development and improvement of the men’s athletic abilities. Also important was the role of the brothers, cousins, and even uncles.

Why do fellow men in the athlete’s lives play such an important role in their identification with sports? The reasons are plentiful, but some of the most critical reasons are that these men are role models so their advice weighs heavily on the athletes (Messner, 1990). Also,

if these influences are formally or presently athletes themselves, they provide a sort of competition so the athlete has specific goals to work toward defeating.

These men socialize the young athlete to follow certain behaviors and norms. The athletes are taught that this is their gift or specialty, and any straying from this would be wasteful and ungrateful. The author explained, “First experiences in sports might often come through relationships with brothers or older male relatives, and the early emotional salience of sports was often directly related to a boy’s relationship with his father” (Messner, 1990).

If men are being influenced to participate in “male sports,” such as football and hockey, which are commonly deemed as more aggressive and involve more contact than many other sports, it may be surprising to find post-concussion data showing that females have more concussions than men. This divergence could be attributed to females simply reporting more symptoms than men, not actually experiencing more concussions, but why is this?

Perhaps such a phenomenon is a result of the lowered prevalence of female athletes in comparison to male athletes in contact sports, where concussions are most common. The best example of this is in the difference between male and female lacrosse rules. In men’s lacrosse, the rules allow for greater physical contact and aggression, while for women, the game is played with very little contact and therefore requires less equipment and protection. It is in sports like these that women are socialized to believe that they are in some way less tough than men.

For females, being deviant and playing aggressive contact sports goes against the social norm that deems these sports as only suitable for males. So whether women believe in this or not, they are cognizant of the fact that many believe women to be less capable of playing contact sports. Therefore, when these women experience a concussion, they may feel it is more

necessary to seek help. Essentially, some women may subconsciously believe that they are less tough and therefore when society proves them wrong, they are quick to ask for help.

Men, on the other hand, are expected to play these sports. When they experience a concussion, it is more normative and less unique. They have been socialized to believe they are tough and can handle the contact. So when men experience concussions, they do not believe they actually need help. Such speculation can serve as a basis for future research.

Gender Differences in Receiving Treatment

It could be the case that men are encouraged to return to the game quicker than females and therefore are able to have expedited medical attention. For example, The Pennsylvania State University football players may be more likely to receive help from the athletic trainers and doctors than the Pennsylvania State University women's soccer team because of the fact that they may be perceived as more valuable to the school. The athletes of popular men's sports are more likely to receive quicker, more thorough medical help than athletes of less popular women's sports.

The greater prevalence of women's reports of concussions may simply be because they do not acquire the right treatment in the same speed that men do. If women are neglected in comparison to men, then they may experience more of the post-concussion symptoms that go along with not being treated. and thus will be labeled as having a more severe concussion

Gender Differences in Brain Structure

It is also possible that women report more symptoms of concussions because they experience more concussions. Consistent with this possibility, research suggests that women have smaller, weaker necks than men (Tierney, Sitler, Swanik, Swanik, Higgins, & Torg 2005). Tierney and colleagues examined the differences between twenty males and twenty females in

their head-neck stiffness and strength after exposure to force. They found that “females exhibited significantly greater head-neck segment peak angular acceleration and displacement” (Tierney et al., 2005, p. 272). This just means that their head moves further and in a more aberrant way due to reduced neck strength. Therefore, when experiencing a concussion, the neck in females is not able to stabilize the head as efficiently, possibly leading to more severe and more frequent brain injuries than in men.

If women are less able to control their necks and head during a brain collision, then they are obviously more likely to experience concussions. In turn, they are more likely to report symptoms of concussion. Therefore, the mediator of this divergence may simply be a result of gender differences in brain and neck physiology.

In research on the rate of concussion in collegiate athletes, weekly injury journals kept by athletic trainers for collegiate sports were examined to explore injury rate differences between genders. The authors noted that female athletes experience more concussions (9.5%) than men (6.4%) during games (Covassin, Swanik, & Sach, 2003). Conversely, men experience more concussions (5.2%) than women (3.6%) during practices (Covassin et al. 2003).

Our data collection focuses on concussions during both games and practices, but a potentially interesting area for further research could be specifying and delineating the difference in concussions based on where the head injury occurred.

Gender Differences in Pain Threshold

Another possible explanation for the greater prevalence of reported symptoms for women when compared to men may lie in the fact that women have a lower tolerance for pain and are therefore more aware of the symptoms. Research has shown that when exposed to a pain

stimulus, females more frequently report being uncomfortable (Ellermeier & Westphal, 1994). This suggests that women may in fact be more susceptible to experiencing pain.

An experiment by Ellermeier and Westphal (1994) was conducted by examining pupil dilations, an indicator of pain experience. What they found was that at high levels of pain, women's pupils dilated more than men. Conversely, though, these investigators noticed that at lower levels of pain, there were no gender differences.

This finding shifts the focus of the cause of gender differences in their reporting of concussion symptoms. What was once believed to be a result of socialization now becomes a result of biology. While men and women may be socialized to play different types of sports and to fill different social roles, there may also be a biological component underlying differences found. Men may simply have, biologically, a greater resistance and tolerance for pain, therefore making them less likely to report symptoms of their concussion. With that said, reactions to pain could also be mediated by early socialization experiences.

Looking at reports of concussion symptoms in terms of the interactions between gender and any of the above noted variables (sports played, brain structure, and pain threshold) may be provide a more complete picture of the confounds that may affect symptom reports.

Future Studies

Future studies could work to decrease the limitations presented in this research. Simply by waiting longer to re-examine the same predictions, there will be a greater sample size with a greater representation of females and thus may provide more significant results. Also, a more detailed motivation scale could be developed that has a greater point scale. A motivation scale could also be developed that looks more specifically into types of motivation and how different influencing motivations could affect reports of concussion symptoms.

Concluding Comments

The rapidly growing prevalence of concussions in society is grounds enough for increased research. Concussions can cause impairments in many brain functions such as sensory, cognitive, and emotional functions. In addition, these effects are intensified when multiple concussions have occurred. For Division I collegiate athletes, it is more common to have experienced multiple concussions than just one, especially for high contact sports. Motivation plays a major role in affecting whether or not a participant is willing to report symptoms of a concussion, which ultimately could lead to falsified reports. Ultimately, not being honest puts the athletes at serious medical risk because they can cause greater harm to themselves in the future. It is important to research how gender interacts with motivation to affect reports of concussion symptoms so that these false lowered reports can be identified and countered. This way, athletes who are in high danger remain off the field and out of harm's way.

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Table 1

Results for Main Effect of Motivation on Post-Concussion Symptom Scale Score

| | Motivation Level | Average PCSS score (<i>M</i>) | Standard Deviation (<i>SD</i>) | F Value | Significance (<i>p</i>) |
|-----------------------|-------------------------|--------------------------------------|---------------------------------------|----------------|--------------------------------|
| Subject-Rated | Low Motivation | 9.44 | 2.16 | 0.038 | 0.845 |
| | High Motivation | 9.96 | 1.61 | | |
| Examiner-Rated | Low Motivation | 12.98 | 1.57 | 7.80 | 0.006 |
| | High Motivation | 5.93 | 1.99 | | |

Table 2

Results for Main Effect of Gender on Post-Concussion Symptom Scale Score

| | Gender | Average PCSS score (<i>M</i>) | Standard Deviation (<i>SD</i>) | F Value | Significance (<i>p</i>) |
|-----------------------|---------------|--------------------------------------|---------------------------------------|----------------|--------------------------------|
| Subject-Rated | Male | 7.74 | 1.27 | 2.11 | 0.15 |
| | Female | 11.66 | 2.38 | | |
| Examiner-Rated | Male | 7.63 | 1.30 | 2.08 | 0.15 |
| | Female | 11.28 | 2.17 | | |

Table 3

Results for Interaction of Motivation and Gender on Post-Concussion Symptom Scale Score

| | Motivation | Gender | Average PCSS score (M) | Standard Deviation (SD) | F Value | Significance (p) |
|-----------------------|-------------------|---------------|-------------------------------|--------------------------------|----------------|-------------------------|
| Subject-Rated | Low Motivation | Male | 9.32 | 1.69 | 1.393 | 0.24 |
| | | Female | 9.56 | 3.97 | | |
| | High Motivation | Male | 6.17 | 1.91 | | |
| | | Female | 13.76 | 2.60 | | |
| Examiner-Rated | Low Motivation | Male | 8.57 | 1.51 | 4.17 | 0.04 |
| | | Female | 17.39 | 2.74 | | |
| | High Motivation | Male | 6.68 | 2.12 | | |
| | | Female | 5.17 | 3.36 | | |

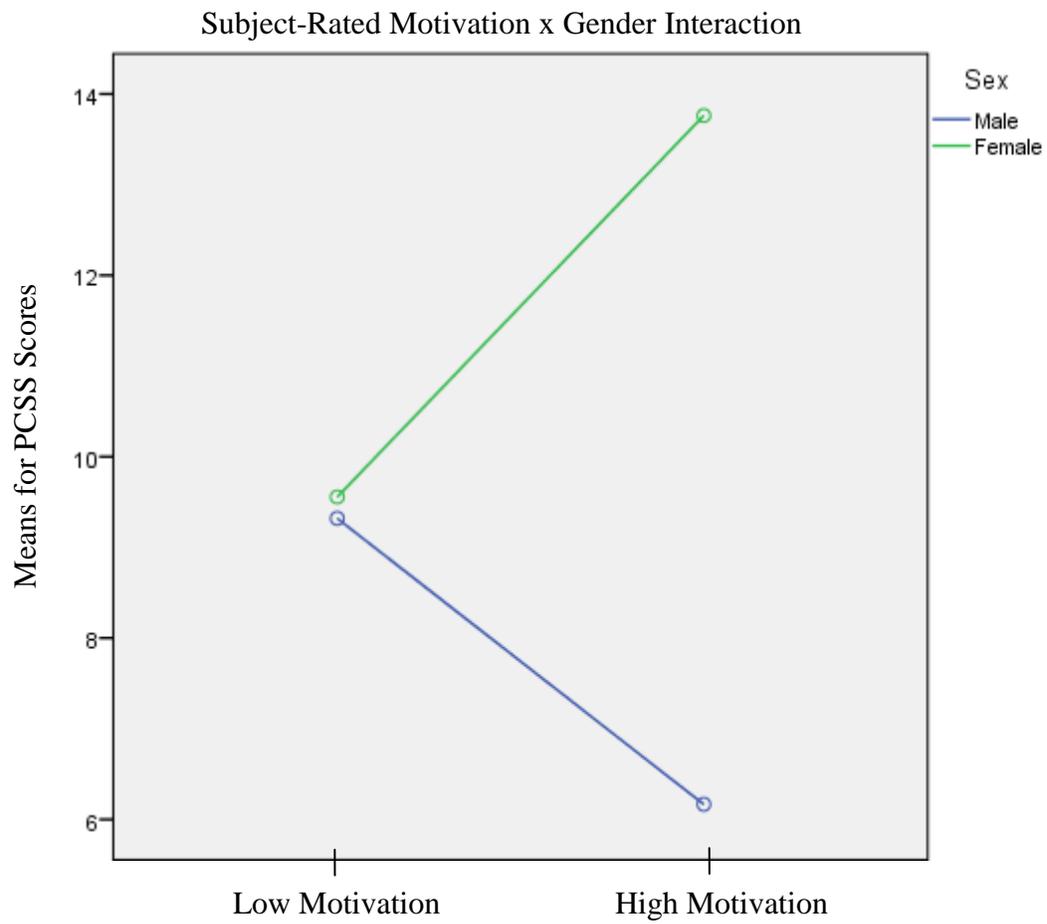


Figure 1. Means for Reports of Concussion Symptoms Based on Subject Motivation Rating. No significant interaction was found between subject-rated motivation and gender.

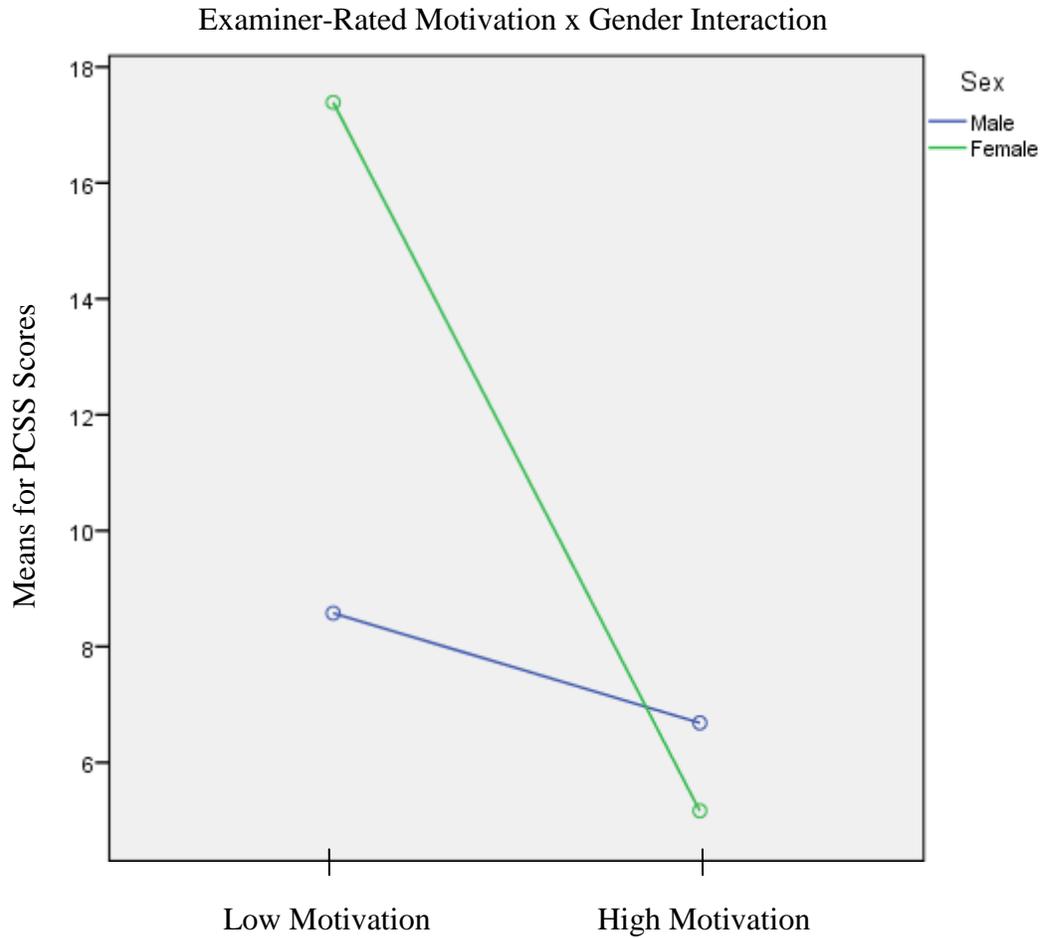


Figure 2. Means for Reports of Concussion Symptoms Based on Examiner Motivation Rating.

A significant interaction was found between examiner-rated motivation and gender.

Appendix A

Subject-Rated Motivation Scale

Scale Description

This scale assesses people's motivation on the psychological testing from the perspective of the subject. The subject assigns a personal score between 1 and 7. A score between 1 and 6 is considered low motivation, while a score of 7 is considered high motivation.

Subject Rating

If 1 is not trying at all and 7 is trying as hard as you can, how hard would you say you were trying on the tests today? Just circle the number that best describes your effort.

1**2****3****4****5****6****7****Not
trying
at all****Trying as
hard as you
can**

Appendix B

Examiner-Rated Motivation Scale

Scale Description

This scale assesses people's motivation on the psychological testing from the perspective of the examiner. The examiner assigns a score between 1 and 7. A score between 1 and 6 is considered low motivation, while a score of 7 is considered high motivation.

Examiner Rating

If 1 is not trying at all and 7 is trying as hard as he or she could, how hard would you say the subject was trying on the tests today? Just circle the number that best describes his or her effort.

1**2****3****4****5****6****7****Not
trying
at all****Trying as
hard as you
can**

Appendix C

Post-Concussion Symptom Scale

Scale Description

This scale is completed by the subject and aims to assess the level of severity of the concussion. The subject is asked to rate the presence of each symptom.

POST-CONCUSSION SYMPTOMS SCALE

| | Rating | | | | | |
|--------------------------------|------------------|----------|----------|----------|----------|----------------------|
| | None 0 | 1 | 2 | 3 | 4 | Severe 5 6 |
| SYMPTOMS | RATING | | | | | |
| Dizziness | | | | | | |
| Headache | | | | | | |
| Nausea | | | | | | |
| Vomiting | | | | | | |
| Balance problems | | | | | | |
| Trouble falling asleep | | | | | | |
| Sleeping more than usual | | | | | | |
| Drowsiness | | | | | | |
| Low energy | | | | | | |
| Sensitivity to light | | | | | | |
| Sensitivity to noise | | | | | | |
| More emotional than usual | | | | | | |
| Irritability | | | | | | |
| Sadness | | | | | | |
| Nervous/anxious | | | | | | |
| Numbness or tingling | | | | | | |
| Feeling slowed down | | | | | | |
| Feeling as though "in a fog" | | | | | | |
| Feeling "pressure" in the head | | | | | | |
| Difficulty concentrating | | | | | | |
| Difficulty remembering | | | | | | |
| Other | | | | | | |
| TOTAL SCORE | | | | | | |

GENDER AND MOTIVATION IN CONCUSSION SYMPTOMS

Appendix D

Academic Vita

Ariel Slavin

Ats5108@psu.edu

Ariels5108@gmail.com

Univesrity Address: 812 West College Avenue, State College, PA 16801

Permanent Address: 1068 Rock Creek Road, Bryn Mawr, PA 19010

Cell Phone Number: (484) 574 – 6037

Education

The Pennsylvania State University, State College, PA

Bachelor of Science in Psychology

Neuroscience Option

Expected Graduation Date: May 2012

Schreyer Honors College

Thesis: “Gender and Motivation in Concussion Symptoms”

Thesis Adviser: Dr. Peter Arnett

Honors Adviser: Dr. Kenneth Levy

Related Experience

Penn State Sports Concussion Neuropsychology Program

Research Assistant

August 2010 – Present

- ❖ Conduct full psychological tests on participants.
- ❖ Analyze psychological tests.
- ❖ Code all data using SPSS.

Global Medical Brigades

Executive Position and Active Member

August 2009 – June 2011

- ❖ Raise funds to buy medication and travel to Honduras.
- ❖ Provide medical aid to rural communities.
- ❖ Lead the organization and the planning of bi-annual trips.

Student Red Cross Club

Active Member

August 2010 – August 2011

- ❖ Help organize and run blood drives throughout campus.
- ❖ Participate in relief efforts and fundraisers.

GENDER AND MOTIVATION IN CONCUSSION SYMPTOMS

Delaware County Memorial Hospital Volunteer Program

Surgical Center Volunteer

May 2010 – August 2010

- ❖ Comfort and care for patients after surgery.
- ❖ Assist nurses with daily duties.

Work Experience

Duffy's Tavern

Waitress

January 2012 – Present

- ❖ Greet customers, take orders, run food, and bus tables.
- ❖ Maintain a professional, welcoming attitude.

Posh Ltd.

Sales Representative and Merchandise Buyer

December 2006 - Present

- ❖ Buy and sell fine jewelry for the company.
- ❖ Interact with and tend to customers.

Susanna Foo Gourmet Kitchen

Hostess and Waitress

May 2011 – Present

- ❖ Answer phone to take take-out orders, answer questions, etc.
- ❖ Complete office work including changing menus and editing documents.
- ❖ Work with other staff to make the restaurant more efficient.

Nittany Notes

Note-taker

January 2009 – May 2011

- ❖ Took detailed notes for Biology 110, Psychology 260, and Biobehavioral Health 101.
- ❖ Created practice quizzes based off material presented in class.

Honors

Dean's List

All semesters

Excellence letter in Chemistry 111

Fall 2008