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Effects of Life-Event Stress and Hardiness on Peripheral Vision in a Real-Life Stress Situation

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Previous research has only examined perceptual deficits that are hypothesized in a model of stress and injury under laboratory-induced stress conditions. The generalizability of findings from such induced-stress conditions is limited beyond the laboratory. The current research examined the influence of life-event stress and hardiness on peripheral narrowing in a real-life stress situation. Athletes completed life-stress and hardiness questionnaires, along with measures of state anxiety and peripheral vision. The stress condition was obtained by assessing the athletes within 2 hours of a competition. The real-life stress condition had a larger effect on state anxiety and peripheral narrowing than the laboratory-induced situations used in previous research, with effect sizes twice and three times as large as those reported in the literature. All athletes experienced significant reductions in peripheral vision prior to competition, regardless of life-event stress or hardiness levels.

Index Terms: *hardiness, life-event stress, peripheral narrowing, real-life stress*

The multicomponent, theoretical model of stress and athletic injury, developed by Williams and Andersen,[1,2] examines the influence of psychosocial variables on the stress response and ultimately the occurrence of injury. Specifically, the model proposes that when athletes encounter stressful situations (for example, demanding practices or competitions), their history of stressors, personality characteristics, and coping resources contribute to their stress response. This resulting stress response is the hypothesized mechanism in the stress-athletic injury relationship, making it the center of Williams and Andersen's model.[1] The stress response is hypothesized to vary in severity and is characterized by physiological and attentional changes that occur during stress. Such changes are predicted to be in the form of increased generalized muscle tension, narrowing of the visual field, and increased distractibility.

Researchers have begun empirically to examine the influence of psychosocial variables on the stress response and ultimately, athletic injury. The most researched component of the predicted stress response is attentional changes. Attentional changes have been hypothesized to result from a preoccupation with stressful events and the possible negative consequences associated with the events.[3] It is proposed that this narrowing of focus may result in potential injury by decreasing capability of responding to dangerous cues in the periphery. Over the last decade, researchers have examined the attentional changes that occur during stress as hypothesized in the Williams and Andersen model,[1] and studies have reported that perceptual deficits do occur during stressful situations as compared to no-stress situations.[4–7] Each of the studies that have examined the changes in peripheral vision during stressful situations as compared with no-stress situations has manipulated the situation in the lab. In other words, the stressful situation consisted of laboratory-induced stress, such as visual and auditory distractions during the peripheral vision examination. For example, the standard protocol of previous research consisted of a baseline condition, in which the participants completed only a peripheral vision examination in a quiet room. This condition was

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followed by the stress condition in which participants completed simultaneously the peripheral vision exam and a Stroop task while concurrently listening to a loud, distracting tape.[4–7] As previously noted, significant decrements in peripheral vision have been reported between such laboratory-induced stress conditions and baseline conditions, but it is important to note that the model of stress and injury predicts that a potentially stressful athletic situation is the setting in which these changes are relevant to athletic injury. Therefore, to further understand the relationships hypothesized in the model, researchers must determine if similar perceptual deficits occur under more realistic, athletic settings.

In addition to the general finding that a narrowing of focus occurs under stress as compared with no stress, research has also demonstrated that athletes who have experienced many major life events tend to exhibit greater peripheral narrowing under stress than athletes who have experienced few major life events.[5,6] More specifically, research has demonstrated that athletes with high negative life-event stress display greater peripheral narrowing during a laboratory-induced stressful situation.[4,7]

In addition to levels of life-event stress influencing one's stress response, the model predicts that certain personality variables may predispose individuals to have less of a response during stressful situations.[8] The personality component of the stress and injury model has received considerably less attention in the research literature than the history of stressors variable. One proposed variable to be influential in the stress and injury relationship is the personality variable of hardiness, a trait encompassing courage, assurance, and the ability to handle change. Research in health psychology has demonstrated that hardiness moderates the relationship between stress and illness.[9,10] It has been demonstrated that individuals with high levels of life-event stress and high levels of hardiness were less likely to fall ill than individuals with high life-event stress and low levels of hardiness.[9] Additional research has shown that stressful life events and hardiness each individually influence the occurrence of illness and that their interaction also has an influence (eg, the impact of high amounts of stressful life events on illness can be buffered by high levels of hardiness).[10]

In the stress and athletic injury literature, only one study has examined the role of hardiness in the stress-injury relationship.[11] In this study, researchers assessed numerous psychological variables, including hardiness and life-event stress, during the preseason. Athletic injury information was collected throughout the season. No significant correlations between life-event stress and athletic injury existed for athletes in either the high or low hardiness group. These results indicated no moderating effects of hardiness in the life-event stress–athletic injury relationship.[11]

The purpose of the current study was to determine the effect of a potentially stressful athletic situation, as proposed in the model, on perceptual deficits. In addition, the current study examined the effects of life-event stress and hardiness on this relationship. It was hypothesized that perceptual deficits would be seen on game days as compared to no-game days, and that the deficits would interact with life-event stress and hardiness levels.

METHOD

Participants

The participants were 25 male high school varsity football players at a Phoenix, Arizona, US high school. The mean age of the participants was 16.7 ($SD = .75$) years. Thirteen (52%) participants identified themselves as Caucasian, 10 (40%) as Hispanic, and two (8%) as African American. Every athlete on the varsity football team had the opportunity to participate in the study. We gave consent forms for participation to each athlete under 18 years of age to be signed by a parent or guardian and to be returned to us prior to the start of the study. The only members of the team who did not participate in the study were those athletes who did not return a consent form from their parent or guardian. We gave athletes 18 years and older informed consent forms to sign, and we gave signed child assent forms to athletes younger than 18. We excluded no athletes from the sample, and athletes did not wear glasses during the peripheral vision exam. The institutional review board at Arizona State University granted approval for the use of human subjects in the current study.

MEASURES

Life Stress

The Life Events Survey for Collegiate Athletes (LESCA),[12] a 69-item life events survey, measures life events experienced during the preceding 12 months. The survey is a checklist on which the participants indicated if they had experienced a life event during the preceding 12 months. The athletes then rated the impact of the events on an 8-point Likert type scale ranging from +4 (extremely positive) to –4 (extremely negative). The questionnaire provides three life-events scores, which include a negative life-event score, a positive life-event score, and a total life-event score. Four items that were specific to a collegiate setting were revised for the current study to target high school-level athletes. Test-retest reliability has been found to range from .76 to .84.[12]

State Anxiety

The State-Trait Anxiety Inventory (STAI)[13] measures current state anxiety. The form consists of 20 self-statements concerning how the participant feels at the moment of completing the questionnaire. Each statement is rated on a 4-point Likert-type scale from 1 (not at all) to 4 (very much so). The range of scores is 20 (low-state anxiety) to 80 (high-state anxiety). The STAI has well-established validity as a measure of state anxiety.[13]

Hardiness

The Cognitive Hardiness Inventory, part of the Stress Assessment Profile,[14] is a 30-item scale that measures attitudes and beliefs about life. These beliefs include the sense of purpose and curiosity with which one approaches life, one's attitudes toward viewing life changes as challenges instead of problems or threats, and beliefs about one's ability to influence the course of events in life. Each question is answered on a 5-point Likert-type scale ranging from 1 (strongly agree) to 5 (strongly disagree), with the range of scores potentially being 30 to 150. The internal consistency of this scale has been shown to be .83,[14] and test–retest reliability has been reported at .84.[15]

Peripheral Vision

Stimuli for the peripheral vision task were presented in a Topcon Perimeter (model SBP-11, Topcon America Corporation, Paramus, NJ). This apparatus is a white half-sphere projection perimeter in which a light target moved along the sphere's surface in either the left or right visual field. The perimeter is identical to the apparatus used in previous research examining peripheral vision in regard to stress and athletic injury and is an ophthalmologic device designed to accurately measure peripheral vision.[4,7] While completing the peripheral vision exam, participants focused their vision on a black dot just below zero degrees latitude and when visual cues were detected they depressed a buzzer with their dominant hand.

PROCEDURES

Permission for football players to participate initially came from the school principal and later from the head football coach at the school. During a preseason meeting at the school, the athletes completed a demographic sheet, the LESCA, and the hardiness scale. The purpose of the study was presented to the athletes as a research project investigating psychological traits related to physical outcomes. Instructions were printed on the top of each questionnaire, and we read them aloud. Athletes were allowed as much time as necessary to complete the questionnaires.

During the first 2 weeks of the season, we tested each athlete in each of two sessions: a no-stress condition and a stress condition. During each of the testing sessions, the athletes completed the STAI and the peripheral vision exam. The no-stress condition took place under controlled conditions within 1 hour prior to the start of football practice, and the stress condition took place under identical conditions within 2 hours before the start of a football game. The order of the two testing conditions was counterbalanced among the participants.

At the start of each testing session, following the completion of the STAI, we explained the function of the perimeter to each athlete. The athletes then received four practice trials on the perimeter. We measured peripheral vision by 16 trials randomly presented in the right and left visual fields with the restriction that 8 trials would be presented on each side. We then averaged the 16 trials to obtain a mean peripheral vision score for each athlete that represented the average number of degrees from the center of the visual field in which the athlete was first able to detect the light.

STATISTICAL ANALYSES

To determine if the athletes perceived the real-life stress situation of athletic competition as more stressful than the practice condition, a paired samples t test was conducted on the STAI measures taken on each respective day. A second paired samples t test was then conducted to examine the changes in peripheral vision between the two conditions (practice and game). A lower peripheral vision score indicated a narrower peripheral vision field. We dichotomized negative life-event stress, positive life-event stress, total life-event stress, and hardiness into upper and lower 40% groups and conducted four separate repeated measure analyses (condition by life-event stress/hardiness) to examine the relationship between narrowing of peripheral vision during stress and life-event stress/hardiness levels.

RESULTS

The means and standard deviations for state anxiety and peripheral vision during the baseline and stress conditions are shown in Table 1. To examine the effectiveness of the real life stress condition, we conducted paired t tests and calculated effect sizes (Hedges's g)[16] between the stress and no-stress conditions for state anxiety and peripheral vision. The stress condition produced significant increases in anxiety, $t(24) = -2.613$, $p < .05$, $ES = .60$, and peripheral narrowing effects, $t(24) = -8.245$, $p < .05$, $ES = 1.03$, as compared to the no-stress condition. Furthermore, Wilcoxon signed ranks tests also demonstrated that the stress condition produced significant decreases in peripheral vision

TABLE 1. Means and Standard Deviations for Life Event Stress and Hardiness During Baseline and Stress Conditions

		Peripheral Vision				State Anxiety			
		Baseline		Stress		Baseline		Stress	
Condition	*n*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Total									
Low	10	48.59	6.76	40.51	8.32	32.80	8.47	40.00	8.99
High	10	47.47	12.82	36.06	9.66	41.00	8.10	43.70	9.98
Negative									
Low	11	49.54	6.31	41.00	7.98	32.09	8.35	38.90	9.27
High	10	46.18	12.41	35.21	9.31	41.20	8.09	44.10	9.89
Positive*									
Low	10	48.08	10.93	41.04	11.19	35.20	9.44	42.20	8.13
High	10	50.18	8.25	37.53	5.95	37.90	9.19	39.50	9.13
Hardiness									
Low	11	44.56	10.66	35.64	9.18	39.55	9.15	44.00	11.53
High	11	49.76	6.81	40.88	8.42	34.00	8.51	40.09	8.41
Total	25	48.14	9.00	39.87	8.61	36.36	8.80	41.64	9.48

*Significant interaction Group × Condition interaction, $p < .05$

($Z = -4.37$, $p < .001$) and significant increases in state anxiety ($Z = -2.65$, $p < .01$) despite heterogeneity of the variances. We used state anxiety only as a manipulation check variable; thus, we did not use it as a dependent variable in further analyses. To examine the differences between levels on the independent variables, we split negative life stress, positive life stress, total life stress, and hardiness into high (40%) and low (40%) groups for analyses of variance.

The repeated measure main effect of condition (no-stress vs stress) revealed significant decrements in peripheral vision across each type of life-event stress and hardiness during the stress condition, $Fs > 47.82$, $ps < .001$.

We examined the interaction between life-event stress or hardiness level and condition for each of the life-event stress variables and for hardiness. The positive life-event stress by condition interaction was significant, such that participants with high positive life stress experienced more perceptual deficits during the stress as compared to no-stress, $F(1,18) = 5.248$, $p < .05$, $ES = 1.02$. We observed no significant condition interactions for total life stress, negative life-event stress, or hardiness.

COMMENT

In line with the predictions from the model of stress and injury,[1] the current study demonstrates that perceptual deficits occur in potentially stressful athletic situations. This is an important finding as previous literature had only observed such deficits in laboratory-induced stress conditions. Additionally, the effect size of the perceptual deficits reported in the real-life stressful situations ($ES = 1.03$) is larger than those seen in laboratory-induced conditions (ES range = 0.27 – 0.70).[4–7] The natural stress situation of the current study also produced larger effects for state anxiety ($ES = .60$) than those reported in previous research using a laboratory stress condition ($ES = .24$).[7] Despite the apparent difference of effect size between laboratory and real-life stress conditions, it must be remembered that differences in effect size are potentially related to the sample studied.

Nevertheless, these findings are important for future research and understanding of the model because the model predicts that the physiological deficits that link psychosocial variables and athletic injury are triggered by "potentially stressful athletic situations."[1] Until this point, it was unknown if such deficits occurred in actual athletic situations. The generalizability of findings from previous literature with laboratory-induced stress conditions was unknown.

Reported in previous research and predicted by the model, life-event stress levels were significantly related to the peripheral deficits seen from the no-stress to stress conditions in the current study. Specifically, individuals with high levels of positive life-event stress experienced significantly more narrowing on game day than those with lower levels of positive life-event stress. The effect size for this relationship was large (*ES* = 1.02) and mirrors findings reported in previous literature (*ES* = .95).[5] Positive life-event stress includes events, such as receiving an award or scholarship, an increased role on the team, or an improvement in performance. Although athletes rate these events as positive, it is possible that these events lead athletes to expect more out of their performance, and they ultimately feel more pressure to perform well during competition, resulting in an elevated stress response prior to performance. It is worth noting that, similar to the findings with peripheral vision, research examining the life-event stress–athletic injury relationship has also demonstrated a link between high levels of positive life-event stress and an increased risk of athletic injury occurrence.[17–18] It could be implied, albeit prematurely, that these findings are in accordance with the predictions of the model of stress and injury, such that the life-event stress–athletic injury relationship is mediated through the stress response, namely peripheral narrowing.

Unlike positive life-event stress, the interactions between negative life-event stress and total life-event stress and the change in peripheral vision from the no-stress to the stress condition were not significant. However, negative life-event stress has been related to peripheral narrowing during stress in previous research,[4,7] and the findings of the current study with a small sample should not imply that the relationship between negative life-event stress and perceptual deficits during a real-life stress situation does not warrant further investigation.

The similarities in the life stress–peripheral vision findings between studies using a laboratory-induced stress situation and the current study using a real-life stress situation provide evidence that the results reported in previous literature are generalizable to real athletic situations, giving credibility to the application of previous results to the model of stress and athletic injury. The effect sizes revealed in the current real-life stress situation are larger than effects observed in laboratory conditions, but the direction of the effects and the overall meaning of the results from the studies is the same.

No research has previously examined the personality trait of hardiness as part of this model, although it has been predicted to influence the life stress–injury relationship. The difference between individuals with high and low levels of hardiness on change in peripheral vision from no-stress to stress was not significant; however, the power to detect this difference in the current study was only .38. Because of the low power to detect a difference in the present investigation and the fact that personality is a complex structure, the lack of a significant result in the current study should not imply that the influences of hardiness and personality characteristics on the stress-injury relationship do not warrant further investigation. Previous research has reported that hardy individuals are more likely to have and use positive coping behaviors,[15] and despite the fact that this relationship was not examined in the current study, coping resources are predicted to influence the stress-injury relationship, and the hardiness-coping resources relationship may play an important role in the model of stress and athletic injury. Additionally, researchers interested in examining the personality characteristics variable in the model should borrow knowledge from decades of personality research in mainstream psychology. Since the 1970s, research has searched for the best way to capture the essence of individual differences in personality, and most researchers agree that personality should be examined using a multifactor approach.

The most important findings of the current study are that a real-life, potentially stressful athletic situation, as predicted in the model of stress and injury,[1] triggers cognitive and physiological stress responses that are influenced by prior life-event stress levels. These relationships have been examined in previous research, but this is the first time they have been shown to exist in actual athletic situations, as predicted by the model. With the general information provided about potentially stressful athletic situations from the current study, several future research directions are warranted. First, relationships tested in the current study and other relationships predicted in the model should be tested with larger sample sizes to examine more completely the stress and injury model under real-life stress conditions. In addition, relationships between the predicted psychosocial variables should be further examined as research has suggested that social support likely moderates the relationship between life stress and injury.[19] This relationship should be further examined accounting for the potential buffering effects of social support. Finally, an investigation of how the reported relationships between a potentially stressful athletic situation, psychosocial variables, and peripheral vision are related to athletic injury occurrence is warranted and necessary for complete understanding of the model.

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