1   Adverse life events, cardiovascular responses, and sports performance under pressure

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3   Dr Lee J. Moore [a], Tom Young [b], Dr Paul Freeman [c], and Dr Mustafa Sarkar [d]

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5   [a] University of Gloucestershire, School of Sport and Exercise, Faculty of Applied Sciences

6   [b] University of South Wales, School of Health, Sport, and Professional Practice, Faculty of Life

7   Sciences and Education

8   [c] University of Essex, School of Biological Sciences, Faculty of Science and Health

9   [d] Nottingham Trent University, Department of Sport Science, School of Science and Technology

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11   Corresponding author: Dr Lee J. Moore

12   School of Sport and Exercise

13   Faculty of Applied Sciences

14   University of Gloucestershire

15   Oxstalls Campus

16   Gloucester

17   GL2 9HW

18   Email: lmoore1@glos.ac.uk

19   Tel: +44 1242 715123

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29   Abstract

30   Research suggests that experiencing a moderate number of adverse life events can benefit future stress

31   responses. This study explored the relationship between adverse life (i.e., non-sport) events and

32   cardiovascular responses to, and performance during, a pressurized sporting task. One hundred

33   participants (64 men, 36 women; M_{age} = 21.94 years, SD_{age} = 4.98) reported the number of adverse life

34   events (e.g., serious accident or injury) they had encountered before completing a pressurized dart-

35   throwing task during which performance was recorded. Before the task, participants' demand and

36   resource evaluations and cardiovascular reactivity were assessed. Adverse life events did not impact

37   demand and resource evaluations. However, participants who reported 4-7 adverse life events

38   displayed cardiovascular responses more reflective of a challenge state (relatively lower total

39   peripheral resistance and/or higher cardiac output) compared to those who reported a lower (<4) or

40   higher (>7) number of events. Furthermore, participants who reported 3-13 adverse life events

41   outperformed those who reported a lower (<3) or higher (>13) number of events. Supplementary

42   analyses suggested that this relationship might be due to a small number of extreme values. However,

43   after outlier analyses, a significant linear relationship remained suggesting that a higher number of

44   adverse life events facilitated performance. The results suggest that experiencing a moderate to high

45   number of adverse life events might have beneficial effects on subsequent cardiovascular responses

46   and performance under pressure. Practitioners should therefore consider prior brushes with adversity

47   when identifying athletes who are likely to excel during stressful competition.

48   *Keywords:* Adversity; appraisal; athletic performance; psychophysiology; stress; threat state

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57   Adverse life events, cardiovascular responses, and sports performance under pressure

Introduction

59   It has been speculated that "talent needs trauma" (Collins & MacNamara, 2012, p.907), and

60   that athletes who experience adversities during their personal lives and sporting careers are more

61   likely to perform optimally under pressure. While intuitively appealing, research has only recently

62   examined this notion in an athletic context (Fletcher & Sarkar, 2012; Howells & Fletcher, 2015).

63   Sarkar and colleagues (2015) interviewed 10 Olympic champions who considered encountering sport

64   (e.g., significant sporting failure) and non-sport (e.g., death of a family member) adversities as

65   essential for winning their gold medals. Research on this topic has often employed retrospective

66   qualitative methods that limit causal understanding of the link between adversities and performance

67   (e.g., Fletcher & Sarkar, 2012; Howells & Fletcher, 2015). Thus, the present study offers a

68   quantitative test of the relationship between adverse life (i.e., non-sport) events and pressurized sports

69   performance, using the biopsychosocial model (BPSM) of challenge and threat states as a theoretical

70   framework (Blascovich, 2008).

71   Akin to cognitive appraisal theory (Lazarus & Folkman, 1984), the BPSM predicts that before

72   a pressurized situation, an individual evaluates the demands of the situation and their resources to cope

73   (Blascovich, 2008). Crucially, these evaluations only occur when an individual is actively engaged in

74   the situation (indicated by increased heart rate [HR] or the number of heart beats per minute; Seery,

75   2011). When resources are judged to match or exceed demands, an individual evaluates the situation

76   as a challenge. When demands are deemed to outweigh resources, an individual evaluates the situation

77   as a threat (Seery, 2011). Inspired by the theory of physiological toughness (Dienstbier, 1989), the

78   BPSM predicts that these evaluations trigger distinct cardiovascular responses (Blascovich, 2008). A

79   challenge evaluation results in sympathetic-adrenomedullary activation, which releases

80   catecholamines that dilate the blood vessels and increase cardiac activity, resulting in greater

81   oxygenated blood flow to the brain and muscles. A threat evaluation also results in pituitary-

82   adrenocortical activation, which releases cortisol that inhibits dilation of the blood vessels and reduces

83   cardiac activity, resulting in less blood flow. Compared to a threat state, a challenge state is therefore

84   indexed by lower total peripheral resistance (TPR; net constriction versus dilation in the arterial

85   system) and/or higher cardiac output (CO; amount of blood in liters pumped by the heart per minute;

86   Seery, 2011). Importantly, the BPSM conceptualizes challenge and threat as anchors of a single

87   bipolar continuum rather than dichotomous states, leading researchers to examine relative (rather than

88   absolute) differences in challenge and threat (i.e., greater vs. lesser challenge or threat; Seery, 2011).

89   The BPSM contends that a challenge state is better for performance than a threat state

90   (Blascovich, 2008), and research has supported this assertion (Blascovich et al., 2004; Moore et al.,

91   2012; Turner et al., 2013). To illustrate, Moore and colleagues (2012) found that evaluating a golf

92   competition as more of a challenge was associated with superior performance. In a follow-up study,

93   Moore and colleagues (2013) manipulated experienced golfers into either a challenge or threat state

94   immediately before a pressurized golf-putting task; golfers in the challenge condition outperformed

95   those in the threat condition, holing a higher percentage of putts and leaving the ball closer to the hole

96   on misses. Similar results have been reported for pressurized tasks in educational (Seery et al., 2010),

97   medical (Vine et al., 2013), and aviation (Vine et al., 2015) settings.

98   Alongside this research, social psychologists have used the BPSM to investigate the

99   relationship between prior exposure to adverse life events and subsequent responses to stress (Seery,

100   Holman et al., 2010; Seery, Leo et al., 2010). Seery and colleagues (2013) assessed participants'

101   histories of negative life events before a computer-based navigation task. Results revealed a

102   curvilinear relationship, with a moderate number of adverse life events (5) related to a cardiovascular

103   response more reflective of a challenge state compared to no (0) or a high (11) number of events.

104   Contrary to the view that experiencing adverse life events increases the risk of future psychological

105   problems (Turner & Lloyd, 1995), this finding suggests that exposure to some negative life events

106   may have a 'silver lining' and benefit individuals during future pressurized situations - helping

107   individuals view such situations as less demanding and/or that they have the ability to cope given their

108   prior adversities. Despite this finding, no research has examined the link between adverse life (i.e.,

109   non-sport) events and subsequent cardiovascular responses to, and performance during, a pressurized

110   sporting task. Indeed, experiencing a moderate number of adverse life events might benefit pressurized

111   performance by fostering a challenge state, while encountering a low or high number of adverse

112   events might harm performance by provoking a threat state.

113   This study aimed to shed light on this issue by examining the relationship between adverse life

114   (i.e., non-sport) events and three outcomes, namely (1) demand and resource evaluations, (2)

115   cardiovascular responses, and (3) task performance. Based on the aforementioned research (Seery et

116   al., 2013), curvilinear relationships were predicted, with a moderate number of adverse life events

117   associated with demand and resource evaluations (i.e., resources exceeding demands) and

118   cardiovascular responses (i.e., lower TPR and/or higher CO) more reflective of a challenge state

119   compared to a low or high number of events. Moreover, it was predicted that experiencing a moderate

120   number of adverse life events would be related to better performance during the pressurized sporting

121   task than a low or high number of events.

Materials and Methods

Participants

124   One hundred participants (64 men, 36 women; $Range_{age}$ = 18-46, M_{age} = 21.94 years, SD_{age} =

125   4.98) were tested individually. Participants reported competing in various team (n = 57; e.g., rugby

126   union) and individual (n = 43; e.g., equestrian) sports, predominately at a club or university/collegiate

127   level. Importantly, participants declared having no formal dart throwing experience and were thus

128   considered novices. Participants were nonsmokers, free of illness, had no known family history of

129   cardiovascular or respiratory disease, had not performed vigorous exercise or ingested alcohol in the

130   preceding 24 hours, and had not consumed food or caffeine in the preceding hour. The protocol was

131   designed in accordance with the British Psychological Society's guidelines and received institutional

132   ethical approval. After reading an information sheet, participants provided written consent.

Measures

134   *Adverse life events*. Cumulative lifetime adversity was assessed using a checklist that asked

135   participants whether they had experienced 37 negative life (i.e., non-sport) events (e.g., serious

136   accident or injury, financial difficulties). Up to six instances of each event was recorded and the

137   number of instances was summed as a measure of adverse life events (as Seery et al., 2013). This

138   checklist, originally derived from the trauma section of the Diagnostic Interview Schedule (Robins,

139   Helzer, Croughnan, Williams, & Spitzer, 1981), was identical to previous measures of adversity (see

140   Seery, Holman et al., 2010). Although this measure does not assess the severity or timing of each

141   adverse event, it has been used in previous research to examine the relationship between negative life

142   events and important outcomes such as psychological wellbeing (see Seery & Quinton, 2016).

143   ***Demand resource evaluations.*** Two self-report items were used to assess evaluations of task

144   demands and personal coping resources respectively (Tomaka et al., 1993): "How demanding do you

145   expect the upcoming dart-throwing task to be?" and "How able are you to cope with the demands of

146   the upcoming dart-throwing task?" Both items were rated on a 6-point Likert scale (1 - *not at all* to 6 -

147   *extremely*). A demand resource evaluation score was calculated by subtracting evaluated demands

148   from resources (range: -5 to +5), with a positive score reflecting a challenge state and a negative score

149   reflecting a threat state. Previous research has used this self-report measure to assess challenge and

150   threat states (e.g., Moore et al., 2013; Vine et al., 2015).

151   ***Cardiovascular responses.*** An ambulatory blood pressure monitoring system (Portapres-2,

152   Finapres Medical Systems, Amsterdam, The Netherlands), which has been shown to be accurate and

153   reliable (see Hirschl et al., 1999), was employed. A finger cuff was attached to the middle finger of

154   their non-dominant hand and was inflated to continuously estimate cardiovascular data. This system

155   estimated HR, TPR, and CO, and has been used in previous research (Zanstra et al., 2010).

156   Cardiovascular reactivity - or the difference between the final minute of baseline and the minute after

157   these instructions - was used to assess whether participants were engaged in the task (a pre-requisite of

158   challenge and threat states; with larger increases in HR reflecting greater engagement), and if they

159   exhibited a cardiovascular response more indicative of challenge or threat (the former characterized by

160   relatively greater decreases in TPR and/or increases in CO; Seery, 2011). Unfortunately, due to signal

161   problems, cardiovascular data from nine participants was not recorded.

162   ***Task performance.*** A dart-throwing task that required participants to throw nine darts to a

163   dartboard (diameter = 44.80 cm; height from floor to bullseye = 1.73 m) from a distance of 2.37 m

164   was used. The dartboard had ten concentric scoring circles, with the innermost circle (bullseye) worth

165   10 points and the outermost circle worth 1 point (as Coffee et al., 2009). Performance was recorded as

166   a score out of 90, with a higher score reflecting better performance.

167   **Procedure**

168   First, participants completed the measure of adverse life events before being fitted with the

169   Portapres-2. Next, participants sat still and quietly while five minutes of baseline cardiovascular data

170   was recorded. Subsequently, participants received instructions about the dart-throwing task designed

171   to elevate pressure (Baumeister & Showers, 1986). Importantly, these instructions have been

172   successful in increasing pressure in previous research (e.g., Cooke et al., 2010), and informed

173   participants that they would be entered into a competition, with the top five performers awarded prizes

174   and the bottom five performers being interviewed about their poor performance. Participants were also

175   instructed that scores would be published on a leaderboard and videos of their performance may be

176   used in presentations to their peers. Next, one minute of cardiovascular data was recorded while

177   participants reflected on these instructions and the upcoming task. Participants then reported demand

178   and resource evaluations before performing the pressurized dart-throwing task. Following the task,

179   participants had all equipment removed, were debriefed, and thanked for their participation.

180   **Results**

181   Participants reported between 0 and 25 adverse life events (8% reported no events). The mean

182   number of adverse life events was comparable to previous research (i.e., Seery et al., 2013). TPR and

183   CO reactivity were combined into a single challenge/threat index by converting reactivity values into

184   z-scores and summing them. TPR was assigned a weight of -1 (i.e., reverse scored) and CO a weight

185   of +1, such that a higher value corresponded with more of a challenge state (as Seery et al., 2009).

186   Data with z-scores greater than 2 were removed from further analyses (three values for each of

187   demand resource evaluation score, challenge/threat index, and task performance; as Moore et al.,

188   2013). Following these outlier analyses, all data were normally distributed (i.e., skewness and kurtosis

189   z-scores did not exceed 1.96). To assess task engagement, a dependent t-test was conducted on the HR

190   reactivity data to establish that, in the sample as a whole, HR increased significantly from baseline

191   (i.e., HR reactivity greater than zero; as Seery et al., 2009). The results confirmed that HR increased

192   by an average of 1.27 beats per minute ($SD = 3.35$), $t(85) = 3.52$, $p = .001$, confirming task

193   engagement and enabling further examination of TPR and CO reactivity (via challenge/threat index).

194   Descriptive statistics and bivariate correlations were calculated (Table 1). To examine the

195   curvilinear relationships between the number of adverse life events and outcomes (i.e., demand

196   resource evaluation score, challenge/threat index, and task performance), hierarchical regression

197   analyses were conducted. The mean centered number of events was entered at step 1, quadratic term

198   (mean centered events^2) at step 2, and cubic term (mean centered events^3) at step 3. The significance

199   of additional variance explained in the outcomes at each step was assessed. The cubic term was added

200   to allow for additional bends in the modelled curve, accounting for the influence of a small number of

201   extreme adverse life events (as Seery et al., 2013). If a cubic term was significant, the quadratic term

202   at mean adverse life events within the cubic model was examined (as Seery et al., 2013). To explore

203   significant quadratic terms, the linear simple slopes at different levels of adversity were examined

204   (Aiken & West, 1991): 1 *SD* below the mean, at the mean, and 1 *SD* above the mean, representing

205   low, average, and high numbers of adverse life events, respectively. To be consistent with the

206   hypotheses, the slopes of the regression lines would be significant and positive at low adverse life

207   events, not significant at average adverse life events, and significant and negative at high adverse life

208   events. We also determined at which specific number of events the relationships between adverse life

209   events and outcomes became (non) significant. This post hoc probing used values from the variance-

210   covariance matrix of the regression coefficients to calculate the standard errors of the slopes of the

211   regression lines and their 95% confidence intervals (Aiken & West, 1991; Cohen et al., 2003). The

212   slopes of the regression lines were considered significant if their 95% confidence intervals did not

213   contain zero.

214   The results revealed no significant linear ($R^2 = .01$, $p = .30$), quadratic ($\Delta R^2 = .02$, $p = .14$), or

215   cubic ($\Delta R^2 = .002$, $p = .68$) relationship between adverse life events and demand resource evaluation

216   score. In the challenge/threat index model, beyond non-significant linear ($R^2 = .01$, $p = .30$) and

217   quadratic ($\Delta R^2 = .02$, $p = .16$) components, a significant cubic ($\Delta R^2 = .09$, $p = .004$) relationship was

218   observed between adverse life events and challenge/threat index (Figure 1). Within this cubic model,

219   there was a significant quadratic relationship at mean adverse life events ($b = -0.02$, $p = .001$, $sr^2 =$

220   .12). The slope of this curve was significant and positive at low adverse life events ($slope_{low} = 0.24$,

221   95% CI 0.10, 0.38), not significant at average adverse life events ($slope_{mean} = 0.05$, 95% CI -0.02,

222   0.11), and significant and negative at high adverse life events ($slope_{high} = -0.15$; 95% CI -0.27, -0.03).

223   The slope of the regression line was significant and positive at adverse life events less than 0.11 *SD*

224   below the mean (*slope* = 0.07, 95% CI 0.001, 0.13), and significant and negative at adverse life events

225   more than 0.72 *SD* above the mean (*slope* = -0.09, 95% CI -0.19, -0.0004). These analyses indicated

226   that individuals who reported 4-7 adverse life events displayed a cardiovascular response more

227   indicative of a challenge state than those who reported a lower (<4) or higher (>7) number of events.

228   Beyond a non-significant linear component (R^2 = .01, p = .46), a significant quadratic (ΔR^2 =

229   .09, p = .003) relationship was observed between adverse life events and performance (Figure 2). The

230   cubic component did not contribute significant additional variance (ΔR^2 = .01, p = .43). The slope of

231   the quadratic relationship was significant and positive at low ($slope_{low}$ = 1.71, 95% CI 0.58, 2.84) and

232   average adverse life events ($slope_{mean}$ = 0.92, 95% CI 0.24, 1.60), but was not significant at high

233   adverse life events ($slope_{high}$ = 0.13; 95% CI -0.33, 0.58). Specifically, the slope of the regression line

234   was significant and positive at adverse life events less than 0.51 *SD* above the mean (*slope* = 0.51,

235   95% CI 0.002, 1.03), and significant and negative at adverse life events more than 2.15 *SD* above the

236   mean (*slope* = -0.79, 95% CI -1.57, -0.003). These analyses indicated that individuals who reported a

237   3-13 adverse life events outperformed those who reported a lower (<3) or higher (>13) number of

238   events. Inspection of Figure 2, however, indicated that the quadratic relationship between adverse life

239   events and performance may be due to a small number of data points at extreme values. To further

240   explore this, supplementary analyses were conducted by removing the outliers (>2 *SDs* above the

241   mean) and also (in a separate analysis) winsorizing the outliers to 1% higher than the next highest non-

242   extreme value before repeating the regression analysis. In these supplementary analyses, the quadratic

243   term was not significant (ΔRs^2 < .02, ps > .05), but a positive linear relationship was observed within

244   these models (bs = 0.77-0.84, ps = .05, sr^2s = .04), indicating that a higher number of adverse life

245   events was associated with better performance.

246   **Discussion**

247   It has been suggested that athletes who encounter adversities are more likely to excel under

248   pressure (Sarkar et al., 2015). The present study provides support for this notion in an athletic context,

249   revealing a curvilinear relationship between adverse life (i.e., non-sport) events and pressurized sports

250   performance. Participants who had encountered 3-13 negative life events performed better during the

251   pressurized task than participants who reported experiencing a lower (<3) or higher (>13) number of

252   adverse life events. It should be noted, however, that supplementary analyses suggested that this

253   curvilinear relationship may be due to a small number of outliers, but there was a significant positive,

254   linear relationship between adverse life events and performance. Regardless, these findings suggest

255   that the 'silver lining' associated with encountering a moderate number of negative life events might

256   extend to individuals who have experienced a relatively high number of negative life events (Seery et

257   al., 2013). Although data on the relationship between adverse life events and stressful task

258   performance is scarce, Seery and colleagues (2013) also found that participants exposed to a

259   moderately high number of adverse life events (5-12) performed better in a cold pressor task than

260   participants with low exposure.

261   Experiencing a moderate number of adverse life events can help individuals respond more

262   adaptively to future stressful scenarios, while encountering a low or (very) high number of events can

263   result in maladaptive responses (Seery et al., 2013). This study is the first to support this notion in a

264   pressurized sporting context, revealing a curvilinear association between adverse life events and

265   cardiovascular response. Importantly, in the sample as a whole, HR increased significantly,

266   confirming task engagement and allowing further examination of TPR and CO reactivity (via

267   challenge/threat index). Compared to participants with a history of low (<4) or high (>7) adverse life

268   events, participants with a history of 4-7 adverse life events responded to the pressurized task with a

269   cardiovascular pattern more reflective of a challenge state (i.e., lower TPR and/or higher CO

270   reactivity). This cardiovascular response is considered more favorable since it results in greater

271   oxygenated blood flow to the brain and muscles, preparing the individual to effectively manage the

272   stressful task (Seery, 2011). Indeed, a cardiovascular response more reflective of a challenge state has

273   been related to better sports performance (Blascovich et al., 2004; Turner et al., 2013). Experiencing a

274   moderate number of adversities might, therefore, benefit future pressurized performance by fostering a

275   challenge state, while encountering a low or (very) high number of adversities might harm future

276   performance by provoking a threat state.

277   From a BPSM perspective, the divergent cardiovascular responses are likely due to the

278   differences in how participants evaluated the pressurized task. Specifically, relative to a history of low

279   or high adverse life events, experiencing a moderate number of adverse events might have helped

280   participants view the task as less demanding and/or that they possessed greater ability to cope given

281   their prior adversities. Although the cardiovascular data supported this notion, the self-report data did

282   not because there was no relationship between adverse life events and demand resource evaluation

283   score. This unexpected finding could be due to self-report bias. Indeed, participants may have been

284   reluctant to report that they had insufficient coping resources (i.e., social desirability bias).

285   Alternatively, reflecting on the negative life events that they had experienced might have biased

286   participants' subsequent task evaluations, leading them to report it as less demanding (i.e., negative-

287   affect-based recall bias; Watson & Pennebaker, 1989). Such issues have led to the recommendation

288   that challenge and threat states may be best assessed using objective indices (Blascovich, 2008).

289   The current findings have several implications. First, they counter the belief that adverse life

290   events only have negative effects on future psychological responses to stress (Turner & Lloyd, 1995).

291   Instead, experiencing a moderate number of adverse life events should be viewed as beneficial and

292   might help athletes' in future high-pressure situations. Second, while not encouraging the experience

293   of negative life events, the findings suggest that practitioners should avoid 'sheltering' athletes from

294   stressors and instead, if suitable, appropriately and progressively optimize the sport-related adversities

295   athletes encounter. This might include exposing athletes to higher levels of competition, different

296   sports and playing positions, de-selection from particular events, and competition in foreign countries

297   (Collins & MacNamara, 2012). Indeed, in other professions where individuals are required to act

298   under pressure (e.g., police), exposing individuals to simulated adversities (e.g., reenactment of a

299   robbery) has facilitated better performance in future stressful scenarios (Arnetz et al., 2009; Robertson

300   et al., 2015). Given the present findings, such training might help athletes thrive during pressurized

301   competition, although more research is required before these interventions become common practice.

302   Alongside these implications, it should be noted that the effect sizes were small to moderate.

303   However, given the increasing interest in marginal gains in achievement and health contexts (e.g.,

304   Richards, 2015), these effects could translate into the difference between success and failure.

305   The limitations of this study also offer possible avenues for future research. First, the focus on

306   non-sport (e.g., parental divorce) rather than sport (e.g., repeated non-selection) adversities could be

307   seen as a limitation. Thus, while the findings suggest the 'silver lining' associated with experiencing a

308   moderate number of adverse life events is not domain specific, and that athletes' may benefit from the

309   adversities they have faced outside of sport, future research should examine the role of both types of

310   adversities. Second, this study focused solely on the frequency of adversities; future research should

311   investigate the severity and timing of adversities, and how athletes interpret adverse events (e.g., as an

312   opportunity for growth). Indeed, exposure to fewer but more severe adversities might also be

313   beneficial, while more recent adversities might have a less favorable impact than less recent

314   adversities. Despite the difficulties in assessing the severity of adverse events (e.g., recall bias; Seery

315   & Quinton, 2016), future research should explore these issues as well as the potential for growth

316   following adversity (Tamminen & Neely, 2016), and possible underlying mechanisms and moderators

317   (e.g., social support). Third, participants were limited to university students with no formal dart-

318   throwing experience. Although this enabled data to be collected from a relatively large sample, future

319   research should examine the link between adverse life events and pressurized sports performance

320   across various populations (e.g., experienced athletes), contexts (e.g., real competition), and research

321   designs (e.g., longitudinal). Indeed, given the challenges associated with creating high levels of

322   pressure in laboratory-based environments, future research is encouraged to replicate the current study

323   among elite athletes in top-level competition. Finally, this study investigated the effects of adverse life

324   events on only three outcomes: (1) demand and resource evaluations, (2) cardiovascular responses,

325   and (3) performance under pressure. Future research should examine if experiencing adverse events

326   influences other key psychological outcomes such as burnout, injury risk, and athlete well being.

327   To conclude, exposure to adverse life (i.e., non-sport) events influenced participants'

328   cardiovascular responses and performance during a pressurized sporting task. Specifically,

329   experiencing a moderate number of adverse life events helped participants respond to the task more

330   favorably, with a response more indicative of a challenge state. Furthermore, encountering a moderate

331   to high number of adverse life events benefitted performance under pressure. Practitioners should

332 therefore consider prior brushes with adversity when identifying athletes who are likely to excel in

333 high-pressure situations in the future.

334 **Perspective**

335 The present study suggests that the 'silver lining' associated with encountering a moderate number of

336 adverse life events might also extend to experiencing a relatively high number of events. It is therefore

337 important to encourage athletes to view facing adverse events as an opportunity for growth and an

338 experience that might benefit their performance during future stressful situations. While not

339 encouraging the experience of adverse events, practitioners should avoid 'sheltering' athletes and

340 instead, appropriately and progressively optimize the sport-related adversities athletes encounter.

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441 **Tables**

442 **Table 1**

443 *Means, Standard Deviations, and Correlations for all Variables*
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	Mean	SD	1	2	3	4
1. Heart rate reactivity	1.27	3.35				
2. Number of adverse life events	4.78	4.23	.05			
3. Demand resource evaluation score	1.35	1.84	-.15	.11		
4. Challenge/threat index	0.44	0.80	.53*	.11	.19	
5. Task performance	53.65	10.47	.00	.08	.33*	.28*

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446 *Note.* * Denotes correlation significant at .05 level (2-tailed)
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Figure Legends

Figure 1. The relationship between the number of adverse life events and challenge/threat index. Within the significant cubic model, there was a significant quadratic relationship at mean adverse life events. The slope of this curve was significant and positive at adverse life events less than 0.11 *SD* below the mean, and significant and negative at adverse life events more than 0.72 *SD* above the mean. These regions of significance are denoted by the vertical dashed lines. Individuals who reported a moderate number of adverse events (4-7) displayed a cardiovascular response more indicative of a challenge state than those who reported a low (<4) or high (>7) number of events.

Figure 2. The relationship between the number of adverse life events and task performance. The slope of the quadratic relationship was significant and positive at adverse life events less than 0.51 *SD* above the mean, and significant and negative at adverse life events more than 2.15 *SD* above the mean. Individuals who reported a moderately high number of adverse life events (3-13) outperformed those who reported a low (<3) or very high (>13) number of events.
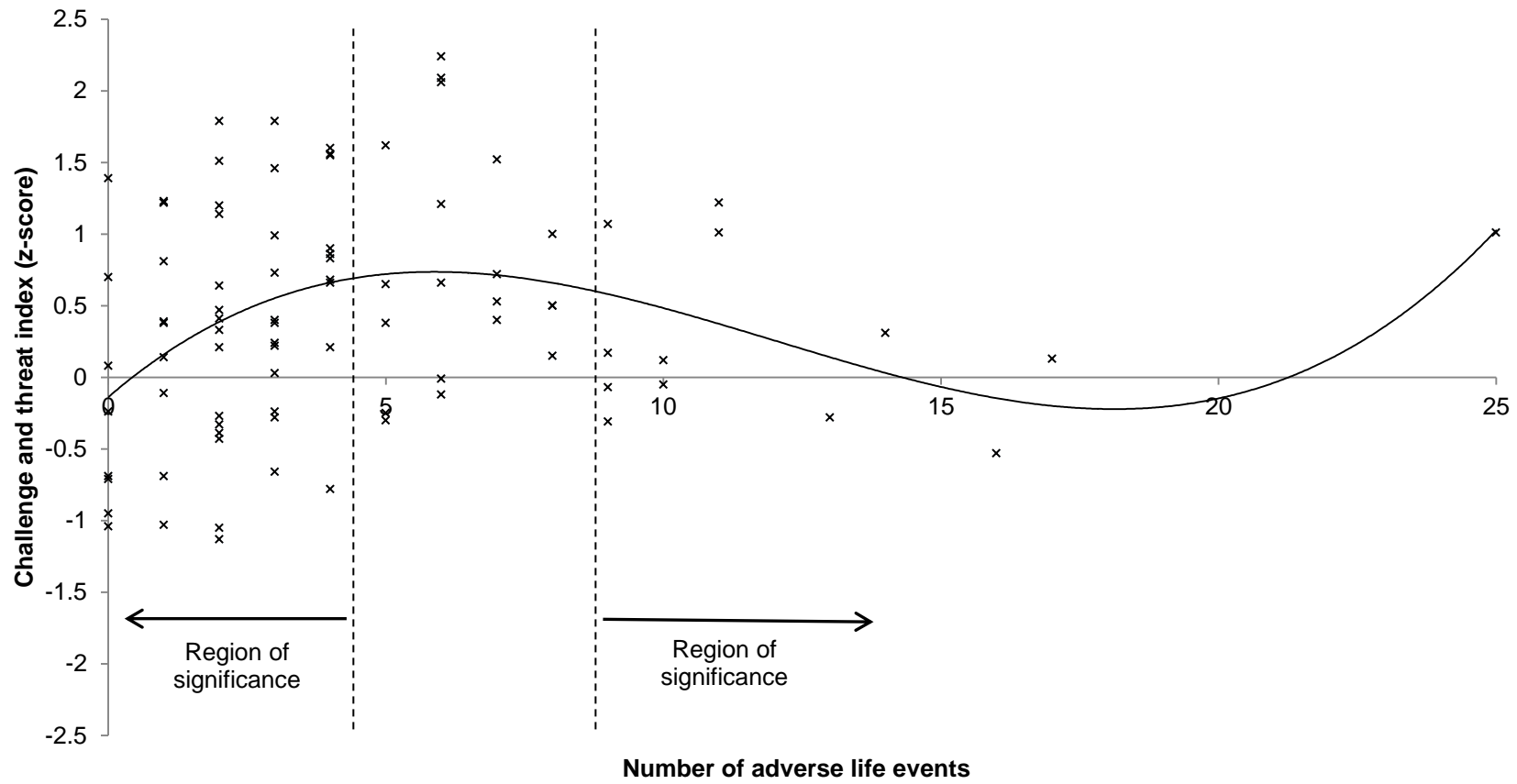
Figure 1.

Figure 2.