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An examination of hardiness throughout the sport injury process

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Objectives. This primary objective of the study was to examine the direct and moderating effects of hardiness on the prediction of sport injury, and the direct and indirect effects of hardiness on athletes' responses to injury.

Design. This study employed a longitudinal methodological design. Specifically, the injury status of 694 asymptomatic participants was monitored for 2 years. From the original sample, 104 athletes subsequently became injured and then completed a number of questionnaires throughout their recovery.

Methods. Logistic regression, Pearson product-moment correlation and Preacher and Hayes's (2008) bootstrapping procedure were used to analyse the data.

Results. Findings revealed a direct and moderating effect of hardiness on the prediction of injury. Hardiness was also found to positively correlate with desirable, and negatively correlate with undesirable post-injury psychological responses and coping strategies throughout recovery. Finally, problem-focused coping was found to mediate certain effects of hardiness on injured athletes' psychological responses.

Conclusions. These findings have important implications for practitioners who have a vested interest in the health and well-being of those who participate in sport and exercise in terms of minimizing rates of injury occurrence and/or facilitating recovery from injury.

Although it is widely accepted that participation in sport and exercise has many health-related benefits, not all of the effects are positive (e.g., Bathgate, Best, Craig, & Jamieson, 2002; Brooks, Fuller, Kemp, & Reddin, 2005; Uitenbroek, 1996). One of the less than positive effects, which can pose a threat to an individual's health and well-being, is injury. Indeed, Uitenbroek demonstrated that participating in sport and exercise is one of the most prevalent causes of injury. Although many of the causes and consequences of injury occurrence are undoubtedly physiological and anatomical in nature, a growing body of empirical research has shown that psychosocial variables may also play an important role (Brewer, 2007; Williams & Andersen, 2007). Over the last two decades,

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a number of psychosocial variables have been observed to not only contribute to the occurrence and prevention of injury, but also to facilitate and inhibit recovery from injury (e.g., Andersen & Williams, 1999; Evans & Hardy, 2002a). Embracing an evidence-based philosophy, this field of research has used these empirical findings to inform the design and implementation of interventions that have been observed to attenuate rates of injury occurrence and expedite recovery from injury (e.g., Evans & Hardy, 2002b; Johnson, Ekengren, & Andersen, 2005).

To date, two models have guided the empirical research into the psychology of sport injury: Williams and Andersen's (1998) stress-based model of the prediction of injury and Wiese-Bjornstal, Smith, Shaffer, and Morrey's (1998) integrated model of injury response. Williams and Andersen's model suggests that personality traits (e.g., hardiness, locus of control, and competitive trait anxiety), history of stressors (i.e., major life events, daily hassles, and previous injuries), and coping resources (e.g., social support, psychological skills, and coping strategies) contribute to the prediction of sport injury either in isolation or interactively. These psychosocial variables are suggested to influence one's susceptibility to injury indirectly through their effects on the stress response, which reflects a bidirectional relationship between cognitive appraisals of, and attentional and physiological responses to, a potentially demanding athletic situation. The model suggests, therefore, that those athletes with undesirable personality traits, a history of many stressors, and inadequate coping resources are more likely to appraise a potentially demanding athletic situation as stressful and exhibit greater attentional (e.g., peripheral narrowing) and/or physiological responses (e.g., increased muscle tension) than athletes with a contrasting profile.

Although the stress response is the mediating mechanism hypothesized to directly influence the risk of injury, researchers have largely examined the main and moderating effects of the psychosocial variables proposed to predict injury occurrence indirectly (i.e., personality traits, history of stressors, and coping resources). Of the psychosocial variables examined to date, the variable that has been most frequently shown to predict injury occurrence is major life events; in particular, negative as opposed to positive major life events (e.g., Andersen & Williams, 1999; Maddison & Prapavessis, 2005; Rogers & Landers, 2005). However, it is important to note that negative major life events have only typically accounted for less than 15% of the variance in injury occurrence. Because of what appears to be a rather weak relationship between negative major life events and injury occurrence, and in an effort to account for additional variance, researchers have sought to examine variables that may moderate this relationship. Indeed, findings have demonstrated that personality traits (e.g., sensation seeking and dispositional optimism) and coping resources (e.g., psychological skills and social support) interact with major life events to influence one's vulnerability or resiliency to injury (e.g., Ford, Eklund, & Gordon, 2000; Rogers & Landers, 2005; Smith, Ptacek, & Smoll, 1992; Smith, Smoll, & Ptacek, 1990). For example, Smith *et al.* (1990) demonstrated that individuals who were low in both social support and psychological skills were more vulnerable to injury from negative major life events than those with the opposite profile, which accounted for 30% of the variance in injury occurrence.

In terms of the consequences of injury, Wiese-Bjornstal *et al.*'s (1998) integrated model extends Williams and Andersen's (1998) model by describing responses to, and rehabilitation from, injury. Wiese-Bjornstal *et al.* suggest that both pre-injury and post-injury factors moderate one's cognitive, emotional and behavioural responses to injury, mediated by the process of appraisal. Pre-injury factors include personality, history of stressors, and coping resources. Post-injury factors include personal (e.g., injury type and

severity) and situational variables (e.g., social support and rehabilitation environment). As a stress-process based model that embraces the concept of change, physical and psychological recovery from injury is viewed as a dynamic, interactive process in which cognitions, emotions, and behaviours are explained within a cyclical framework. Although Wiese-Bjornstal *et al.*'s integrated model has yet to be examined in its entirety, the majority of researchers who have sought to support or refute its suggestions have focused on the emotional responses experienced and coping strategies used by injured athletes over the course of their recovery (e.g., Appaneal, Levine, Perna, & Roh, 2009; Bianco, Malo, & Orlick, 1999; Carson & Polman, 2008; Gallagher & Gardner, 2007; Tracey, 2003).

In relation to injured athletes' emotional responses, the aforementioned research has generally supported their transient nature. For example, the literature has observed that shock, anxiety, anger, apprehension, depression, and feelings of helplessness are prevalent at injury onset, whereas frustration, relief, jealousy, happiness, guilt, and apathy characterize athletes' responses during their rehabilitation from injury. Impatience, re-injury anxiety, excitement, and fluctuating levels of confidence have generally been reported to replace these emotions once athletes return to sport. With regard to injured athletes' use of coping strategies, researchers have generally found injured athletes to employ problem-focused coping strategies (e.g., Gould, Udry, Bridges, & Beck, 1997; Udry, 1997), which have been observed to increase confidence and autonomy as well as decrease negative mood states (e.g., Carson & Polman, 2008; Gallagher & Gardner, 2007). Researchers who have explored some of the factors that might influence injured athletes' use of coping strategies have also found, for example, that athletes who appraise their injury as more stressful are more likely to employ coping strategies that deal directly with the injury (i.e., problem-focused; Albinson & Petrie, 2003).

Despite the fact that Williams and Andersen's (1998) model suggests that personality traits contribute to the prediction of injury occurrence, and Wiese-Bjornstal *et al.*'s (1998) integrated model suggests that this pre-injury variable can affect athletes' responses to injury, few researchers have examined the effect of specific personality traits either pre-injury or post-injury, particularly those that reflect a resilient disposition. This omission is surprising considering that resilience has often been associated with 'bouncing back' from various forms of adversity, which can include negative major life events (i.e., a significant predictor of injury) and injury itself (Galli & Vealey, 2008). One pathway to resilience according to Bonanno (2004) is what Kobasa (1979) conceptualized as the personality trait of *hardiness*. Kobasa observed that those individuals who experience adversity without experiencing any negative health-related implications were characterized by hardiness, which she found to reflect three resilient attitudes: commitment, control, and challenge (i.e., the 3Cs of hardiness). Specifically, *commitment* is a, 'tendency to involve oneself in (rather than experience alienation from) whatever one is doing or encounters' (Kobasa, Maddi, & Kahn, 1982, p. 169); *control* is a, 'tendency to feel and act as if one is influential (rather than helpless) in the face of the varied contingencies of life' (p. 169); and *challenge* is the, 'belief that change rather than stability is normal in life and that the anticipation of changes are interesting incentives to growth rather than threats to security' (p. 169–170). Put simply, individuals high in hardiness feel deeply involved in or committed to the activities in their lives, believe that they can at least partially control events they experience, and consider change as an exciting challenge to further development.

Since Kobasa's (1979) pioneering study, the influence of hardiness has been considered in many fields of psychology, including health psychology (e.g., Funk, 1992),

organizational psychology (e.g., Maddi, 2002), positive psychology (e.g., Maddi, 2006), and military psychology (e.g., Maddi, 2007). This body of literature has explored its direct, indirect (e.g., through adaptive appraisals and coping strategies), and moderating effects on various health- and performance-related outcomes. However, one health-related outcome that has not been afforded adequate research attention to date is sport injury. This omission is surprising considering that hardiness was not only proposed by Kobasa (1979) to buffer the detrimental effects of major life events, a significant predictor of injury occurrence (e.g., Rogers & Landers, 2005), but has also been shown to be negatively associated with strain reactions such as depression (e.g., Funk & Houston, 1987), which has direct relevance to athletes' responses to injury (e.g., Appaneal *et al.*, 2009). Furthermore, the few researchers who have investigated hardiness in this area of research have found hardiness to negatively predict sport injury, positively moderate the detrimental effects of major life events on injury occurrence, and have a favourable effect on athletes' post-injury psychological responses (Ford *et al.*, 2000; Grove, Stewart, & Gordon, 1990). However, although these preliminary findings are encouraging, more than two decades have passed since the first call for research to examine hardiness in the context of sport injury (Andersen & Williams, 1988), and despite repeated calls (Williams & Andersen, 1998, 2007), this construct has yet to be examined systematically.

Although there is a clear rationale to examine the effect of hardiness in the context of sport injury, it is important that researchers who investigate this construct are cognizant of, and account for, a number of conceptual and measurement issues (e.g., Ford-Gilboe & Cohen, 2000; Funk, 1992; Funk & Houston, 1987; Hull, Van Treuren, & Virnelli, 1987). For example, there is an ongoing debate in the literature as to whether hardiness should be conceptualized as a composite of commitment, control, and challenge or as three distinct components. To clarify, hardiness was originally conceptualized by Kobasa (1979) as a single, unitary construct, with the three attitudes of hardiness considered imperfect representations from which the underlying construct of interest emerges. Put simply, 'it is the combination of all 3Cs that constitutes hardiness' (Maddi, 2002, p. 176). However, several researchers have since advocated examining the separate effects of the hardiness attitudes (e.g., Funk & Houston, 1987; Hull *et al.*, 1987), thereby suggesting that hardiness is not a unitary phenomenon and as a result its attitudes should not be combined to form a composite. As a result of these contrasting views, researchers over the past decade have tended to examine the effect of both the hardiness composite score and each of its components (e.g., Ford *et al.*, 2000; Klag & Bradley, 2004).

In terms of measurement, the main issue is the use of negative indicators in the early measures of hardiness (i.e., high scores indicating an absence of hardiness) and the plethora of different measures used across studies. Indeed, Funk (1992) suggested, 'The proliferation of scales makes the body of hardiness research difficult to interpret. For example, it is difficult to determine whether differences in health outcomes across studies are real or reflect differences in the hardiness scales used' (p. 336). As a result, Funk recommended that future research should continue to employ the Dispositional Resilience Scale (DRS; Bartone, Ursano, Wright, & Ingraham, 1989), which includes positive indicators of hardiness and has been shown to have sound psychometric integrity (e.g., Bartone, 1989; Maddi, 1999). Finally, additional issues often referred to in the literature include the use of retrospective designs and the frequent and inappropriate use of analysis of variance (ANOVA) (e.g., Ford-Gilboe & Cohen, 2000; Funk, 1992). For example, previous hardiness research has been criticized for fitting continuous variables into an ANOVA framework; that is, researchers have tended to perform median-splits on the hardiness scales, categorizing participants into high- and low-hardiness groups,

leading to a loss of information (i.e., those participants scoring the median) and statistical power (cf. Biddle, Markland, Gilbourne, Chatzisarantis, & Sparkes, 2001). As a result, it has been recommended that future research employs regression analyses and, where appropriate, longitudinal designs (Klag & Bradley, 2004).

The purpose of this study was to explore hardiness throughout the full temporal sport injury process. Specifically, this study aimed to examine the direct and moderating effect of hardiness on the prediction of injury occurrence, and the direct and indirect effect of hardiness on athletes' responses to injury. As far as the authors are aware, no researchers have fully integrated these distinct but related lines of research to provide a more complete picture of the sport injury process. Consistent with Williams and Andersen's (1998) model and associated research (e.g., Ford *et al.*, 2000; Rogers & Landers, 2005), the following hypotheses were generated with regard to the prediction of injury occurrence: (1) an increase in negative rather than positive major life events will increase the likelihood of injury occurrence, (2) an increase in hardiness will decrease the likelihood of injury occurrence, and (3) hardiness will positively moderate the relationship between negative major life events and injury occurrence. In line with Wiese-Bjornstal *et al.*'s (1998) model and associated research (e.g., Florian, Mikulincer, & Taubman, 1995; Grove *et al.*, 1990), the following hypotheses were forwarded in terms of athletes' responses to injury: (1) hardiness will positively correlate with desirable, and negatively correlate with undesirable psychological responses; (2) hardiness will positively correlate with problem- and emotion-focused coping strategies, and negatively correlate with avoidance coping; (3) the relationship between hardiness and psychological responses will be mediated by coping (total indirect effect) and this will be determined by problem- and emotion-focused coping strategies rather than avoidance coping (specific indirect effects).

Method

Participants

The participants ($n = 694$), who were drawn from five sports institutions based within the United Kingdom, represented eight team and 18 individual sports. The competitive level at which they participated ranged from recreational to international, with an average of three years' experience at their current level. The mean age of participants was 19.17 ($SD = 1.69$ years) and 56% of the sample was male. The injury status of the participants was monitored for 2 years. From the original sample of 694, 104 participants incurred an injury, which included fractures, dislocations, strains, and sprains of different body parts. All injuries were diagnosed by a doctor, nurse, or physiotherapist, and the resulting time loss from training and competition ranged from 14 to 504 days (M days $= 49.90$; $SD = 81.35$). The injured participants represented eight team and 10 individual sports from recreational to international standards of competition. Participants had an average of 3 years' experience at their current competitive level. The mean age of participants was 19.22 ($SD = 1.10$ years) and 53% of the sample was male.

Measures

Major life events

The Life Events Survey for Collegiate Athletes (LESCA) was used pre-injury to measure major life events (Petrie, 1992). The LESCA comprises 69 major life events. Participants rated the perceived impact and desirability of each event they had encountered in the

last 12 months on an 8-point Likert scale, anchored at −4 (extremely negative) and +4 (extremely positive). The LESCA provides three outcomes: a score for positive major life events, negative major life events, and total major life events. Positive and negative major life event scores reported by the participants were calculated by summing the respective impact scores, whereas the total major life event score was derived by totalling the absolute values for positive and negative major life events. However, because total major life events was found to be highly correlated with negative major life events in this study ($r = .84$, $p < .01$), total major life events were considered redundant and omitted from this study (Tabachnick & Fidell, 2001). Petrie reported 1-week test–retest reliabilities ranging from .76 to .84, and 8-week test–retest reliabilities ranging from .48 to .72 for the LESCA. Petrie also provided evidence of predictive, discriminant, and convergent validity.

Hardiness

The DRS was used pre-injury to measure hardiness and its three subcomponents: commitment, control, and challenge (Bartone *et al.*, 1989). The DRS consists of 45 statements about life in general that individuals often feel differently about (15 items per subcomponent). Participants were asked to indicate the truthfulness of each statement for them on a 4-point Likert scale anchored at 0 (not at all true) and 3 (completely true). Scores for each subcomponent ranges from 0 to 45. The composite hardiness score ranges from 0 to 135. Cronbach's alpha coefficients of .82 for hardiness, .80 for commitment, .72 for control, and .68 for challenge were found for the present study.

Coping strategies

A situational-specific version of the Coping Orientation to Problems Experienced (COPE) scale was used post-injury to assess the use of different coping strategies over time (Carver, Scheier, & Weintraub, 1989). The COPE comprises of 52 items that reflect 13 different coping strategies, with four items representative of each strategy. Participants were required to respond to each item on a 4-point Likert scale anchored at 1 (I am not doing this at all) and 4 (I am doing this a lot). Cronbach's alpha coefficients ranged from .48 to .90 in this study. Consistent with conceptual models of coping (Hoar, Kowalski, Gaudreau, & Crocker, 2006) and a series of second-order factor analyses (Ingledew, Hardy, Cooper, & Jemal, 1996; Litman, 2006; Lyne & Roger, 2000; Stowell, Kiecolt-Glaser, & Glaser, 2001), the 13 coping strategies were summated into three higher order factors: (1) *problem-focused coping* (i.e., positive reinterpretation and growth, planning, active coping, suppression of competing activities, restraint coping, and acceptance), (2) *emotion-focused coping* (i.e., seeking social support for emotional reasons, focus on and venting of emotions, and seeking social support for instrumental reasons), and (3) *avoidance coping* (i.e., behavioural disengagement, denial, and mental disengagement). The coping strategy *turning to religion* was excluded from the study on the basis that researchers are unclear what function it serves and have demonstrated its failure to load on any derived factors (Litman, 2006; Stowell *et al.*, 2001).

Psychological responses

The Psychological Responses to Sport Injury Inventory (PRSII) was used to measure athletes' post-injury psychological responses (Evans, Hardy, Mitchell, & Rees, 2008). The PRSII consists of six subscales: devastation, dispirited, reorganization, feeling cheated, restlessness, and isolation. Each subscale has four items each, apart from reorganization

that consists of three items. Participants were asked to indicate the extent to which each statement reflected how they presently feel on a 5-point Likert scale anchored at 1 (strongly disagree) and 5 (strongly agree). Each subscale score (with the exception of reorganization) ranges from a low of 4 to a high of 20. For reorganization, this equates to a low of 3 and a high of 15. Evans *et al*. provided evidence of content and predictive validity. Cronbach's alpha coefficients averaged over the time phases of injury were .82 for devastation, .78 for dispirited, .75 for reorganization, .77 for feeling cheated, .85 for restlessness, and .72 for isolation in this study.

Injury

Consistent with Williams and Andersen's (1998) stress-based model of injury prediction and associated research (e.g., Johnson *et al*., 2005; Rogers & Landers, 2005), the number of injuries sustained by the participants served as the outcome variable. An injury was defined as a medical problem resulting from sport participation that prevented normal training and competition for a minimum period of two weeks. Minor scrapes and bruises that may require certain modifications (e.g., strapping or protective garments) for training and competition purposes were not classified as injuries (Andersen & Williams, 1999). In addition, although the number of injuries sustained served as the dependent variable in the pre-injury analysis, injury severity (as measured by time loss) was accounted for in the post-injury analysis.

Procedure

Asymptomatic participants were recruited by approaching a number of recognized sports institutions within the United Kingdom, which had large cohorts of competitive athletes. The five institutions approached agreed to participate and provided consent for the first author to contact their athletes to request their participation in the study. A number of group sessions were subsequently undertaken at each institution to explain the nature of the study and what participation would entail. Considering the longitudinal nature of the study (i.e., 2-year time period), a small number of athletes declined to participate because they were either moving country or ceasing their participation in sport and exercise. The athletes who agreed to participate provided written informed consent in line with the University Research Ethics Committee; participation was entirely voluntary (i.e., the performers were not compensated in anyway). Participants subsequently completed a demographic data sheet and pre-injury baseline questionnaires (i.e., LESCA and DRS). The questionnaires included standardized instructions based upon the recommendations of Petrie (1992) and Bartone *et al*. (1989) and were counterbalanced (i.e., ordered randomly).

The lead author monitored and recorded the injury status of the original sample for a period of 2 years by contacting them on a weekly basis after scheduled training sessions or competitions. If an athlete became injured, they were asked to complete the PRSII and COPE at three time points: Time 1 was within the first week of their injury occurrence (i.e., injury onset), Time 2 was midway through their rehabilitation (i.e., rehabilitation), and Time 3 was within the first week of their return to full training (i.e., return to competitive sport). During the first time point, four other details were also recorded: (1) date of injury occurrence, (2) type and location of the injury, (3) who diagnosed the injury, and (4) estimated duration for recovery (i.e., the approximated number of weeks the athlete would be injured and unable to participate in normal training and competition). The latter information was used to estimate the

subsequent two time points (i.e., rehabilitation and return to competitive sport), which was subsequently monitored and confirmed by the first author as the participants rehabilitation progress unfolded. Post-injury measures included standardized instructions based upon the recommendations of Evans *et al*. (2008) and Carver *et al*. (1989), and were counterbalanced.

Data analysis

Data analysis involved four stages. First, data screening procedures were conducted to investigate the accuracy of the data. Second, hierarchical logistic regression was used to predict injury status (i.e., non-injured vs. injured). This analysis examined the direct and moderating effects of the pre-injury variables on injury status. When examining moderation, each pre-injury variable was mean-centred to avoid multicollinearity and to meaningfully interpret the regression coefficients. Third, Pearson product-moment correlation was used to examine the direct effect of hardiness on post-injury responses at each time point. Finally, Preacher and Hayes's (2008) bootstrapping procedure was employed to examine total (i.e., coping) and specific (i.e., problem-focused coping, emotion-focused coping, and avoidance coping) indirect effects of hardiness on psychological responses. This analysis was performed using Preacher and Hays's (2011) INDIRECT macro; 95% confidence intervals were employed and 5,000 bootstrapping resamples were run. Data analysis was performed using SPSS 17.0 for Windows.

Results

Prediction of sport injury

Preliminary data analysis

Thirty-one asymptomatic athletes were removed from the analysis because of incomplete data. Complete data entry on all variables of interest was obtained from 694 athletes. From this sample, 104 athletes incurred an injury. None of the injured participants reported experiencing more than one injury. Consequently, injury outcome was treated as a binary variable (0 = non-injured, 1 = injured). Before proceeding to the main analyses, the extent to which the demographic variables were related to injury status was assessed using logistic regression. Gender, sport type (i.e., individual vs. team sports), and competitive level (i.e., club, county/regional, vs. national/international), all failed to predict injury status (ps $> .05$); therefore, all further analyses were collapsed across these variables. Descriptive and correlational data for pre-injury variables are displayed in Table 1.

Direct effects

Negative major life events (Wald test = 84.591, $p < .001$; OR = 1.070, CI = 1.054, 1.085), hardiness (Wald test = 32.922, $p < .001$; OR = 0.947, CI = 0.930, 0.965), commitment (Wald test = 33.106, $p < .001$; OR = 0.894, CI = 0.860, 0.928), control (Wald test = 29.462, $p < .001$; OR = 0.881, CI = 0.842, 0.923), and challenge (Wald test = 4.919, $p < .05$; OR = 0.948, CI = 0.904, 0.994) were shown to significantly contribute to the prediction of injury status. That is, as negative major life events increased, the likelihood of injury occurrence also increased. In contrast, as hardiness, commitment, control, and challenge increased, the likelihood of injury occurrence decreased. Positive major life

Table 1. Descriptive and correlational data for pre-injury variables

Variable	*M*	*SD*	1	2	3	4	5	6	7
1. TMLE	30.55	21.36	–	.71**	.84**	−.03	.00	−.03	−.05
2. PMLE	12.71	11.34		–	.24**	.05	.08*	.00	.00
3. NMLE	17.90	15.54			–	−.07	−.05	−.05	−.05
4. Hardiness	85.43	11.62				–	.85**	.83**	.65**
5. Commitment	31.12	5.56					–	.64**	.30**
6. Control	29.87	4.77						–	.30**
7. Challenge	24.48	4.46							–

Note. TMLE, total major life events; PMLE, positive major life events; NMLE, negative major life events. $^{*}p < .05$; $^{**}p < .01$.

events did not significantly contribute to the prediction of injury status (Wald test = 3.403, $p < .07$; OR = 1.016, CI = 0.999, 1.034).

Moderating effects

The two-way interaction terms between negative major life events and hardiness (Wald test = 24.100, $p < .001$; OR = 0.996, CI = 0.994, 0.997), commitment (Wald test = 16.119, $p < .001$; OR = 0.993, CI = 0.990, 0.997), control (Wald test = 27.083, $p < .001$; OR = 0.988, CI = 0.984, 0.993), and challenge (Wald test = 4.993, $p < .001$; OR = 0.996, CI = 0.992, 0.999) were found to significantly contribute to the prediction of injury status. That is, as hardiness and its components increased, the effect of negative major life events on injury status decreased. Figures 1–4 illustrate these interaction terms by depicting the predicted log odds for hardiness, commitment, control, and challenge at three levels: low, medium, and high (Jaccard, 2001). Specifically, the low and high levels

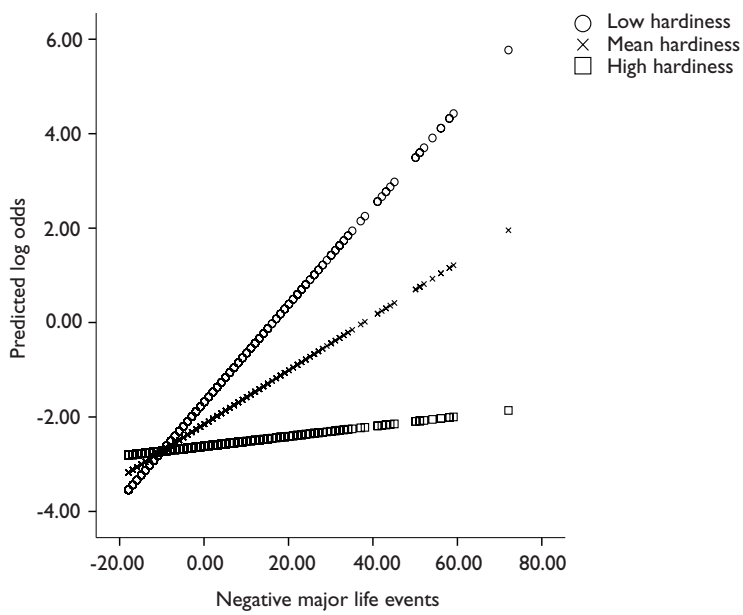

Figure 1. Interaction of hardiness and negative major life events on injury status.

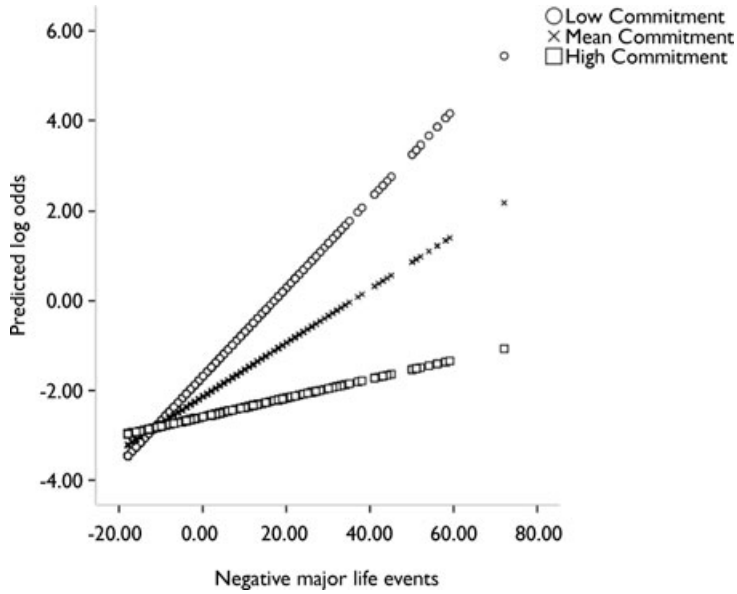

Figure 2. Interaction of commitment and negative major life events on injury status.

reflect one standard deviation below and above the mean of the variable, respectively, whereas the medium level reflects its mean.

Responses to sport injury

Preliminary data analysis

Of the 104 injured athletes, four athletes were removed from the analysis because of incomplete data. One hundred athletes successfully completed post-injury measures that

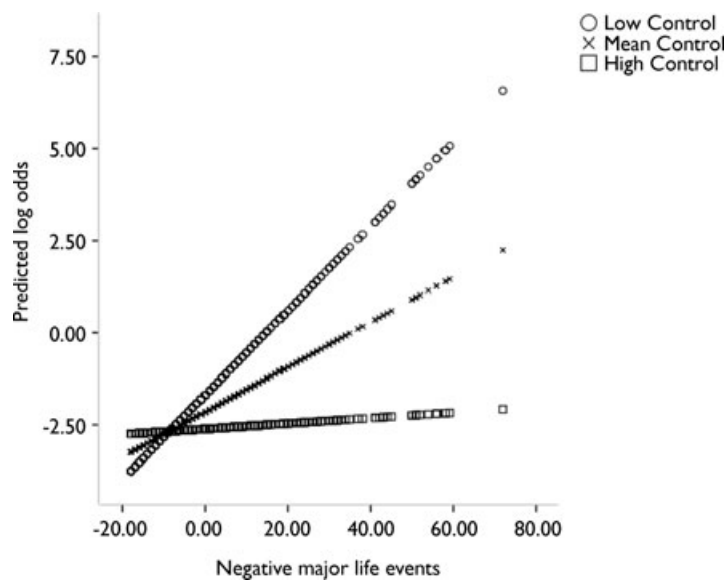

Figure 3. Interaction of control and negative major life events on injury status.

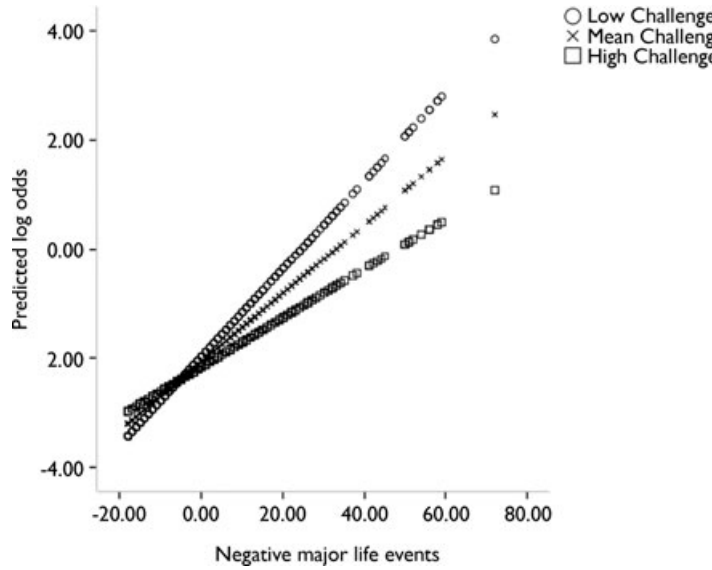

Figure 4. Interaction of challenge and negative major life events on injury status.

examined psychological responses and coping strategies at each of the three post-injury time phases. Before proceeding to the main analyses, the extent to which demographic variables were related to the post-injury responses at each time phase was assessed. A series of one-way multivariate analysis of variance revealed that there were no significant differences on the post-injury variables for gender, sport type, and competitive level (ps > .05); therefore, all further analyses were collapsed across these variables. We also examined whether any of the pre-injury variables were related to injury severity (i.e., time loss); however, all the correlations were non-significant (ps > .05). Descriptive data for post-injury variables are displayed in Table 2, whereas correlational data for post-injury variables are displayed in Tables 3–5.

Table 2. Descriptive data for post-injury variables across each time point

	Time 1		Time 2		Time 3	
Post-injury responses	*M*	*SD*	*M*	*SD*	*M*	*SD*
Devastation	11.49	1.55	7.77	1.84	6.65	1.98
Dispirited	11.33	2.36	8.91	2.66	7.16	2.12
Reorganization	5.54	1.51	9.38	1.68	11.17	1.65
Feeling cheated	9.24	3.05	8.53	3.61	5.73	1.84
Restlessness	9.13	2.54	8.51	2.54	8.08	1.56
Isolation	8.89	3.08	8.05	2.24	5.88	1.86
Problem-focused coping	51.09	11.38	53.69	11.27	53.72	13.14
Emotion-focused coping	23.95	7.13	23.84	6.20	20.28	6.49
Avoidance coping	19.80	4.03	20.45	3.83	19.31	3.77

Note. Time 1, injury onset; Time 2, rehabilitation; Time 3, return to competitive sport.

Table 3. Correlational data for post-injury variables at injury onset

Post-injury responses	1	2	3	4	5	6	7	8	9
1. Devastation	–	.56**	−.28**	.28**	.17	.23*	−.33**	−.02	.19
2. Dispirited		–	−.19	.21*	.17	.30**	−.37**	−.18	.16
3. Reorganization			–	−.13	.05	−.16	.36**	−.01	−.10
4. Feeling cheated				–	.31**	.48**	−.02	.19	.36**
5. Restlessness					–	.60**	−.01	.29**	.13
6. Isolation						–	−.08	.29**	.26**
7. Problem-focused coping							–	.42**	−.29**
8. Emotion-focused coping								–	.02
9. Avoidance coping									–

Note. $^{*}p < .05$; $^{**}p < .01$.

Table 4. Correlational data for post-injury variables at rehabilitation

Post-injury responses	1	2	3	4	5	6	7	8	9
1. Devastation	–	.42**	−.09	.44**	.42**	.35**	−.09	.25*	.14
2. Dispirited		–	−.23*	.45**	.49**	.54**	−.13	.39**	.26
3. Reorganization			–	−.09	−.10	−.24*	.44**	.08	−.20
4. Feeling cheated				–	.56**	.53**	.02	.45**	.29**
5. Restlessness					–	.55**	.03	.38**	.19
6. Isolation						–	−.13	.48**	.30**
7. Problem-focused coping							–	.27**	−.44**
8. Emotion-focused coping								–	.06
9. Avoidance coping									–

Note. $^{*}p < .05$; $^{**}p < .01$.

Table 5. Correlational data for post-injury variables at return to competitive sport

Post-injury responses	1	2	3	4	5	6	7	8	9
1. Devastation	–	.66**	−.22*	.58**	.47**	.58**	−.04	.57**	.42**
2. Dispirited		–	−.38**	.58**	.28**	.48**	−.11	.36**	.34**
3. Reorganization			–	−.24*	−.12	−.18	.59**	.07	−.16
4. Feeling cheated				–	.31**	.42**	−.06	.43**	.35**
5. Restlessness					–	.37**	−.03	.36**	.36**
6. Isolation						–	.03	.58**	.23*
7. Problem-focused coping							–	.29**	−.24*
8. Emotion-focused coping								–	.30**
9. Avoidance coping									–

Note. $^{*}p < .05$; $^{**}p < .01$.

Direct and indirect effects of hardiness on post-injury responses at injury onset

Table 6 displays the correlations between hardiness, commitment, control, and challenge with post-injury responses at injury onset. Hardiness was found to positively correlate with reorganisation, problem-focused coping and emotion-focused coping, and negatively correlate with devastation and dispirited. In terms of its subcomponents, challenge positively correlated with reorganization and problem-focused coping, and

Table 6. Correlational data for hardiness and post-injury variables at injury onset

Post-injury responses	Hardiness	Commitment	Control	Challenge
1. Devastation	−.23*	−.18	−.18	−.23**
2. Dispirited	−.28**	−.15	−.27**	−.30**
3. Reorganization	.29**	.27**	.15	.31**
4. Feeling cheated	−.07	.03	−.05	−.21*
5. Restlessness	.10	.13	.10	.03
6. Isolation	−.05	.01	−.04	−.12
7. Problem-focused coping	.27**	.16	.20*	.36**
8. Emotion-focused coping	.21*	.20*	.20	.12
9. Avoidance coping	.10	.19	.04	.01

Note. $^{*}p < .05$; $^{**}p < .01$.

negatively correlated with devastation, dispirited, and feeling cheated; commitment positively correlated with emotion-focused coping and reorganization; and control positively correlated with problem-focused coping and negatively correlated with dispirited. Follow-up multiple mediation models showed that the total indirect effects for coping mediating the relationship between hardiness and psychological responses were non-significant (ps $> .05$). However, an examination of the specific indirect effects indicated that problem-focused coping mediated the relationship between hardiness and reorganization (indirect effect = .01). With regard to the subcomponents of hardiness, the total and specific indirect effects for commitment and control were non-significant (ps $> .05$). In contrast, a significant total indirect effect was observed for coping (i.e., problem-focused coping, emotion-focused coping, and avoidance coping) mediating the relationship between challenge and reorganization (indirect effect = .04). Examining the specific indirect effects showed that problem-focused coping mediated the relationship between challenge and reorganization (indirect effect = .05) and challenge and devastation (indirect effect = −.04). Table 7 and Figures 5–7 illustrate these findings.

Direct and indirect effects of hardiness on post-injury responses at rehabilitation

Table 8 displays the correlations between hardiness, commitment, control, and challenge with post-injury responses at rehabilitation. Hardiness was found to positively correlate with reorganization and problem-focused coping, and negatively correlate with avoidance coping. In terms of its subcomponents, challenge positively correlated with reorganization and problem-focused coping, and negatively correlated with avoidance coping. In contrast, commitment only positively correlated with reorganization, and control only positively correlated with problem-focused coping and negatively correlated with avoidance coping. Follow-up multiple mediation models showed that the total indirect effects for coping mediating the relationship between hardiness (and its components) and psychological responses were non-significant (ps $> .05$). However, an examination of the specific indirect effects indicated that problem-focused coping mediated the relationship between hardiness and reorganization (indirect effect = .02) and challenge and reorganization (indirect effect = .04). Table 9 and Figures 8 and 9 illustrate these indirect findings.

Table 7. Indirect effects of hardiness on psychological responses through proposed mediators at injury onset

	Bootstrap effect	Normal effect	Normal theory tests			Bias corrected and accelerated CIs	
			SE	*Z*	*P*	Lower	Upper
Hardiness and reorganization							
Total effect	.01	.01	.01	1.22	.22	−.00	.02
PFC	.01	.01	.01	2.22	**.03**	.00	.03
EFC	−.01	−.01	.00	−1.53	.13	−.02	.00
AC	.00	−.00	.00	−0.10	.92	−.00	.00
Contrasts for indirect effects							
PFC versus EFC	.02	.02	.01	2.31	**.02**	.00	.04
PFC versus AC	.01	.01	.01	2.32	**.02**	.00	.03
EFC versus AC	−.01	−.01	.00	−1.39	.16	−.02	.00
Challenge and reorganization							
Total effect	.04	.04	.02	2.24	**.02**	.01	.09
PFC	.05	.05	.02	2.49	**.01**	.02	.10
EFC	−.01	−.01	.01	−1.02	.30	−.05	.00
AC	.00	.00	.00	0.05	.96	−.01	.00
Contrasts for indirect effects							
PFC versus EFC	.06	.06	.02	2.37	**.02**	.02	.13
PFC versus AC	.05	.05	.02	2.49	**.01**	.01	.10
EFC versus AC	−.01	−.01	.01	−1.02	.30	−.04	.01
Challenge and devastation							
Total effect	−.03	−.03	.02	−1.87	.06	−.07	−.00
PFC	−.04	−.04	.02	−2.14	**.03**	−.09	−.01
EFC	.01	.01	.01	0.86	.39	−.00	.04
AC	.00	.00	.00	0.08	.93	−.01	.01
Contrasts for indirect effects							
PFC versus EFC	−.05	−.05	.02	−2.05	**.04**	−.11	−.01
PFC versus AC	−.04	−.04	.02	−2.20	**.03**	−.09	−.01
EFC versus AC	.00	.00	.01	0.69	.49	−.01	.04

Note. PFC, problem-focused coping; EFC, emotion-focused coping; AC, avoidance coping. Significant ($p < .05$) effects indicated using bold text.

Direct and indirect effects of hardiness on post-injury responses at return to competitive sport

Table 10 displays the correlations between hardiness, commitment, control, and challenge with post-injury responses at return to competitive sport. Hardiness, commitment, control, and challenge were all found to be positively correlated with reorganization and problem-focused coping. Follow-up multiple mediator models indicated that the only significant total indirect effects were for coping mediating the relationship between hardiness (and its components) and reorganization: hardiness (indirect effect = .04), commitment (indirect effect = .06), control (indirect effect = .10), and challenge (indirect effect = .10). Examination of the specific indirect effects indicated that problem-focused coping mediated the relationship between hardiness and reorganization (indirect effect = .04), commitment and reorganization (indirect effect = .07), control and reorganization (indirect effect = .10), and challenge and reorganization (indirect effect = .10). Table 11 and Figures 10–13 illustrate these indirect findings.

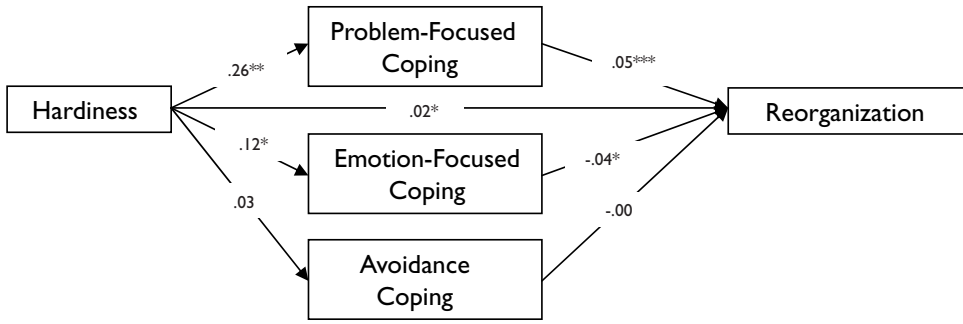

Figure 5. Coefficients representing effects of hardiness on coping and reorganization at injury onset. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$. The multiple mediator model was significant, $F(4,95) = 6.24$, $p < .001$, accounted for 21% of the variance (Adj. $R^2 = .17$).

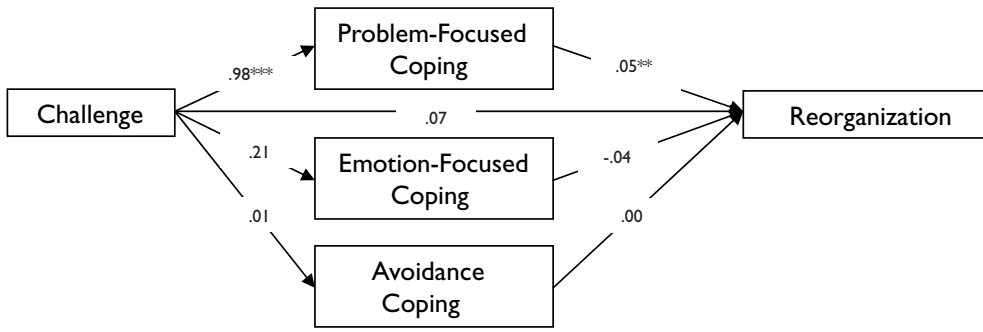

Figure 6. Coefficients representing effects of challenge on coping and reorganization at injury onset. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$. The multiple mediator model was significant, $F(4,95) = 5.72$, $p < .001$, accounted for 19% of the variance (Adj. $R^2 = .16$).

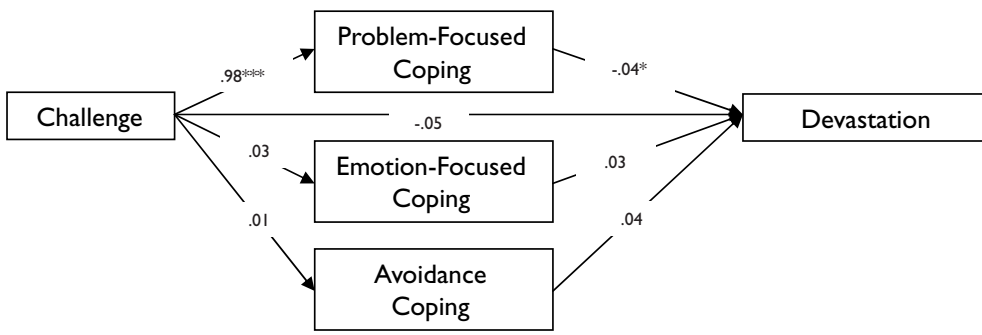

Figure 7. Coefficients representing effects of challenge on coping and devastation at injury onset. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$. The multiple mediator model was significant, $F(4,95) = 4.14$, $p < .01$, accounted for 15% of the variance (Adj. $R^2 = .11$).

Discussion

This study examined the effects of major life events and hardiness on the prediction of injury occurrence, and the effect of hardiness on how athletes' psychologically respond to, and cope with, injury over time. In relation to the pre-injury findings, a direct effect for negative rather than positive major life events provided support for the first hypothesis

Table 8. Correlational data for hardiness and post-injury variables at rehabilitation

Post-injury responses	Hardiness	Commitment	Control	Challenge
1. Devastation	.06	.14	.06	−.08
2. Dispirited	.06	.10	.03	.01
3. Reorganization	.27**	.21*	.18	.31**
4. Feeling cheated	−.03	.10	−.05	−.14
5. Restlessness	.10	.15	.08	.01
6. Isolation	−.08	−.01	−.08	−.11
7. Problem-focused coping	.26**	.18	.22*	.27**
8. Emotion-focused coping	.15	.15	.12	.10
9. Avoidance coping	−.25*	−.18	−.21*	−.26**

Note. $^{*}p < .05$; $^{**}p < .01$.

Table 9. Indirect effects of hardiness on psychological responses through proposed mediators at rehabilitation

	Bootstrap effect	Normal effect	Normal theory tests			Bias corrected and accelerated CIs	
			SE	*Z*	*P*	Lower	Upper
Hardiness and reorganization							
Total effect	.01	.01	.01	1.83	.07	−.00	.03
PFC	.02	.02	.01	2.25	**.02**	.00	.03
EFC	−.00	−.00	.00	−0.66	.51	−.01	.00
AC	−.00	−.00	.00	−0.45	.66	−.01	.00
Contrasts for indirect effects							
PFC versus EFC	.02	.01	.01	2.20	**.03**	.00	.04
PFC versus AC	.01	.02	.01	1.97	.05	.00	.04
EFC versus AC	.00	.00	.00	0.05	.96	−.01	.01
Challenge and reorganization							
Total effect	.04	.04	.02	2.24	**.02**	.01	.09
PFC	.05	.05	.02	2.49	**.01**	.02	.10
EFC	−.01	−.01	.01	−1.02	.30	−.05	.00
AC	.00	.00	.00	0.05	.96	−.01	.00
Contrasts for indirect effects							
PFC versus EFC	.06	.06	.02	2.37	**.02**	.02	.13
PFC versus AC	.05	.05	.02	2.49	**.01**	.01	.10
EFC versus AC	−.01	−.01	.01	−1.02	.30	−.04	.01

Note. PFC, problem-focused coping; EFC, emotion-focused coping; AC, avoidance coping. Significant ($p < .05$) effects indicated using bold text.

of this study and associated research (i.e., as negative major life events increased, the risk of injury increased). Indeed, negative major life events have also been found to predict injury occurrence in 196 collegiate athletes participating in a range of sports (Andersen & Williams, 1999), 144 high school varsity soccer players (Rogers & Landers, 2005) and 470 rugby union and league players (Maddison & Prapavessis, 2005). A potential

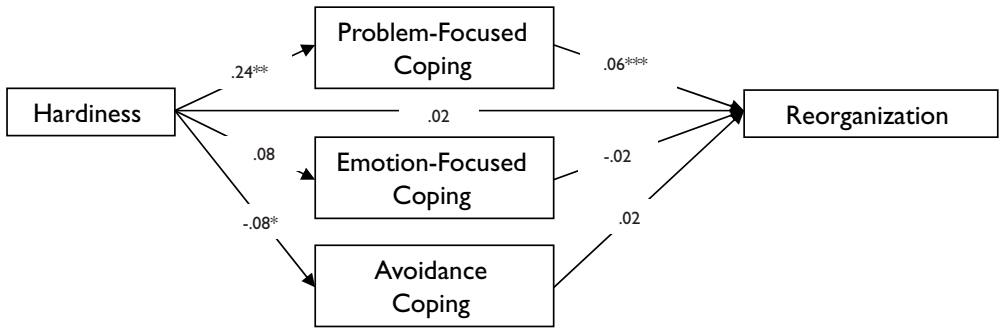

Figure 8. Coefficients representing effects of hardiness on coping and reorganization at rehabilitation. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$. The multiple mediator model was significant, $F(4,95) = 7.01$, $p < .001$, accounted for 23% of the variance (Adj. $R^2 = .20$).

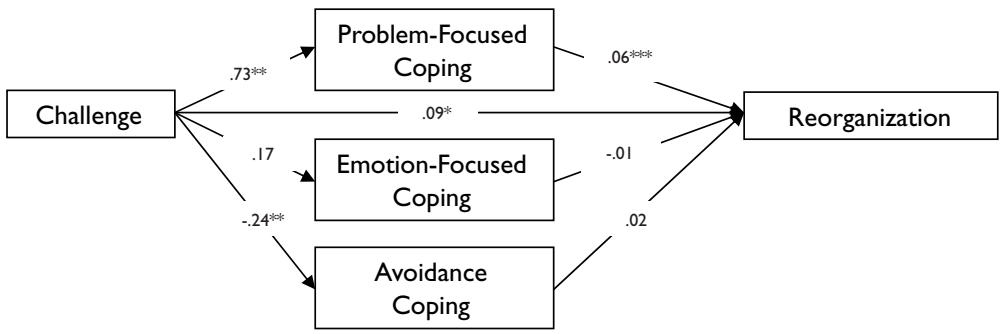

Figure 9. Coefficients representing effects of challenge on coping and reorganization at rehabilitation. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$. The multiple mediator model was significant, $F(4,95) = 7.42$, $p < .0001$, accounted for 24% of the variance (Adj. $R^2 = .21$).

Table 10. Correlational data for hardiness and post-injury variables at return to competitive sport

Post-injury responses	Hardiness	Commitment	Control	Challenge
1. Devastation	−.06	−.02	.03	−.14
2. Dispirited	−.02	.03	−.01	−.14
3. Reorganization	.36**	.25*	.28**	.40**
4. Feeling cheated	−.08	−.06	−.06	−.08
5. Restlessness	.07	.13	.06	−.06
6. Isolation	−.02	.04	.00	−.13
7. Problem-focused coping	.52**	.37**	.47**	.48**
8. Emotion-focused coping	.17	.17	.17	.06
9. Avoidance coping	−.04	−.05	−.04	−.01

Note. $^{*}p < .05$; $^{**}p < .01$.

explanation for this finding is that negative major life events require a substantial amount of physiological, psychological, and behavioural readjustment (Brown & Harris, 1978; Holmes & Rahe, 1967), which, according to Williams and Andersen's (1998) model, could exacerbate the mechanism that is proposed to directly lead to injury occurrence

Table 11. Indirect effects of hardiness on psychological responses through proposed mediators at return to sport

	Bootstrap effect	Normal effect	Normal theory tests			Bias corrected and accelerated CIs	
			SE	*Z*	*P*	Lower	Upper
Hardiness and reorganization							
Total effect	.04	.04	.01	4.09	**.00**	.02	.06
PFC	.04	.04	.01	4.12	**.00**	.02	.07
EFC	−.00	−.00	.00	−1.03	.30	−.01	.00
AC	.00	−.00	.00	−0.19	.85	−.00	.00
Contrasts for indirect effects							
PFC versus EFC	.04	.04	.01	3.95	**.00**	.02	.07
PFC versus AC	.04	.04	.01	4.04	**.00**	.02	.07
EFC versus AC	−.00	−.00	.00	−1.01	.31	−.01	.00
Commitment and reorganization							
Total effect	.06	.06	.02	3.22	**.00**	.02	.11
PFC	.07	.07	.02	3.38	**.00**	.02	.12
EFC	−.01	−.01	.01	−1.07	.28	−.02	.00
AC	.00	−.00	.00	−0.25	.80	−.01	.00
Contrasts for indirect effects							
PFC versus EFC	.08	.07	.02	3.30	**.00**	.03	.13
PFC versus AC	.07	.07	.02	3.32	**.00**	.03	.13
EFC versus AC	−.01	−.01	.01	−1.02	.30	−.02	.01
Control and reorganization							
Total effect	.10	.09	.02	3.98	**.00**	.05	.15
PFC	.10	.10	.03	4.03	**.00**	.05	.16
EFC	−.01	−.01	.01	−1.04	.30	−.03	.00
AC	.00	−.00	.00	−0.22	.82	−.01	.01
Contrasts for indirect effects							
PFC versus EFC	.11	.11	.03	3.88	**.00**	.05	.18
PFC versus AC	.10	.10	.03	3.97	**.00**	.05	.17
EFC versus AC	−.01	−.01	.01	−1.00	.32	−.03	.01
Challenge and reorganization							
Total effect	.10	.10	.03	3.85	**.00**	.05	.17
PFC	.10	.10	.03	3.77	**.00**	.05	.17
EFC	−.00	−.00	.00	−0.53	.60	−.02	.00
AC	.00	.00	.00	0.00	.10	−.01	.01
Contrasts for indirect effects							
PFC versus EFC	.11	.11	.03	0.00	**.00**	.05	.18
PFC versus AC	.10	.10	.03	0.00	**.00**	.05	.17
EFC versus AC	−.00	−.00	.00	0.59	.59	−.02	.01

Note. PFC, problem-focused coping; EFC, emotion-focused coping; AC, avoidance coping. Significant ($p < .05$) effects indicated using bold text.

(i.e., the stress response). For example, a female recreational rugby union player who has recently moved home and is unable to find a job, might not only be physically exhausted from the relocation itself, but she may also be experiencing disruptions to her normal sleeping pattern because of her work-related concerns. As a result, when she comes to

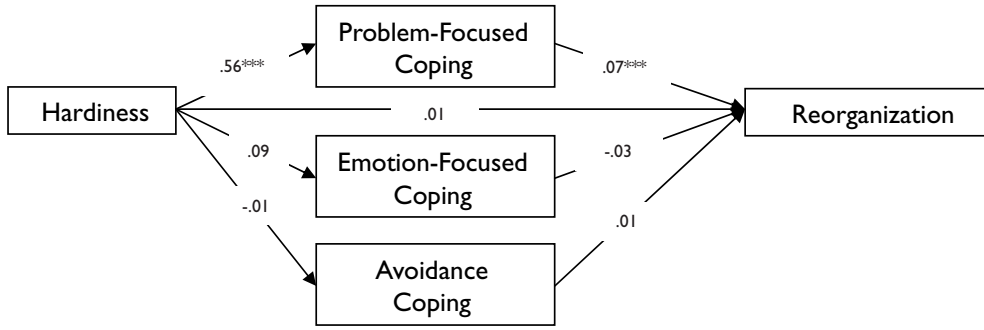

Figure 10. Coefficients representing effects of hardiness on coping and reorganization at return to sport. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$. The multiple mediator model was significant, $F(4,95) = 13.49$, $p < .0001$, accounted for 36% of the variance (Adj. $R^2 = .34$).

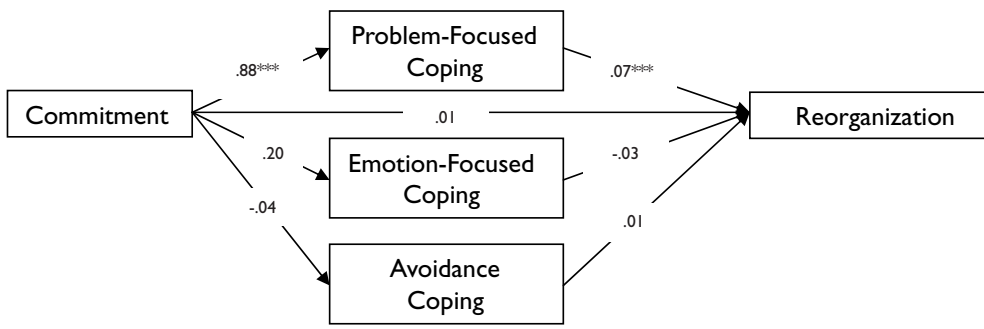

Figure 11. Coefficients representing effects of commitment on coping and reorganization at return to sport. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$. The multiple mediator model was significant, $F(4,95) = 13.35$, $p < .0001$, accounted for 36% of the variance (Adj. $R^2 = .33$).

play a competitive rugby match, she may appraise that she had insufficient physical resources to cope effectively with its associated demands, which may exacerbate the physiological (e.g., increased muscle tension) and attentional (e.g., narrowing of the visual field) aspects of her stress response and heighten her subsequent risk of injury.

In relation to hardiness, as hypothesized, it was found to predict injury occurrence (i.e., as hardiness increased, the risk of injury decreased), which was also found for each of its subcomponents. These findings could be explained by drawing on Williams and Andersen's (1998) model and associated research (e.g., Rhodewalt & Agustsdottir, 1984; Rhodewalt & Zone, 1989). That is, although athletes high in hardiness may experience a potentially demanding athletic situation in the same way as athletes low in hardiness, they have been demonstrated to appraise or reappraise its associated demands in less stressful terms; therefore, potentially decreasing the severity of the stress response and subsequent risk of injury. In addition, individuals high in hardiness have been observed to engage in positive health practices (e.g., adequate nutrition, exercise, and relaxation) whilst avoiding negative health practices such as alcohol and drug use (e.g., Maddi, Wadhwa, & Haier, 1996; Nagy & Nix, 1989; Wiebe & McCallum, 1986), which might have also impacted on their susceptibility to injury. Interestingly, this study also found

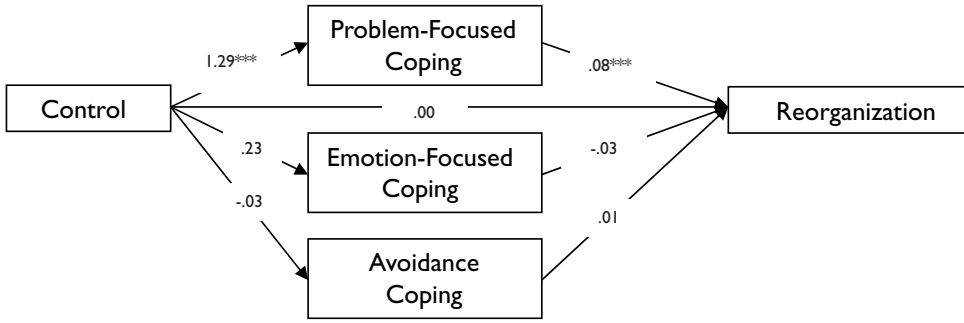

Figure 12. Coefficients representing effects of control on coping and reorganization at return to sport. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$. The multiple mediator model was significant, $F(4,95) = 13.23$, $p < .0001$, accounted for 36% of the variance (Adj. $R^2 = .33$).

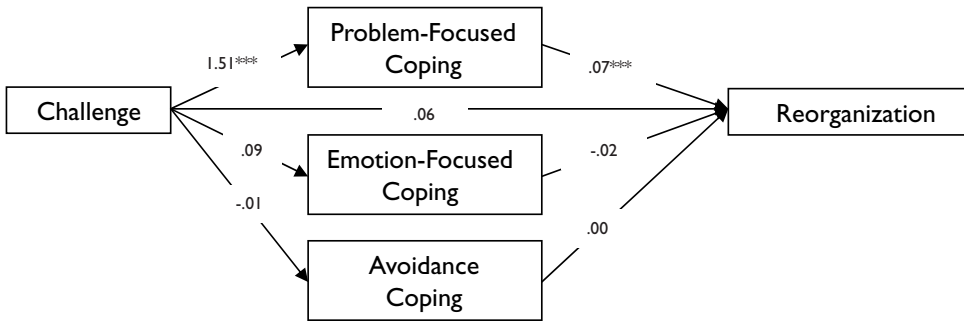

Figure 13. Coefficients representing effects of challenge on coping and reorganization at return to sport. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$. The multiple mediator model was significant, $F(4,95) = 14.23$, $p < .0001$, accounted for 37% of the variance (Adj. $R^2 = .35$).

hardiness and its subcomponents to moderate the relationship between negative major life events and injury occurrence, which supports Kobasa's (1979) original hypothesized effect of hardiness. Indeed, individuals high in hardiness are suggested to transform major life events from potentially debilitating experiences into opportunities for growth and development through a number of mechanisms (i.e., adaptive appraisals, use of problem- and emotion-focused coping strategies, giving and receiving of social support, and positive health practices; Maddi, 2002). In line with Williams and Andersen's (1998) model that suggests a history of *more* major life events will increase the risk of injury, athletes high in hardiness might therefore resolve the events they experience through the aforementioned mechanisms, thereby reducing their history of *unresolved* major life events and ultimately lowering their risk of injury (cf. Turner & Avison, 1992).

Although this study shows that athletes high in hardiness are less likely to become injured through the effects of negative major life events, it is important to recognize that there are many other and perhaps more prevalent causes of injuries (e.g., fatigue, improper technique, and/or the actions of other competitors). If athletes high in hardiness do become injured through these alternative means, the post-injury findings suggest that these athletes can facilitate their psychological recovery from injury. Specifically,

as hypothesized, hardiness was negatively correlated with feelings of dispiritedness and devastation at injury onset, and positively correlated with reorganization at injury onset, rehabilitation, and return to sport. Although there were some inconsistencies amongst the subcomponents of hardiness in terms of their relationship with psychological responses, they essentially supported the findings derived from the composite hardiness score. However, one notable inconsistency was that only challenge was negatively correlated with feeling cheated at injury onset. A potential explanation for this finding is that challenge is associated with believing that the anticipation of changes (e.g., onset of injury) are interesting incentives for growth; therefore, rather than feeling cheated and viewing injury as a potentially debilitating experience, athletes high in challenge are likely to view their injury as an opportunity for growth and development (cf. Wadey, Evans, Evans, & Mitchell, in press).

In relation to coping, consistent with the study's hypotheses and previous hardiness research (e.g., Florian *et al.*, 1995; Klag & Bradley, 2004; Maddi & Hightower, 1999), this study revealed that hardiness was positively correlated with emotion-focused coping at injury onset and negatively correlated with avoidance coping during rehabilitation. Despite these significant relationships, athletes high in hardiness and its subcomponents were found to use more problem focusing coping strategies throughout their recovery. In addition, the results of the mediation analyses revealed specific indirect effects of hardiness through the use of problem-focused coping strategies on psychological responses, which was not found for emotion-focused coping or avoidance coping. That is, problem-focused coping mediated the relationship between hardiness and reorganization at injury onset, rehabilitation, and return to sport. Put simply, athletes high in hardiness used more problem-focused coping, which in turn increased feelings of reorganization throughout recovery (e.g., feeling confident and mentally stronger). This indirect effect was also found for each of the subcomponents of hardiness during the return to sport phase. In addition, indirect effects were found for challenge at injury onset (i.e., problem-focused coping mediated the relationship between challenge and reorganization and devastation) and rehabilitation (i.e., problem-focused coping mediated the relationship between challenge and reorganization). But despite these significant mediation effects, it is important that practitioners are cognizant that the resilient attitudes of hardiness are proposed to provide the motivation to use problem-focused coping strategies (Maddi, 1999). Therefore, it might not be enough for practitioners to help athletes acquire problem-focused coping strategies to address their psychological responses to injury; they firstly may need to develop or deepen the attitudes of commitment, control, and challenge (Maddi & Khoshaba, 2004).

This study had a number of strengths and limitations. An important strength was that it explored the psychological factors related to the occurrence of, and responses to, injury. As far as the authors are aware, no researchers have yet integrated these fields of research to provide a more complete picture of the full temporal sport injury process. Consistent with recent methodological recommendations (e.g., Evans *et al.*, 2006; Petrie & Falkstein, 1998), this study also provided a longitudinal account of the sport injury process rather than a retrospective and cross-sectional analysis. Despite these strengths, this study did have a number of limitations. One key limitation is that the pre-injury variables were only assessed at one point in time. Petrie and Falkstein (1998) recommended the importance of measuring pre-injury variables on multiple occasions across the time frame of interest. However, considering this study's large sample size and that it also embraced athletes' responses to injury, this addition to the methodological design was not considered feasible. Another limitation of this study is

that it did not compare injured athletes' post-injury responses with a matched non-injured control group, which would have helped to support the hypothesis that injury occurrence is the causal factor of post-injury psychological responses (cf. Appaneal *et al.*, 2009). Finally, it is important to note that a small number of performers declined to participate because they were moving country or ceasing participation in sport and exercise; it is unclear whether those athletes who participated differed from those who declined.

There are several avenues for future research emanating from this study. From a practical perspective, subsequent studies should observe the efficacy and/or effectiveness of hardiness-training programmes in reducing the risk of, and facilitating recovery from, injury (cf. Maddi, 1987; Maddi, Kahn, & Maddi, 1998; Maddi, Khoshaba, Jensen, Carter, Lu, & Harvey, 2002). In terms of reducing the risk of injury, however, it is important that practitioners recognize that hardiness-training programmes go above and beyond the recommendations provided within Williams and Andersen's (1998) model. This model suggests that practitioners should employ interventions that address the stress response itself (e.g., recognizing and controlling for physiological and attentional changes). In contrast, hardiness-training programmes are more proactive and preventative in that they aim to increase athletes' resilience to injury by resolving the stressors (e.g., negative major life events) that give rise to the stress response. From a theoretical perspective, another avenue for future research is to explore the application of Williams and Andersen's (1998) and Wiese-Bjornstal *et al.*'s (1998) models to other health-related outcomes. For example, Bianco *et al.* (1999) and Petrie and Perna (2004) have suggested that these models could be extended to encapsulate illness and other indicators of health and well-being. To widen the focus of this study even further, future research could take an interdisciplinary approach. For example, subsequent studies could consider the additive and/or synergistic effects of major life events, hardiness, and other psychosocial variables with, for example, physiological and biomechanical indicators associated with the prediction of, and recovery from, injury. Finally, future research should continue to integrate pre-injury and post-injury phases to observe the relationships between these two currently independent domains of research, which will help to develop a more unified body of research. Once future research has explored these relationships, they should seek to integrate and potentially extend Williams and Andersen's (1998) and Wiese-Bjornstal *et al.*'s (1998) models. Such theoretical integration would help to stimulate systematic lines of inquiry investigating the full-temporal sport injury process, which will be fundamental to enhancing the knowledge and understanding of this field of research. Importantly, each of the aforementioned future avenues of research will potentially have a number of implications for coaches, medical practitioners, and sporting (e.g., national governing bodies and international federations) and non-sporting organizations that have a vested interest in the health- and performance-related benefits derived from participating in sport and exercise.

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