

## Adverse events and pressurized performance

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

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## Abstract

Research suggests that experiencing a moderate number of adverse life events can benefit future stress responses. This study explored the relationship between adverse life (i.e., non-sport) events and cardiovascular responses to, and performance during, a pressurized sporting task. One hundred participants (64 men, 36 women;  $M_{\text{age}} = 21.94$  years,  $SD_{\text{age}} = 4.98$ ) reported the number of adverse life events (e.g., serious accident or injury) they had encountered before completing a pressurized dart-throwing task during which performance was recorded. Before the task, participants' demand and resource evaluations and cardiovascular reactivity were assessed. Adverse life events did not impact demand and resource evaluations. However, participants who reported 4-7 adverse life events displayed cardiovascular responses more reflective of a challenge state (relatively lower total peripheral resistance and/or higher cardiac output) compared to those who reported a lower (<4) or higher (>7) number of events. Furthermore, participants who reported 3-13 adverse life events outperformed those who reported a lower (<3) or higher (>13) number of events. Supplementary analyses suggested that this relationship might be due to a small number of extreme values. However, after outlier analyses, a significant linear relationship remained suggesting that a higher number of adverse life events facilitated performance. The results suggest that experiencing a moderate to high number of adverse life events might have beneficial effects on subsequent cardiovascular responses and performance under pressure. Practitioners should therefore consider prior brushes with adversity when identifying athletes who are likely to excel during stressful competition.

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

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

58 **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.

## 122 **Materials and Methods**

### 123 **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.

### 133 **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<sup>2</sup>) at step 2, and cubic term (mean centered events<sup>3</sup>) 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  $95\% \text{ CI } 0.10, 0.38$ ), not significant at average adverse life events ( $slope_{mean} = 0.05, 95\% \text{ CI } -0.02,$   
 222  $0.11$ ), and significant and negative at high adverse life events ( $slope_{high} = -0.15; 95\% \text{ CI } -0.27, -0.03$ ).



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 ( $\Delta R^2 =$   
 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 ( $\Delta R^2 = .01$ ,  $p = .43$ ). 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 ( $\Delta R^2 < .02$ ,  $ps > .05$ ), 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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## Tables

**Table 1**

*Means, Standard Deviations, and Correlations for all Variables*

	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*

*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.

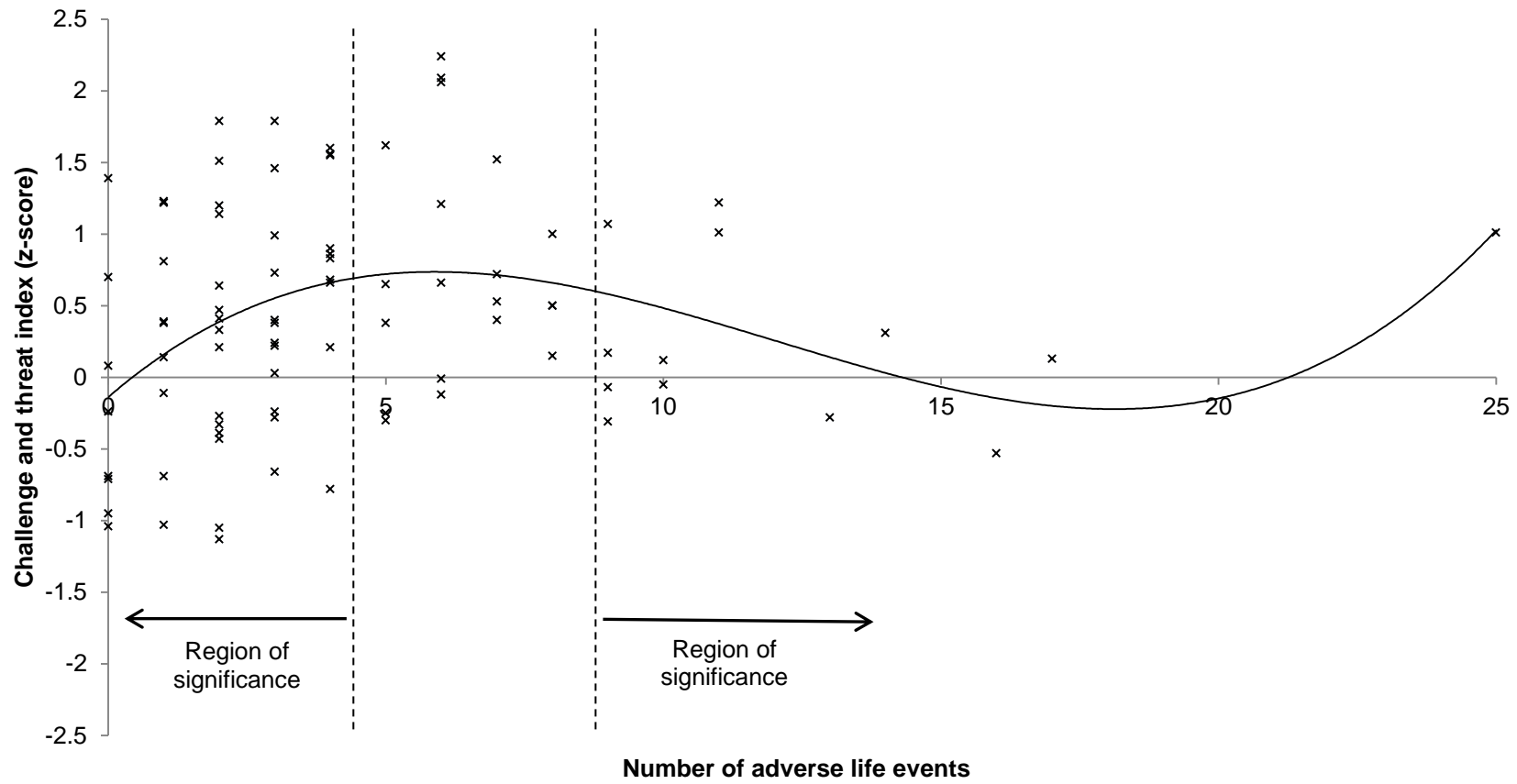


Figure 2.

