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Immunological effects of written disclosure in athletes

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Running Head: WRITTEN DISCLOSURE IN ATHLETES

The Immunological Effects of Written Disclosure in Athletes

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Abstract

Many studies have demonstrated the health benefits of written disclosure of traumatic or stressful events. These benefits include improved psychological well-being, fewer health clinic visits, shorter hospital stays after surgery, and increased immune function. In athletes, high immune function is necessary to ward off illness during training and competition, but much research has shown that athletes tend to have lowered immune function. Therefore, writing about traumatic events may be a way for athletes to remain healthy during their seasons. To test this hypothesis, 21 varsity athletes and 15 individuals who exercised less than three hours per week participated in the current study. Saliva samples and reported psychological and physical health measures were taken before participants wrote in an online journal on four consecutive days. Saliva samples were taken again both one and three weeks after baseline, and reported health was measured again three weeks after baseline. It was expected that for those who wrote about traumatic events, both reported health and the secretory IgA content of the saliva would increase. The data showed that those who wrote about traumatic events experienced a decrease in negative affect, but not an increase in physical well-being. The immune data was not usable.

Introduction

Since the time of Freud, it has been a commonly-held belief that expressing negative feelings such as anger or sadness is better than holding them in. Much empirical research has been done to determine whether or not this belief is true. As part of this research, the effects of written disclosure of traumatic events on health-related outcomes have been widely studied. Although the observed effects have varied, the majority of research indicates that written disclosure has beneficial effects. Benefits have been found in many areas, including improved psychological well-being in areas such as negative affect, positive affect, and anxiety (Smyth, 1998), decreased number of health clinic visits (Gidron et al., 2002; Richards et al., 2000), and missing fewer days at work (Francis & Pennebaker, 1992). Klein and Boals (2001) observed that participants showed increased working memory capacity after a written disclosure task, and Solano and colleagues (2003) found that those who had written about traumatic events stayed in the hospital for a shorter length of time after surgery.

Much research has also shown the direct benefits of written disclosure to the immune system (e.g. Smyth et al., 1999; Esterling et al., 1994; Petrie et al., 1998). In a classic study, Pennebaker and associates (1988) had undergraduates write for 20 minutes about either traumatic events or neutral topics on four consecutive days. Blood was drawn the day prior to the writing days, the fourth writing day, and six weeks after writing. Lymphocytes were separated from the blood and assayed to determine their proliferation response to the mitogens phytohemagglutinin (PHA) and concanavalin A (ConA) as a measure of immune function. The researchers found that the lymphocytes of those in the traumatic events condition proliferated more in response to the mitogens than those of the control participants, indicating increased immune function among the

individuals who wrote about traumatic events. This suggests that keeping a journal in which one writes about traumatic or stressful events may actually help one's body ward off illnesses.

Other researchers have also found that written disclosure improves one's immune function. For example, Petrie and colleagues demonstrated that written disclosure increases the number of circulating CD4 lymphocytes in both healthy participants and HIV patients (1998; 2004). They also determined that those who wrote about traumatic events had more antibodies than controls after four and six months in response to a hepatitis B vaccine (1995). Similarly, other research has shown that people with Epstein-Barr virus had improved immune control over the virus after completing a written disclosure task (Esterling et al., 1994). People with the autoimmune diseases rheumatoid arthritis and asthma also showed a reduction of symptoms after writing about stressful events (Smyth et al., 1999). However, Harris and colleagues (2005) reported that symptoms of asthma were not affected by written disclosure. Participants in the Smyth and colleagues study wrote on three consecutive days, whereas those in the Harris and coworkers study wrote once per week for three weeks, which may account for the differing results.

Some researchers have also found that written disclosure confers no health benefits in some populations. For example, Reynolds and associates (2000) found that writing about emotional events had little effect on depression, anxiety and physical symptoms in school children. Ames and colleagues (2005) also observed that expressive writing did not aid young adults to quit cigarette smoking. No reduction in suicidal thoughts beyond controls was seen by Kovac and Range (2002) in suicidal undergraduates. Clearly, more research is needed to determine exactly which populations of people show health benefits after writing about traumatic experiences and which writing procedures confer the optimal benefits.

In athletes, high immune function is necessary to ward off illness during training and competition. Athletes who have common colds can only perform mild exercise and must wait to resume normal training for a few days after their symptoms reside. However, if athletes have a more serious disease, they must wait 2-4 weeks before resuming training (Nieman, 1996). Current methods that athletes use to stay healthy include eating a balanced diet, minimizing life stress, avoiding overtraining, spacing out workouts and competitions, losing weight slowly, and avoiding others who are sick (Nieman, 1996). Written disclosure may be another way for athletes to lower their risk of becoming ill.

In addition, many studies suggest that athletes undergoing intense training have lowered immunity. For example, Brenner and colleagues (1994) found that athletes were more vulnerable to viral infections that controls. Nieman and coworkers (1989) also demonstrated that those who had recently run a marathon had more respiratory infections than controls. These results indicate that athletes are more vulnerable than non-athletes to the very illnesses they need to avoid in order to compete at their best.

The relationship between IgA levels and exercise has also been examined. MacKinnon and colleagues (1990) determined that athletes have normal serum IgA levels. However, they also found that secretory IgA levels were decreased in top swimmers (1987), in elite cyclists after intense cycling (MacKinnon & Hooper, 1994), and in non-athletes after endurance exercise (MacKinnon & Jenkins, 1993). Tharp and colleagues (1990) also found decreased levels of secretory IgA after swimming, and Tomasi and associates (1982) showed that secretory IgA levels were lowered in nordic skiers immediately following a race. Thus, it appears that many types of athletes have decreased IgA levels, which may contribute to their vulnerability to illness.

Most of the previous studies on written disclosure have either had the participants write diaries or come into the lab in order to perform the written disclosure task. This is done to increase the ecological validity of the sample of participants. The current study, however, is the first to evaluate the use of Live Journal, a popular online journaling website, in written disclosure tasks. Although many people use Live Journal to keep in contact with others, accounts were made confidential for this study. Live Journal accounts were chosen over normal diaries to make journal submission easier for the participants and because journaling online is more popular among college students than on-paper journaling. Also, the experimenter was able to monitor the participant's entries and make sure the participant is writing each day. If the participant was not writing properly, the experimenter was able to send an email to the participant reminding him or her to write. Sheese and colleagues (2004) found that the email submission of written disclosure entries resulted in the normal written disclosure effect.

The current study examined the effects of written disclosure of traumatic experiences on the secretory IgA levels of athletes and non-athletes. It contributes to the growing literature on written disclosure by (1) determining whether or not athletes are affected by written disclosure, and (2) determining the effectiveness of using confidential weblogs as a means of entry submission. It was expected that those who wrote about traumatic events would have increased levels of secretory IgA over baseline, and those who wrote about mundane events would maintain the same level of secretory IgA over baseline. It was also expected the same pattern for reported physical and psychological health, suggesting that these differences translated into actual health outcomes.

Method

Participants

Thirty-six undergraduates were recruited from the Psychology Subject Pool and Colby varsity athletic teams. Twenty-one were athletes on Colby varsity sports teams ("athletes") and fifteen were individuals who exercise fewer than three hours per week ("non-athletes"). The athletes played on at least one of the following sports teams: squash, field hockey, cross country, indoor/outdoor track and field, volleyball, ice hockey, swimming, diving, crew, nordic skiing, soccer, or softball. The exercise measures (see below) were analyzed to determine any differences between the two groups. A one-factor ANOVA revealed that in comparison to non-athletes, the athletes reported spending significantly more time doing active things, $F(1, 34) = 29.79$, $p < 0.05$, spending significantly less time doing inactive things, $F(1, 34) = 9.29$, $p < 0.05$, and exercising significantly more hours per week, $F(1, 32) = 8.94$, $p < 0.05$ (see Table 1). However, the athletes and non-athletes did not vary significantly in other factors such as the number of hours slept per week. The athletes and non-athletes were randomized into the experimental ("trauma") and control ("control") groups. The trauma condition had twelve athletes and eight non-athletes, and the control condition had nine athletes and seven non-athletes. These four groups did not differ significantly in age, class year, grade point average, family socioeconomic status, sex or race (see Table 2).

Measures

Measures of exercise were taken as a manipulation check to make sure that the athletes did in fact exercise more often and more intensely than the non-athletes. Psychological and physical health measures were taken and used as dependent variables in addition to secretory IgA levels. This showed to what extent variations in secretory IgA levels translated into actual health outcomes. Finally, several other questionnaires were used to make sure that participants did not

vary in levels of social support or stress levels, which could have affected the outcome of the study.

Exercise Measures. Two measures of exercise were used. One, adapted from Pate and colleagues (2003), asked participants to estimate the number of hours they spent doing various activities, both related to exercise and not. Example items are sleeping, homework, jogging and tennis.

The other measure of exercise, which was created for this study, asked participants to record what type of exercise and the length of time spent exercising for each of the days in the previous week. For example, a participant might write "Tuesday: 3 mile jog, ½ hour."

Health Measures. Three measures of health were used as additional dependent variables. The MOS Short-form General Health Survey (Stewart et al., 1988) asked participants to subjectively rate their health and also give information on more specific aspects of health. For example, they were asked "Does your health keep you from working at a job, doing work around the house/dorm or going to school?"

The Physical/Psychophysical Symptoms Measure (Sherbourne et al., 1992) asked participants to record how often they had felt various symptoms in the previous four weeks. For example, one symptom is nausea or upset stomach.

Finally, participants were asked to state how many times in the past month they had visited the health center. They were also asked to report the number of times they had missed class due to illness in the past month.

Positive and Negative Affect Schedule (PANAS). Both trait and state PANAS were used as a measure of emotion (Watson et al., 1988). Trait PANAS had participants rate on a 1-5 scale to what extent they generally feel nervous, excited, guilty, etc. State PANAS had the same items,

but asked participants to rate how they had been feeling in the previous week. The internal consistency of this data was high for both negative affect felt in general ($\alpha = 0.79$) and negative affect experienced in the past week ($\alpha = 0.87$ before and $\alpha = 0.66$ after the writing task). The internal consistency of the positive affect data was also high, both as felt in general ($\alpha = 0.83$) and as felt in the past week ($\alpha = 0.85$ before and $\alpha = 0.87$ after the writing task).

Social Readjustment Rating Questionnaire (SRRQ). This measure, adapted from Holmes and colleagues (1967), recorded whether or not different stressful life events had occurred to the participant in the previous month. Example items include death of a family member, outstanding personal achievement, and exams. Each item was given a numerical value, with more stressful events receiving higher numbers, and the sum of the values was recorded for each participant.

Social Support Questionnaire. This measure (Sarason et al., 1983) assessed a participant's social support in family and friends. Participants were asked to rate on a 1-7 scale how much they agree or disagree with statements such as "I get the emotional help and support I need from my family."

Perceived Stress. This measure (Cohen et al., 1983) asked participants to rate on a 1-5 scale how often they had had certain feelings. For example participants were asked "In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?" The perceived stress data had high internal consistency both before the writing task ($\alpha = 0.80$) and after ($\alpha = 0.84$).

Writing Task

Participants were instructed to write in their Live Journal accounts for 20 minutes on each of four consecutive days. The trauma group was instructed as follows:

> During each of the four writing days, I want you to write about the most traumatic and upsetting experiences of your entire life. You can write on different topics

> each day or on the same topic for all four days. The important thing is that you write about your deepest thoughts and feelings. Ideally, whatever you write about should deal with an event or experience that you have not talked with others about in detail.

The control group was instructed as follows:

> During each of the four writing days, I want you to write about the activities you have done or will do on that day. You can write about one specific event or several events. The important thing is that you do not write about your thoughts or feelings about the event(s). Ideally, whatever you write should be completely objective.

Procedure

After giving informed consent, participants received participant numbers and access to a Live Journal account corresponding to the participant number. They were instructed in the use of their account, including how to change their password and how to post to their account. The settings of these accounts were adjusted so that only the participant and the experimenter were able to read the participants' entries. They were also given their writing instructions and told not to share them with anyone. Five mL saliva samples were then collected in test tubes. Wrigley's Doublemint gum was used to stimulate salivation to aid in the collection of the saliva samples.

Over the course of the four writing days, the posts of the participants were monitored. If a participant was not writing according to instructions, an email was sent to the participant with more instructions on how to write. For example, if a participant wrote very short posts, an email was sent asking him or her to write more. Identifying information was removed and the posts were copied to Microsoft Word documents for later analysis.

Participants returned to the lab within five days of completing the writing task, and saliva samples (5 mL) were collected again. Two weeks following this appointment, the participants again returned to the lab to give a final saliva sample (5 mL) and fill out the remaining

questionnaires. After this, they were debriefed about the purposes of the experiment and asked to delete their online journals to further maintain confidentiality.

Data Processing

Writing Samples. The participants' journal entries were analyzed using the Linguistic Inquiry and Word Count (LIWC) text analysis software (Francis & Pennebaker, 1993). The entries were prepared by correcting spelling and removing unusual contractions and abbreviations. The Microsoft Word files were converted to text files and the computer program was run to determine such factors as word count and the number of emotional words in each of the samples.

A two-factor ANOVA revealed, interestingly, that there was no main effect of condition, and no interaction between condition and exercise category in negative or positive emotion words. However, there was a main effect of exercise category, with athletes using more emotion words overall, especially negative emotion words, $F(1, 31) = 72.76$, $p < 0.05$. In addition, word count was significantly higher for athletes than non-athletes, $F(1, 31) = 6.98$, $p < 0.05$. It may be the case that athletes are accustomed to sharing their feelings with their teammates, so they were more readily able to write about their emotions in the journal. This may be true even though athletes and non-athletes do not differ in their levels of social support.

However, an informal evaluation of the journal entries indicated that the participants did follow the instructions, with those in the trauma group making more references to traumatic events than those in the control group. This is supported by the fact that those in the trauma condition wrote significantly more about events in the past those in the control condition, $F(1, 31) = 4.09$, one-tailed $p < 0.05$, whereas those in the control condition wrote marginally more about events in the present than those in the trauma condition, $F(1, 31) = 2.32$, one-tailed $p =$

0.07. However, for an unknown reason, the non-athletes did not use as many negative emotion words as the athletes. Therefore, throughout the main analyses, the number of negative emotion words was controlled for.

Immune Assays. To determine the levels of secretory IgA in each saliva sample, assays were performed according to the protocols of the secretory IgA enzyme-linked immunosorbant assay (ELISA) kits (Alpco, Inc.). Three such kits were used. In short, the samples were frozen at -20º Celsius until they could be analyzed as a group. Samples were then diluted 1:2000 in wash buffer solution. The plates were washed with wash buffer and loaded with standards and samples. The plates were then incubated for one hour at room temperature on a horizontal mixer. The wells were emptied and washed with wash buffer. The conjugate (mouse anti-sIgA) was added, followed by another one-hour incubation at room temperature on the horizontal mixer. The wells were again emptied and washed with wash buffer. The tetramethylbenzidine substrate was added and incubated for 7.5 minutes at room temperature on the horizontal mixer. The stop solution was added, and the absorption was read with a plate reader at 450 nm.

Data Analysis

Data for psychological well-being, physical well-being and immune function were analyzed separately. For psychological well-being, the questionnaire data were used to determine any differences between the groups before and after the writing task in positive affect, negative affect, stressful life events, perceived stress, and social support. The questionnaire data were also used for physical well-being to uncover any differences between the groups before and after the writing task in general health, reported illness, number of health center visits, and number of classes missed due to illness. Finally, for immune function, the participants' saliva sample data

were analyzed to determine any differences between the groups before and after the writing task in secretory IgA levels.

Results

Psychological Well-Being

To determine any changes in the participants' psychological well-being after the writing task, the data from the questionnaires were examined. Positive and negative affect were determined from the state and trait PANAS, stressful live events from the SRRQ, and levels of perceived stress from the perceived stress questionnaire.

Affect. A two-factor ANCOVA revealed a main effect of condition in negative affect, $F(1, 28) = 4.94$, $p < 0.05$ (see Figure 1), with those in the trauma condition reporting less negative affect than controls. There was no main effect of exercise category, nor an interaction between the two. This analysis controlled for trait negative affect and negative affect reported at the beginning of the study. Controlling for levels of social support did not affect this result.

No main effects or interactions in positive affect were found using a two-factor ANOVA. These analyses indicate that while writing about traumatic or stressful events does not increase the amount of positive emotions felt, it does decrease the amount of negative emotions one feels.

Stress. A two-factor ANOVA showed a main effect of exercise category in stressful life events ($F(1, 31) = 7.45$, $p < 0.05$). Athletes reported fewer stressful life events than non-athletes. There was no main effect of condition or interaction. However, there were no main effects, nor was there an interaction in perceived stress found by a two-factor ANOVA. This suggests that while athletes may not have as many stressful events in their lives, both athletes and non-athletes feel the same level of stress. The absence of a main effect of condition or interaction for either

stressful life events or perceived stress indicates that writing about traumatic events does not have an effect on perceived or actual stress levels for athletes or non-athletes.

Physical Well-Being

To find any changes in the participants' reported physical well-being due to the writing task, the questionnaire data were analyzed. General health and current illness were determined from questions on the General Health Survey, and the numbers of health center visits and classes missed due to illness were reported specifically by the participants.

A chi-square analysis revealed no significant differences in changes to general health between the conditions. Similarly, there were no significant differences between the groups in current levels of illness. Categorical analyses were used because there was little variation in the data from before and after the writing task.

The change in number of health center visits also did not differ significantly between the groups as revealed by a chi-square analysis. Likewise, there were no significant differences in number of classes missed due to illness between the groups. Again, categorical analyses were used because of the small levels of variation between the reports before and after the writing task.

Immune Function

To determine the level of secretory IgA in each participant's saliva samples, the data from the ELISA assays were analyzed. However, the calibration curves returned for each plate were not usable, so it was not possible to extract the secretory IgA levels.

Discussion

Previous research has demonstrated a link between written disclosure of traumatic or stressful events and improved psychological well-being, enhanced physical well-being, and

heightened immune function. The present study attempted to add to that body of research by determining whether or not the beneficial effects of written disclosure also occur for athletes.

Psychological Well-Being

The analysis of positive affect indicates that for both athletes and non-athletes, writing about traumatic or stressful events does not alter the amount of positive emotions one feels. However, the analysis of negative affect suggests that this written disclosure does decrease the amount of negative emotions one feels in both athletes and non-athletes. This result is particularly striking because those in the trauma condition were writing about negative events.

The analysis of stressful life events indicates that athletes have fewer stressful life events than non-athletes. There is no obvious reason why this would be true, and it may be merely a characteristic of the sample in the current study. In spite of this difference between athletes and non-athletes in stressful life events, there was no difference between them in perceived stress, suggesting that both groups feel the same amount of stress. This may be because each person becomes accustomed to his or her own level of stress, and any deviation from this normal level would result in the perception of high or low stress.

The analyses of stressful life events and perceived stress also revealed no main effect of writing condition. This implies that writing about traumatic events does not affect actual or perceived stress levels. However, this may actually indicate a therapeutic effect of written disclosure because the remembering and writing of traumatic events is likely to be stressful. Thus, if stress levels are unaffected, the writing may actually be having a beneficial effect.

Physical Well-Being

The analyses of changes in measures of physical well-being, including general health, current illness, number of health center visits, and number of classes missed due to illness,

revealed no significant differences between the conditions. This may suggest that the written disclosure effect shown in previous research does not hold for athletes. However, because the control group also did not show these health effects, other factors may be playing a role.

Immune Function

There could be many reasons for the lack of usable results from the secretory IgA ELISA. For example, two of the plates were purchased several months before the assays were run. Although none of their contents were expired, the delay may have affected the results. Additionally, the protocol requires the plates to be incubated for 5-15 minutes after the substrate is added. I incubated them for 7.5 minutes, which may have been too short or too long.

Although no usable data was collected on the immune function of the participants, some extrapolations can be made. The lack of significant differences between conditions in reported physical well-being suggests that health was not have been affected by writing about traumatic or stressful events. This may further indicate that immune function was also not affected, which would have been demonstrated by no change in secretory IgA levels throughout the study. However, it is possible that secretory IgA levels did increase from baseline, and this increase in immune function had not yet been transferred into health outcomes.

Limitations

One limitation of the present study was the small sample size. Only 36 participants were used, and one cell had as few as 7 participants in it. A larger sample size was not feasible in this study due to time constraints, but future studies may want to incorporate more participants. If the results of this study are replicated, one could be confident that the non-significant findings are not due to the small sample size.

Another limitation of the current study is that because there are few well-known scales for measuring physical health, many of the items used to determine physical well-being were single questions. These may not have been specific enough to detect subtle changes in health. The sample used was also healthy as a whole, meaning that changes in health were often quite small. This small variation required the use of conservative chi-square tests for analysis. In addition, numbers of health center visits and missed classes may not accurately represent the participants' health because students are unlikely to visit the health center or miss class unless they are seriously ill. Future researchers may need to devise a new way of measuring reported physical well-being that better records participants' health.

A final limitation of the present study is that due to time constraints only three weeks elapsed between the participants' first and last visits to the lab. In contrast, the final lab visit of participants in the study by Pennebaker and colleagues (1988) was six weeks after their first visit. It is possible that the lack of significant findings in reported health was due to this short time frame because the effects of the written disclosure task had not yet been realized. Significant increases in the secretory IgA levels of participants would have supported this conclusion. Future studies should lengthen the time between lab visits to determine if the results of this study are due to the short time frame.

Conclusions

The current study demonstrated that written disclosure of traumatic events has beneficial effects on one's psychological well-being, specifically by decreasing the amount of negative affect one experiences. This implies that keeping a journal may be a way for athletes to maintain their emotional health over the course of their competitive seasons. The study also suggested that there were no beneficial effects of written disclosure of traumatic events on physical well-being.

However, the immune system effects are still yet to be determined. These results may indicate that the health benefits of written disclosure found in other groups do not hold for athletes, and thus writing about their stressful experiences may not be a way for them to maintain their physical health during training and competitions. It may also be the case that the use of an online journal is not an effective way for one to receive the health benefits of written disclosure. The form may be too impersonal for the health benefits to occur, or one may not tend to write about issues that are as emotional as if writing on paper. This seems unlikely, however, because the email submission of journal entries was successful in bringing about the written disclosure effect (Sheese et al., 2004). It appears that for athletes, written disclosure of traumatic or stressful events is a tool that can be used to improve psychological well-being, but not physical well-being.

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Table 1

Hours per Week Spent Doing Various Activities

	Active Things		Inactive Things		Exercise		Sleep	
Group	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Athletes	21.19	8.27	50.70	20.16	13.05	14.70	44.86	16.97
Non-Athletes	6.10	8.04	70.62	18.08	1.62	1.44	51.47	13.75

*p < 0.01

Table 2

Demographic Data for Athletes and Non-Athletes in Each Condition

	Age		Class Year		GPA		Socioeconomic Status		Sex (% Female)	Race (% Caucasian)
Group	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*M*
Trauma										
Athletes	19.58	1.31	2009	1.08	3.36	0.34	3.83	0.72	66.7%	91.7%
Non-Athletes	19.13	1.36	2009	1.17	3.47	0.26	3.63	0.74	62.5%	100.0%
Control										
Athletes	20.2	0.97	2008	0.83	3.4	0.23	3.89	0.6	66.7%	88.9%
Non-Athletes	19.43	0.98	2009	1	3.61	0.18	3.43	1.27	100.0%	71.4%

Figures

Figure 1. A significant main effect of condition was found for negative affect in both athletes and non-athletes (mean +/- SE, n = 36).

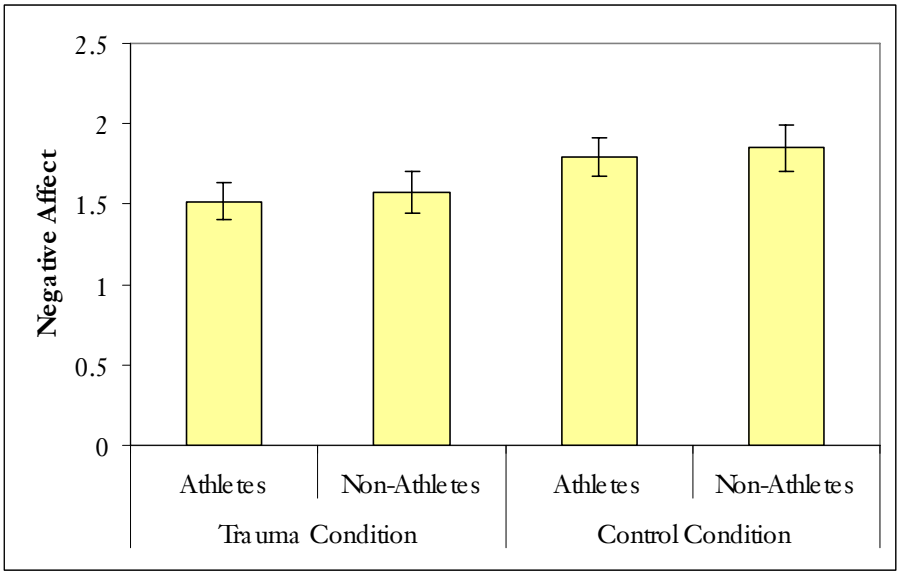
2.5
2
1.5
1
0.5
0
Negative Affect
Athletes
Non-Athletes
Athletes
Non-Athletes
Trauma Condition
Control Condition

Figure 1.