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Investigating the Effects of Irrational and Rational Self-Statements on Motor-Skill and Hazard Perception Performance

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Author Note

Within its previous form and prior to the peer review process, results from Experiment 1 were presented in a poster format at the West Midlands British Psychological Society Conference, Birmingham (2016). Correspondence concerning this article should be addressed to Andrew Wood, Centre for Sport, Health, and Exercise Research, Staffordshire University, Stoke-on-Trent, ST4 2D. Tel +44 7834408125. Electronic correspondence can be sent to andrew.wood@staffs.ac.uk

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Abstract

67 Rational Emotive Behavior Therapy (REBT) is a psychotherapeutic approach based on the
68 premise that when faced with adversity irrational beliefs determine unhealthy negative
69 emotions and maladaptive behaviors, whereas rational beliefs lead to healthy and adaptive
70 alternatives. The detrimental effects of irrational beliefs on psychological health are
71 established, however less is known about the deleterious effects on human behavior and
72 performance. In the present study we examined the effects of irrational and rational self-
73 statements on motor-skill performance (Experiment 1), performance effectiveness, and
74 efficiency during a modified hazard perception task, and task persistence during a breath-
75 holding task (Experiment 2). Using a repeated measures counter balanced design, two cohorts
76 of 35 undergraduate university students were recruited for Experiment 1 and 2, each
77 participating in no self-statement, irrational, and rational self-statement conditions. Data
78 indicated no differences in motor-skill and task performance, performance efficiency, task
79 persistence, mental effort, and pre-performance anxiety between irrational and rational self-
80 statement conditions. In contrast to previous research the findings provide insight into a
81 juxtaposition that irrational beliefs hinder psychological health, yet may help performance,
82 highlighting important distinctions in factual and practical rationality that have been
83 overlooked within the extant literature. The findings have important practical implications
84 for practitioners that may look to REBT to enhance the psychological health and performance
85 for individuals who operate in high performance contexts. Further, the short and long-term
86 effects of irrational and rational beliefs on performance and psychological health warrants
87 greater investigation.

88

89 *Key words:* REBT, irrational beliefs, rational beliefs, behavior, emotion.

90

91 **Investigating the Effects of Irrational and Rational Self-Statements on Motor-Skill and** 92 **Hazard Perception Performance**

93 Rational Emotive Behavior Therapy (REBT; Ellis, 1957) was created by Albert Ellis in 1955
94 and is summarized by the ancient proverb “people are not disturbed by things, but by the view
95 they take of them” (Epictetus 55-135). Central to REBT is the premise that irrational beliefs
96 lead to psychological disturbance, whereas rational beliefs lead to enhanced psychological
97 well-being (David, Szentagotai, Eva, & Macavei, 2005). Using the ABCDE framework
98 (Ellis, 1997), the process of REBT aims to identify the clients activating event (A) and elicit
99 the relevant irrational beliefs (B) that lead to the corresponding unhealthy negative emotions
100 and maladaptive behaviors (C). Irrational beliefs are then disputed (D) and replaced with
101 rational alternatives (E), thus when encountering future adversities individuals will
102 experience healthy negative emotions and adaptive behaviors that facilitate goal achievement
103 (C; Dryden & Branch, 2008, Turner & Barker, 2014). Essentially, REBT allows the client to
104 comprehend that in the face of failure, rejection, and poor treatment it is their beliefs that
105 determine the functionality of their emotional and behavioral response (C), not the event (A).
106 Irrational beliefs are characterized as extreme, rigid, illogical, and when encountering
107 adversity (i.e., failure, rejection, or poor treatment) lead to unhealthy negative emotions (e.g.,
108 anxiety, depression) that propagate maladaptive behaviors (i.e., avoidance or escape-based
109 behaviors) and hinders goal achievement (Dryden & Branch, 2008). Instead, rational beliefs
110 are non-extreme, flexible, logical, and when encountering adversity are purported to lead to
111 healthy negative emotions (e.g., concern, sadness) that facilitate adaptive behaviors (i.e.,
112 approach or assertive behaviors). When encountering adversity an individual’s beliefs are
113 central in determining the functionality of emotional and behavioral responses towards goal
114 achievement (Ellis & Dryden, 1997), consequently having clear implications for those
115 operating in performance contexts.

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116 Presently there exists an extensive body of research demonstrating the association
117 between irrational beliefs and psychological distress. To illustrate, a recent meta-analysis of
118 83 primary studies reported a moderate positive association between irrational beliefs and
119 general distress ($r = .36$), depression ($r = .33$), anxiety ($r = .41$), anger ($r = .25$), and guilt ($r =$
120 $.29$; Visla, Fluckiger, Holtforth, & David, 2016). Furthermore, the efficacy of REBT on
121 psychological health has been supported with hundreds of studies and three previous meta-
122 analyses (e.g., Engels, Garnefski, & Diekstra, 1993). Originally REBT was put forth as a
123 clinical model of therapy, and despite much research demonstrating the association between
124 irrational beliefs and deleterious emotional and behavioral consequences less is known about
125 the effects of rational beliefs and/or irrational beliefs on human behavior and performance
126 (Turner & Barker, 2014). This is surprising as REBT is widely considered to offer a model of
127 human functioning (David, Freeman, & Digiuseppe, 2010). For those who operate in
128 challenging and demanding contexts (e.g., business, elite sport, military) a rational
129 philosophy (i.e., the endorsement of rational beliefs that are supported empirically, logically,
130 and pragmatically) offers a pro-active approach that facilitates psychological health and goal
131 achievement (Turner, 2016). Furthermore, the use of REBT has been reported across various
132 performance settings such as, sport (e.g., Turner & Barker, 2014), education, and business
133 (e.g., Criddle, 2007).

134 Rational beliefs are proposed to reduce excessive concerns of failure and likely to lead
135 to a healthy negative emotion (e.g., concern) and exert a positive influence on performance
136 (Kombos, Fournet, & Estes, 1989). Irrational beliefs are proposed to lead to an exaggeration
137 of the importance of performing well and being accepted by others, which may lead to
138 unreasonable and self-imposed demands that are largely unattainable (Bonadies & Bass,
139 1984). Furthermore, the anticipation that it would be “awful” (100% bad) when faced with
140 failure, rejection, or poor treatment, may lead to an unhealthy negative emotion (e.g., anxiety)

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141 and therefore hinder performance (Turner & Barker, 2014). Amongst the scant evidence base,
142 Schill, Monroe, Evans, and Ramanaiah (1978) first evidenced that the adoption of irrational
143 self-talk led to significantly more errors on a mirror-tracing task (i.e., reduced behavioral
144 efficiency) compared to rational self-talk and control conditions. Additionally, the adoption of
145 irrational self-talk has also been associated with reduced performance efficiency and
146 increased anxiety during a mirror-tracing task, (e.g., Bonadies & Bass, 1984), as well as
147 reduced performance during a series of trail making tasks (Kombos et al., 1989).
148 Nevertheless, studies have reported only partial support for this hypothesis. For example,
149 researchers have reported participants who adopted rational self-talk instead of irrational self-
150 talk reported decreased anxiety, whilst reporting no differences in persistence during an
151 insolvable performance task (e.g., Rosin and Nelson, 1983). Evidence indicates the adoption
152 of irrational self-talk may hinder task performance and reduce behavioral efficiency, (e.g.,
153 Bonadies, & Bass, 1984; Kombos et al.; Schill, Monroe, Evans, & Ramanaiah, 1978),
154 however, findings remain inconclusive due to a lack of critical mass and methodological
155 shortcomings within the extant studies.

156 To explain, previous studies have largely relied upon the use of imagined rather than
157 real stressful events, whereby irrational self-statements are thought to only activate during
158 real-life and meaningful situations (e.g., Ellis, 1994). Previous studies have also: failed to
159 include a control group (e.g., Bonadies & Bass, 1984), used leading statements (e.g.,
160 participants were told these statements would help reduce errors in performance; Schill et al.,
161 1978), failed to discern the believability of the self-statements, and used performance tasks
162 that lack in ecological validity (i.e., mirror-tracing task). Further, although researchers
163 suggest that self-talk is better charatcerised in terms of directional interpretation (e.g., Hardy,
164 2006), no studies have yet matched the perceived helpfulness of irrational and/or rational self-
165 talk statements with performance outcomes. On these grounds the investigation into the

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166 effects of irrational and rational self-talk on performance warrants more rigorous
167 examination.

168 Not restricted to experimental settings the effects of irrational beliefs and/or rational
169 beliefs on performance have been tested through the examination of REBT on important
170 psychological outcomes (i.e., anxiety, perceived control) and competitive performance in elite
171 sport. For example, researchers indicated that reductions in irrational beliefs were coupled
172 with reductions in cognitive anxiety (e.g., Turner & Barker, 2013), enhanced facilitative
173 interpretations of anxiety (e.g., Lerner, Morris, & Marchant, 2007), perceived psychological
174 and performance benefits (Turner, Slater, & Barker, 2015), as well as short and long-term
175 improvements in self-efficacy, perception of control, and athletic performance (A.G. Wood,
176 Barker, & Turner, in press). Collectively, the applied data indicate irrational beliefs may
177 hinder whereas rational beliefs may be helpful for athletic performance. However, little
178 research has included objective markers to assess the effects of REBT on performance
179 (Turner, 2016), as well the samples (i.e., elite athletes) constrain the external validity of the
180 study findings across other performance settings. Ultimately, the effects of rational and
181 irrational beliefs on important psychological outcomes, behaviors, and performance are yet to
182 be established and require further enquiry (A. G. Wood et al., 2016).

183 In sum, there is a paucity of objective and empirical research that examines the effects
184 of irrational beliefs and/or rational beliefs on performance. Moving beyond previous research
185 methods and shortcomings, in the current study we aimed to conduct a rigorous examination
186 into the effects of irrational and rational beliefs on behavior using measures of competitive
187 performance. We add to the extant literature by examining the effects of irrational and
188 rational self-statements on cognitions, emotions, and performance. To illustrate, in
189 Experiment 1 we used a laboratory-based competitive golf-putting task as measure of motor-
190 skill performance (e.g., Wulf & Su, 2007). In Experiment 2 we used a modified hazard

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191 perception task as an objective measure of performance efficiency (visual search behavior)
192 and performance effectiveness (hazard perception performance). In addition, a breath-holding
193 task was used to measure task persistence.

194 **Experiment 1**

195 In Experiment 1 we examined the effects of irrational and rational self-statements on
196 performance outcomes, pre-performance anxiety, concentration disruption, and the perceived
197 helpfulness of self-statements. Previous research demonstrates that participants who adopt
198 irrational self-statements record lower behavioral efficiency during a visual-spatial task
199 compared to participants who adopt rational self-statements (e.g., Bonadies, & Bass, 1984;
200 Kombos et al., 1989; Schill et al., 1978). Similarly, in Experiment 1 we used self-statements
201 closely aligned with REBT theory (DiGiuseppe, Doyle, Dryden, & Backx, 2013) to promote
202 irrational and rational performance approaches to a competitive golf-putting task (e.g., Wulf
203 & Su, 2007) and assess performance. Addressing the limitations of past research (i.e., tasks
204 lack in ecological validity) we used a motor-skill task as a measure of performance whilst
205 controlling for participants total irrational belief scores. Furthermore, we incorporated: a real-
206 life motivated performance situation rather than imagined scenario using competitive task
207 instructions (e.g., Turner, Jones, Sheffield, & Cross, 2012), controlled for participants current
208 (baseline) task proficiency, and ascertained participants perception of the self-statements in
209 terms of helpfulness and believability. Based on previous research we hypothesized that when
210 participants used irrational self-statements they would report higher-levels of pre-
211 performance anxiety, higher performance concentration disruption, and achieve lower
212 performance scores in the competitive golf-putting task compared to when they used rational
213 self-statements. Finally, we hypothesized participants would perceive the rational self-
214 statements to be more helpful towards the performance task, but report no differences in
215 believability between self-statement conditions.

216 **Method**217 **Participants**

218 Previous research most akin to the present study (i.e., examined effects of IBs, similar
219 research design, & measures; Visla et al., 2016; Wilson, Wood, & Vine, 2009) reported
220 moderate to large effects, thus supporting the expectation for medium effects. An apriori
221 power analysis using (G*Power 3) showed that based on a medium effect size ($\eta^2 = .06$) and a
222 power of .80 a minimum number of 28 participants were required for the present study.
223 Thirty-five undergraduate students (26 = Male, 9 = Female) were purposively recruited at a
224 UK university aged between 18 and 53 years ($M_{age} = 20.92$, $SD_{age} = 5.62$). Institutional
225 ethical approval and participant consent was obtained prior to all data collection, whilst a
226 power analysis was considered as part of the peer review process.

227 **Measures**

228 **Trait irrational beliefs.** The Shortened General Attitudes and Beliefs Scale (SGABS;
229 Lindner, Kirkby, Wertheim, & Birch, 1999) was used as a measure of total irrational beliefs .
230 Consisting of 22-items, the total irrational belief subscale reported a good internal reliability
231 score of $\alpha = .84$. The rational belief subscale consisted of 4 items and reported an
232 unacceptable internal reliability score of $\alpha = .38$ and was omitted from the data analysis
233 process. Participants reported on a 5-point Likert-scale ranging from 1 (*strongly disagree*) to
234 5 (*strongly agree*) the extent they agreed with each statement.

235 **Pre-performance anxiety.** The State Trait Anxiety Inventory (STAI; Spielberger,
236 1983) includes 20-items which assess pre-performance state- anxiety. Participants reported
237 their answers on a 4-point Likert-scale ranging from 1 (*not at all*) to 4 (*very much so*). A
238 Cronbach's alpha coefficient reported an excellent internal reliability score $\alpha = .93$.

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239 **Concentration disruption.** Items associated with concentration disruption subscale
240 were taken from the Sport Anxiety Scale-2 (SAS-2; Smith, Smoll, Cumming, & Grossbard,
241 2006) measuring concentration during the competitive performance task. Participants
242 reported on a 4-point Likert-scale ranging from 1 (*not at all*) to 4 (*very much so*). The
243 concentration disruption subscale consisted of four-items and reported an excellent reliability
244 score of $\alpha = .93$.

245 **Golf putting performance.** The competitive performance task consisted of 10 putts.
246 The target consisted of a putting hole worth 10 points, surrounded by 4 concentric circles
247 separated at 5 cm intervals. Each concentric circle from the centre hole were scored with 8, 6,
248 4, and 2 points respectively. Zero points were scored if, the ball landed outside of the
249 outermost concentric circle or participants exceeded the 10 seconds time limit allocated to
250 each competitive putt. A maximum of 100 points and a minimum of 0 points were available
251 for the 10 competitive putts for each experimental condition.

252 **Task engagement.** To discern participant's motivation towards the competitive
253 performance task, engagement was measured using a single item on a 7-point Likert scale
254 ranging from 1 (*not at all*) to 7 (*completely*).

255 **Self-statement perception.** Participants' perceptions (i.e., the helpfulness,
256 believability, and engagement) of the self-statements were determined using three items on a
257 7-point Likert-scale ranging from 0 (not at all) to 7 (completely).

258 **Procedure**

259 Participants attended the lab individually on three separate occasions, first completing
260 a baseline condition (A; no self-statements), then completing irrational (B) and rational (C)
261 self-statement conditions in a counterbalanced design (ABC/ACB; Foley, 2004; see Figure 1).

262 **Laboratory set-up.** Prior to attending the lab a survey link using Qualtrics software
263 (Copyright © 2015) was distributed via email to all participants' to collect total irrational

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264 belief scores. On arrival participants were briefed on the research protocol and the
265 expectations of their involvement. To control for learning effects participants were first
266 familiarized to the golf-putting task during the baseline condition.

267 **Competitive task instructions.** Competitive task instructions were first read to the
268 participants to create a motivated performance situation (e.g., Turner et al., 2012). The
269 instructions emphasized the task demands prior to the performance task and minimized
270 possible reductions in task motivation and effort over successful trials (e.g., Wilson et al.,
271 2009). Specifically, the participants were informed that their scores would be compared and
272 ranked on a publically available leader board, and the winner for each condition would be
273 awarded a £25 cash prize (e.g., Barker, Jones, & Greenlees, 2010). The task instructions also
274 emphasized the time-constraints, uncertainty, evaluation, and effort that would be required to
275 complete the performance task.

276 **Self-statements.** Following the task instructions during the baseline condition,
277 participants were asked to self-report their pre-performance anxiety and motivation towards
278 the upcoming golf-putting task. Instead for irrational and rational self-statement conditions,
279 prior to completing the self-report measures participants were asked to engage with, and
280 adopt a set of self-statements. Each set consisted of one self-statement for each of the four
281 core beliefs central to REBT theory (Dryden & Branch, 2008). The extent to which self-
282 statements were understandable was examined in a pilot study ($N = 8$) with minor structural
283 and content alterations being made. Self-statements were worded in reference to the content
284 area of 'achievement' and the competitive golf-putting task (available on request from the
285 first author). Specifically, irrational and rational beliefs each consist of four core beliefs that
286 are dichotomously matched and are related to a single content area (e.g., control, comfort,
287 achievement; DiGiuseppe et al., 2013). Irrational beliefs consist of the core beliefs of:
288 demandingness (e.g., "I really would like to be successful, therefore I must"), low-frustration

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289 tolerance (e.g., “If I am not successful it would be intolerable”), awfulizing (e.g., “if I was not
290 successful it would awful”), and self/other/life-downing (e.g., not being successful would
291 make me a complete failure”). Instead, rational beliefs consist of the four core beliefs of:
292 preferences (e.g., “I would like to be successful, but that does not mean I have to”), anti-
293 awfulizing (e.g., “not being successful would be bad but certainly not terrible”), high-
294 frustration tolerance (e.g., although I would like to be successful, not being so would be
295 tolerable”), and unconditional self-acceptance (e.g., not winning does not make me a
296 complete failure, only that I have failed this time and this shows that I am a fallible human
297 being”). To check understanding of the self-statements participants were asked to detail and
298 summarize the content in their own words. Following this, participants then self-reported
299 their pre-performance anxiety and motivation towards the upcoming golf-putting task.

300 **Golf-putting performance task.** After completing the questionnaires participants
301 were instructed when to begin and that the task would end when they had played all 10 golf
302 putts. Immediately prior to the golf-putting task participants were reminded that their
303 performance was being video recorded and was to be evaluated by an expert golfing coach,
304 that they only had 10 seconds to play each putt, and that their score would be placed on leader
305 board that was accessible to all participants. Between every two putts they were instructed to
306 engage with the self-statements by using a cue card located next to the putting position.

307 **Data Analysis**

308 Prior to the main analyses data screening procedures were completed. To limit the
309 effect of outlying values, self-report data with Z score values greater than ± 3 were
310 winsorized and replaced with the smallest or highest untrimmed score (Keselman, Algina,
311 Lix, Wilcox, & Deering, 2008). A Shapiro-Wilks test was conducted on all data sets to test
312 for assumptions of normality. A one-way analysis of co-variance was completed to compare
313 the effects of irrational and rational self-statements (condition - predictor variable) with

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314 dependent variables while controlling for baseline scores (baseline covariate) and the effects
315 of total irrational beliefs (covariate). Preliminary checks were conducted to ensure that there
316 was no violation of assumptions of normality, linearity, homogeneity of variances,
317 homogeneity of regression slopes, and reliable measurement of the covariate. In the instance
318 dependent variables were correlated a multivariate analysis of co-variance was performed
319 (Mertler & Vannatta, 2002). Preliminary assumption testing was conducted to check for
320 normality, linearity, univariate, and multivariate outliers, homogeneity of covariance
321 matrices, multicollinearity, and no covariates were highly correlated with one another ($r >$
322 $.08$). Effect size values (eta squared) were interpreted in line with guidelines presented by
323 Cohen, (1988): $.01$ = small effect, $.06$ = moderate effect, $.14$ = large effect.

324 **Results**

325 **Preliminary Analyses**

326 **Manipulation checks.** To test the participants understanding of the self-statements
327 the content of the written summaries were subjectively assessed by the lead author in
328 accordance to the four core beliefs central to REBT theory (Dryden & Branch, 2008). To test
329 whether the participants' irrational and rational beliefs during the golf-putting task was
330 successfully manipulated, the participants adoption of irrational and rational self-statements
331 were examined using a single 'engagement' item on the self-statement perception scale.
332 Statistical analysis revealed that regardless of the condition participants were engaged with
333 the self-statements ($M = 4.44$, $SD = 1.34$), $t(69) = 27.80$, $p < .001$. In addition, statistical
334 analysis revealed participants did not differentiate in engagement with the self-statements
335 between irrational ($M = 4.37$, $SD = 1.44$), and rational ($M = 4.51$, $SD = 1.25$) self-statement
336 conditions, $F(1, 33) = .33$, $p = .57$.

337 **Task engagement.** The participant's engagement towards the golf-putting
338 performance task was assessed using a single item on a self-report scale. Statistical analysis

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339 revealed that regardless of the condition participants were motivated towards the golf-putting
340 performance ($M = 5.30$, $SD = .89$), $t(104) = 61.16$, $p < .001$. Further, participants did not
341 differ in task engagement between baseline ($M = 5.29$, $SD = .83$), irrational ($M = 5.23$, $SD =$
342 $.88$), and rational ($M = 5.37$, $SD = .98$) self-statement conditions, $F(2, 33) = .35$, $p = .71$.

343 **Main Analyses**

344 Three one-way analyses of covariance were used to investigate differences in golf-
345 putting performance, performance anxiety, and concentration disruption between irrational
346 and rational self-statement conditions. After adjusting for baseline scores and trait irrational
347 beliefs, analysis revealed no significant differences in putting performance $F(1, 32) = 2.27$, p
348 $= .14$, Wilks' Lambda $= .93$, $\eta^2 = .07$, performance anxiety, $F(1, 32) = .41$, $p = .53$, Wilks'
349 Lambda $= .99$, $\eta^2 = .01$, and concentration disruption, $F(1, 32) = .13$, $p = .73$, Wilks' Lambda
350 $= .99$, $\eta^2 = .01$ (see Table 1).

351 A multivariate analysis of covariance was conducted to investigate whether
352 participants differed in their perceived helpfulness and believability of irrational (ISS) and
353 rational self-statements (RSS). After controlling for the effect of trait irrational beliefs
354 analysis revealed no significant effects for perceived helpfulness (ISS - $M = 3.66$, $SD = 2.26$;
355 RSS - $M = 3.43$, $SD = 1.79$) and believability (ISS - $M = 4.46$, $SD = 1.88$; RSS - $M = 5.03$, SD
356 $= 1.48$), $F(2, 32) = 1.15$, $p = .33$, Wilks' Lambda $= .93$, $\eta^2 = .07$.

357 **Discussion**

358 Past literature has suggested that irrational beliefs should hinder performance, while
359 rational beliefs should help performance, but research to date has not examined acute skilled
360 performance as conducted in the current study. In sum, data evidenced no differences in
361 motor skill performance, pre-performance anxiety, concentration disruption, perceived
362 helpfulness, and believability of the statements between the irrational or rational self-
363 statement conditions. Data do not support the study hypotheses or previous research findings

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364 (e.g., Bonadies, & Bass, 1984; Kombos et al., 1989; Turner & Barker, 2013), indicating that
365 acute performance was not differentiated by irrational and rational approaches to a
366 competitive task. Further, participants perceived no differences in the helpfulness of irrational
367 and rational self-statements towards the competitive golf-putting task. Nevertheless,
368 performance outcomes alone (e.g., task score) may not fully reflect the complexity of skilled
369 performance. For example, previous research used visual spatial tasks (e.g., mirror tracing) as
370 a measure of performance efficiency, indicating that irrational self-talk led to reductions in
371 performance efficiency (e.g., Bonadies & Bass, 1984; Schill et al., 1978), but not necessarily
372 competitive performance outcomes. In contrast to previous research (e.g., Rosin & Nelson,
373 1983), the results also show the adoption of irrational self-statements did not determine
374 higher levels of pre-performance anxiety or concentration disruption compared to rational
375 self-statements. This may be explained by first, contemporary REBT theory posits healthy
376 (e.g., concern) and unhealthy negative emotions (e.g., anxiety) are distinguished by
377 functionality rather than the intensity (Hyland & Boduszek, 2012). Hence, we may expect to
378 observe changes in functionality via the assessment of participant's perceived helpfulness of
379 anxiety. Second, the measurement of anxiety via self-report may not accurately reflect pre-
380 performance emotional responses due to social desirability (e.g., Williams & Krane, 1992),
381 thus more objective markers are warranted. Previous research has evidenced greater
382 physiological arousal (measured via Galvanic Skin Response) when adopting irrational self-
383 statements compared to rational self-statements (e.g., Master & Gershman, 1983). Therefore,
384 objective markers of physiological arousal may yield more accurate findings. Accordingly, a
385 more refined and detailed investigation into the precise influence of irrational and rational
386 self-statements across various psychophysiological outcomes and performance indicators
387 (e.g., efficiency, task persistence, objective outcomes) is warranted.

388

389

Experiment 2

390 In this experiment we examined the effects of irrational and rational self-statements
391 on measures of performance efficiency and effectiveness, task persistence, and competitive
392 task performance outcomes, extending Experiment 1, which measured task performance
393 outcomes only. In Experiment 2 we measured visual gaze behavior (measuring performance
394 efficiency and effectiveness) during a competitive Hazard Perception Task (HPT; phase one)
395 and persistence during a Breath Holding Task (BHT; phase two). In line with Experiment 1,
396 pre-performance anxiety and concentration disruption were measured. Further building on
397 Experiment 1, heart rate and perceived helpfulness of anxiety were also measured to provide
398 an objective measure of physiological arousal and a directional measure of pre-performance
399 anxiety respectively.

400 According to the processing efficiency theory (PET; Eysenck & Calvo, 1992)
401 emotions such as anxiety may take up available processing resources in the working memory,
402 in turn hindering performance efficiency. However, decrements in efficiency may not be
403 reflected in performance outcomes (e.g., task score), as performance can be maintained
404 (Wilson, Smith, Chattington, Ford, & Marple-Horvat, 2006). Using a hazard perception task,
405 previous research has evidenced a quicker ability to fixate on a hazard after its appearance
406 underpins hazard perception performance (Crundall et al., 2012). In addition, researchers
407 have also shown an increase in fixation duration to a detected hazard is also indicative of
408 performance effectiveness and increased attentional capture (Garrison & Williams, 2013).
409 Moving beyond Experiment 1, this was the first study to use markers of visual search
410 behavior as an objective measure of performance efficiency and effectiveness, thus providing
411 a rich dynamic source of psychological processes during the competitive hazard perception
412 task (Richardson & Spivey, 2004).

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413 Past laboratory research (e.g., Rosin & Nelson, 1983) indicated no differences in task
414 persistence between irrational and rational self-statements. However, researchers suggest that
415 irrational beliefs may be acutely motivational on the approach to an important competitive
416 event, and therefore may lead to greater persistence (Turner, 2016). Further, REBT
417 practitioners have indicated that irrational beliefs such as “I must succeed” may be considered
418 motivational by performers (Turner & Barker, 2014). Therefore in Experiment 2, alongside
419 measuring participants perceived mental effort, a Breath Holding Task (Hajek, Belcher, &
420 Stapleton, 1987) was used as a raw measure of task persistence whilst tolerating discomfort
421 (e.g., Sütterlin et al., 2013).

422 Drawing on the aforementioned literature we propose a series of hypotheses for
423 Experiment 2. First, participants using irrational self-statements would record reduced
424 performance efficiency, in terms of decreases in both fixation durations to the detected hazard
425 and ability to fixate on the hazard after its appearance (i.e., time elapsed between hazard
426 appearance and first hazard fixation; Crundall et al., 2012). Second, participants would record
427 worse performance outcomes (hazard perception score) when adopting irrational self-
428 statements compared to rational self-statements. Finally, participants who adopted irrational
429 self-statements would also record greater task persistence, greater mental effort, higher
430 anxiety intensity, lower perceived helpfulness, and increased physiological arousal (i.e.,
431 increased heart rate) compared to when using rational self-statements.

432 **Method**

433 **Participants**

434 As in Experiment 1, the effect sizes reported in research similar to the present study
435 (e.g., Williams & Cumming, 2012; Wilson et al., 2006) reinforced the expectation for
436 medium effects. Based upon an apriori power analysis, 35 undergraduates (26 = Male, 9 =
437 Female) were purposively recruited at a UK university and were aged between 18 and 30

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438 years ($M_{age} = 21.09$, $SD_{age} = 2.92$). All held a full UK driving license and had been driving
439 for a minimum of 6-months. None of the participants had visual or hearing impairments that
440 impeded their ability to complete the tasks.

441 **Measures**

442 As used in Experiment 1, measures of trait irrational beliefs were collected using the SGABS
443 ($\alpha = .84$).

444 **Pre-performance anxiety.** To ascertain levels of pre-performance anxiety and reduce
445 completion time the STAI was reduced from 20 to 10 items. These 10 items were selected
446 based upon the best psychometric properties within the State Trait Anxiety Inventory (STAI
447 Form Y; Spielberger, 1983) as validated within the State Trait Personality Inventory (STPI;
448 Spielberger & Reheiser, 2009). A Cronbach's alpha coefficient reported excellent internal
449 reliability ($\alpha = .90$). Participants also reported on a 7-point Likert-scale ranging from -3 (*Not*
450 *at all helpful*) to 3 (*Extremely Helpful*) the directional interpretation of their pre-performance
451 anxiety in relation to the upcoming competitive task.

452 **Physiological arousal.** Participants heart rate were measured using a MP45 Biopac
453 (Biopac Systems Inc. 2016) to provide an objective and accurate assessment of physiological
454 arousal on approach to both competitive performance tasks (HPT and BHT). A Biopac
455 Analysis software (Biopac Systems Inc. 2016) ascertained changes in heart rate scores
456 between baseline phase (after receiving the self-statements and before the pre-performance
457 preparation phase) and pre-performance preparation phase (between starting pre-performance
458 preparation and immediately prior to beginning the task).

459 **Hazard perception performance.** A HPT provided an objective measure of task
460 performance (i.e., response time), specifically measuring participants' ability to quickly
461 perceive and respond to a potentially dangerous driving situation (G. Wood, Hartley, Furley,
462 & Wilson, 2016). Hazard perception scores were marked out of 20 and measured using

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463 response times (milliseconds) between the onset of the hazard and when the participant
464 indicated the presence of a hazard (mouse click). Participants were provided with a window
465 of 5000 milliseconds and in the instance a click was not registered 0 points were awarded.
466 Scores from each clip were summed to produce a final performance score. Hazard perception
467 performance was assessed using three hazard perception clips each containing one major
468 developing hazard - lasting between 55 and 60 seconds. Each clip was: specific to driving,
469 featured everyday road scenes, contained one developing major hazard, and was fully
470 counterbalanced between conditions.

471 **Eye tracking and fixation analyses.** Participants' visual search behavior during the
472 appearance of the major hazard provided an objective indicator of performance efficiency and
473 effectiveness (Garrison & Williams, 2013). First, fixation duration to the detected hazard was
474 measured as an indicator of attentional capture and a predictor of effective hazard perception
475 performance (G. Wood et al., 2016). Specifically, fixation duration was calculated as a
476 change score of mean fixation duration between the baseline phase (total clip length prior to
477 onset of the major hazard) and during the presence of the major hazard. Mean scores were
478 calculated across three hazard perception clips. In addition, the time taken to fixate on the
479 major hazard after its appearance was measured as an indicator of performance efficiency and
480 predictor of effective hazard perception performance (Crundall et al., 2012). Time taken to
481 fixate on the hazard was calculated as a mean time elapsed between the appearance of the
482 major hazard and time of first fixation towards the hazard location (milliseconds). A fixation
483 was defined as a gaze that remained on a single location for longer than 100ms and the
484 frequency of the gaze was calculated as the mean number of times a location was fixated on
485 (milliseconds; Garrison & Williams, 2013). SR Research Ltd. Experiment Builder software
486 (Copyright 2016) monitored patterns of visual gaze behavior via the Eye Link 1000 sampling

487 at a rate of 2000 Hz that recorded monocular gaze direction with an accuracy of 0.25 – 0.5
488 degrees.

489 **Breath-holding task.** The BHT (Hajek, Belcher, & Stapleton, 1987) provided a
490 behavioral indicator of task persistence whilst tolerating discomfort (e.g., Sütterlin et al.,
491 2013). Breath holding performance scores were measured in seconds from when the
492 participant initiated the first inhalation until the first exhalation. Participants' compliance with
493 the BHT was measured on a 9-point Likert-scale (a) to what degree they followed the
494 instructions precisely, (b) to what degree they tried to hold their breath as much as possible,
495 and (c) whether they could hold their breath for any longer (Sütterlin et al., 2013).

496 **Perceived mental effort.** The Rating Scale Mental Effort (RSME; Zijlstra, 1993)
497 provided a validated uni-dimensional measure of mental effort. After the completion of both
498 HPT and BHT participants were required to indicate on a continuous vertical scale the
499 amount of mental effort invested within the task. The scale consists of anchor points ranging
500 from 0 (*Absolutely no effort*), 75 (*moderately effortful*) to 150 (*Extreme effort*).

501 **Manipulation checks and task engagement.** As in Experiment 1, perceptions of self-
502 statements were collected in reference to both HPT and BHT. Furthermore, Participants'
503 motivation towards both competitive performance tasks was measured using a single item. In
504 line with previous research increases in heart rate were also measured using MP45 Biopac
505 (Biopac Systems Inc. 2016) to provide an objective indicator of participant's engagement
506 with the HPT (e.g., Turner et al., 2012).

507 **Procedure**

508 As in Experiment 1, measures of total irrational beliefs were collected prior to arrival.
509 Participants then attended the lab individually on three separate occasions in a
510 counterbalanced design (ABC/ACB; Foley, 2004). Experiment 2 spanned two phases with the
511 study procedure (see Figure 1) repeated for both the HPT (phase one) and BHT (phase two)

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512 in one testing session (see Figure 1). Data collection was completed using a combination of
513 on-screen instructions and verbal cues from the researcher (Lead author). Psychological data
514 was collected using an external laptop positioned in close proximity to the participants seating
515 position. Using the Biopac software participants were fitted with electrodes to continuously
516 monitor participants' heart rate(s) throughout the entirety of Experiment 2.

517 **Phase one.** On arrival participants were calibrated to the eye tracker using a 9-point
518 grid displayed on the computer screen. Once calibrated, participants were provided with on
519 screen instructions and a familiarization hazard perception clip. The provision of self-
520 statements or no self-statements followed the procedures used in Experiment 1. Participants,
521 were asked to summarize the content of the self-statements in their own words before self-
522 reporting the intensity and perceived helpfulness of their pre-performance anxiety, as well
523 as their motivation towards the upcoming task. Prior to the HPT participants were asked to
524 take a few moments to re-familiarize and engage with the given set of self-statements, or to
525 think (baseline) and prepare themselves for the upcoming performance (specific instructions
526 available from the first author). Immediately prior to and between each of the three
527 randomized hazard perception clips participants were re-calibrated using drift correct
528 measures. On completion, participants remained connected to the MP45 Biopac to monitor
529 heart rate(s) before proceeding to phase two.

530 **Phase two.** As in phase one, participants were asked to read a new set of competitive
531 instructions regarding the BHT and provided with verbal instructions on how to complete a
532 BHT. Specifically, participants were asked to sit comfortably on a chair, to pinch their nose,
533 and asked to hold their breath for as long as possible, even if they felt the urge to breathe
534 again (Sütterlin et al., 2013). Once familiarized and practiced with this technique the
535 participant was provided and asked to adopt self-statements that were tailored to their
536 performance in the BHT. As used in phase one, participants then completed a series of self-

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537 report measures before taking a moment to re-familiarize and engage with the self-statements
538 and prepare for the BHT. At the end, participants were asked to complete measures of
539 perceived mental effort and compliance with the BHT. Additionally, in reference to both the
540 hazard perception and breath-holding task participants self-reported their perceptions of the
541 self-statements.

542 **Data Analysis**

543 The statistical analysis procedures followed those use in Experiment 1 fgreen

544 **Results**

545 **Preliminary Analyses**

546 **Manipulations check.** All 35 participants indicated successful understanding of the
547 self-statements. In reference to both hazard perception and breath-holding tasks, statistical
548 analysis revealed regardless of the condition participants were equally engaged with the self-
549 statements ($M = 4.37$, $SD = 1.64$), $t(69) = 22.26$, $p < .001$. Analysis also indicated
550 engagement with the self-statements did not differ between irrational and rational self-
551 statement conditions after controlling for trait irrational beliefs, $F(1, 33) = 2.84$, $p = .10$.

552 **Task engagement.** As in Experiment 1, statistical analysis was conducted to test
553 participant's motivation towards both hazard perception and breath-holding tasks using a
554 single self-report item. Analysis of self-report data revealed regardless of the condition
555 participants were engaged with both the HPT ($M = 5.23$, $SD = .97$), $t(104) = 55.05$, $p < .001$
556 and BHT ($M = 5.07$, $SD = 1.32$), $t(104) = 39.41$, $p < .001$. Furthermore, analysis indicated
557 engagement with the self-statements did not differentiate between baseline, irrational, and
558 rational self-statement conditions in both HPT, $F(2, 33) = .22$, $p = .81$ and BHT, $F(2, 33) =$
559 $.415$, $p = .66$. Statistical analysis also revealed regardless of the condition participants were
560 engaged with the HPT, as indicated by mean increases in heart rate scores ($M = 2.67$, $SD =$
561 4.91), $t(104) = 5.58$, $p < .001$. In addition, participants did not differentiate in heart rate

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562 increases between baseline ($M = 3.06$, $SD = 5.69$), irrational ($M = 2.35$, $SD = 4.39$), and
563 rational self-statement conditions ($M = 2.61$, $SD = 4.68$), $F(2, 33) = .20$, $p = .82$. Statistical
564 analysis showed regardless of the condition participants reported compliance with the BHT,
565 as indicated by three items on a BHT compliance measure ($M = 6.28$, $SD = 1.46$), $t(104) =$
566 44.08 , $p < .001$. Furthermore, analysis indicated participants did not differ in BHT
567 compliance between baseline ($M = 6.11$, $SD = 1.56$), irrational ($M = 6.35$, $SD = 1.56$), and
568 rational self-statement conditions ($M = 6.39$, $SD = 1.29$), $F(2, 33) = .86$, $p = .68$.

569 **Main Analyses**

570 The main analyses are presented in three sections. The effects of irrational and
571 rational self-statements on outcomes measures are reported in reference to the modified HPT
572 and BHT in the first two sections (see Table 1). The final section reports participant's
573 perceptions of helpfulness and believability of the self-statements between irrational and
574 rational conditions.

575 **Hazard perception task.**

576 *Hazard perception performance.* To test the effects of irrational and rational self-
577 statements on hazard perception performance a one-way analysis of covariance was
578 conducted. Statistical analysis reported no significant differences between irrational and
579 rational self-statement conditions after controlling for trait irrational beliefs and baseline
580 scores, $F(1, 32) = .94$, $p = .18$, $\eta^2 = .06$.

581 *Visual gaze behavior.* To examine the effects of irrational and rational self-statements
582 on participant's performance efficiency, after adjusting for baseline and trait irrational beliefs
583 two one-way analyses of covariance were conducted. Analysis revealed no significant main
584 effects between self-statement conditions in mean fixation duration during the presence of the
585 major hazard, $F(1, 32) = .58$, $p = .45$, $\eta^2 = .02$. Further statistical analysis also revealed no

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586 significant differences in time taken to first fixation of the major hazard, $F(1, 32) = .59, p =$
587 $.45, \eta^2 = .02$.

588 ***Pre-performance anxiety.*** Two one-way analyses of covariance were used to
589 investigate differences in the intensity and the directional interpretation of pre-performance
590 anxiety between irrational and rational self-statement conditions prior to the HPT. After
591 controlling for trait irrational beliefs and baseline scores analysis revealed no significant
592 differences in intensity, $F(1, 32) = .08, p = .78$, Wilks' Lambda = .99, $\eta^2 = .00$, the directional
593 interpretation of pre-performance anxiety, $F(1, 32) = .62, p = .44$, Wilks' Lambda = .98, $\eta^2 =$
594 $.02$.

595 ***Physiological arousal.*** To examine the effects of irrational and rational self-
596 statements on participant's physiological arousal a one-way analysis of covariance was
597 conducted. No significant effects were found in heart rate between conditions after
598 controlling for trait irrational beliefs and baseline scores, $F(1, 32) = 1.82, p = .67, \eta^2 = .01$.

599 **Breath-holding task.**

600 ***Task persistence and perceived mental effort.*** Two one-way analyses of covariance
601 were used to examine differences in task persistence and perceived mental effort between
602 irrational and rational self-statement conditions during a BHT. After controlling for trait
603 irrational beliefs and baseline scores analysis revealed no significant differences in task
604 persistence $F(1, 32) = 1.63, p = .21$, Wilks' Lambda = .95, $\eta^2 = .05$, and perceived mental
605 effort $F(1, 32) = 3.81, p = .06$, Wilks' Lambda = .89, $\eta^2 = .11$,

606 ***Pre-performance anxiety.*** Two one-way analyses of covariance were used to
607 investigate differences in the intensity and the directional interpretation of their pre-
608 performance anxiety between irrational and rational self-statement conditions prior to the
609 BHT. After adjusting for trait irrational beliefs and baseline scores analysis revealed no
610 significant differences in intensity, $F(1, 32) = .31, p = .58$, Wilks' Lambda = .99, $\eta^2 = .01$, the

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611 directional interpretation of pre-performance anxiety, $F(1, 32) = .56, p = .46$, Wilks' Lambda
612 $= .98, \eta^2 = .02$.

613 **Physiological arousal.** To examine the effects of irrational and rational self-
614 statements on changes in physiological arousal, as measured by changes in heart rate a one-
615 way analysis of co-variance was conducted. After controlling for total irrational belief scores
616 and baseline scores, analysis revealed no main effects between irrational and rational self-
617 statement conditions, $F(1, 32) = 1.67, p = .21, \eta^2 = .05$.

618 **Self-statement perception.** Statistical analysis was conducted to examine participants
619 perceived helpfulness of the self-statements between irrational and rational conditions for
620 both the hazard perception and breath-holding task. After controlling for total irrational belief
621 scores, a one way analysis of co-variance reported no significant effect in perceived
622 helpfulness for both HPT, $F(1, 33) = 2.41, p = .13, \eta^2 = .07$, and the BHT, $F(1, 33) = 1.86, p$
623 $= .18, \eta^2 = .05$. The results indicate irrespective of the condition participants reported no
624 difference in perceived helpfulness between the rational self-statements (RSS) and irrational
625 self-statements (ISS) for both the HPT (RSS - $M = 4.83, SD = 1.40$; ISS - $M = 3.46, SD =$
626 1.82) and BHT (RSS - $M = 4.86, SD = 1.48$; ISS - $M = 3.77, SD = 1.94$). In reference to both
627 hazard perception and BHT a one-way analysis of covariance reported significant differences
628 in the believability of self-statements between irrational ($M = 3.74, SD = 1.82$) and rational
629 self-statements ($M = 5.17, SD = 1.48$) after controlling for trait irrational beliefs, $F(1, 33) =$
630 $1.66, p = .21, \eta^2 = .05$.

631 Discussion

632 Experiment 2 sought to extend the findings from Experiment 1 by assessing the
633 effects of irrational and rational self-statements on objective measures of performance and
634 performance efficiency during a competitive hazard perception task; as well task persistence
635 during a breath-holding task. As in Experiment 1, data indicate no differences in competitive

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636 performance, performance efficiency, task persistence, mental effort, and pre-performance
637 anxiety (self-reported and heart rate) between irrational and rational self-statement conditions.

638 REBT theory indicates the endorsement of rational beliefs is unhelpful, whereas
639 irrational beliefs hinder performance (Dryden & Branch, 2008). In Experiment 2 both fixation
640 duration to detected hazard and time taken to fixate on the major hazard were assessed as
641 objective and sensitive indicators of performance efficiency predictive of hazard perception
642 performance (G. Wood et al., 2016). The present findings indicate no differences in
643 performance effectiveness and efficiency between irrational and rational self-statement
644 groups and accordingly support the results of Experiment 1, whilst contrasting with data from
645 previous studies (e.g., Bonadies & Bass, 1984; Kombos et al., 1989; Schill et al. 1978). To
646 further understand the effects of beliefs Turner and Barker (2014) suggested when
647 encountering adversity (i.e., sporting competition) irrational beliefs may harbour motivational
648 qualities. However, in-line with previous research (e.g., Rosin & Nelson, 1983) both task
649 persistence and perceived mental effort were not differentiated by either an irrational and
650 rational approach towards a competitive task. In contrast to previous studies the findings
651 suggest irrational beliefs did not enhance self-reported pre-performance anxiety (e.g., Rosin
652 & Nelson, 1983) or lead to higher levels of physiological arousal (e.g., Master & Gershman,
653 1983) when approaching the competitive hazard perception or breath-holding task.

654 Furthermore, an irrational or rational approach did not determine differences in the perceived
655 helpfulness of the pre-performance anxiety. Notably however, significant differences were
656 recorded in the believability between the self-statement groups with participants reporting
657 irrational self-statements to be less believable compared to rational alternatives.

658 **General Discussion**

659 The investigation into understanding human beliefs offers important implications for
660 research and practice aiming to enhance human functioning across various performance

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661 contexts. In the present study we aimed to examine the effects of irrational and rational self-
662 statements on acute performance, as well as important psychological outcomes previously
663 associated with performance. Collectively, the findings disconfirmed the study hypotheses,
664 challenging previous research that indicated irrational self-statements were associated with
665 reduced task performance (e.g., Bonadies & Bass, 1984; Schill et al., 1978). In addition, the
666 results challenge predictions of REBT theory that irrational beliefs hinder, whereas rational
667 beliefs are helpful towards performance. There exists a plethora of research supporting the
668 detrimental effects of irrational beliefs on psychological health (David et al., 2005; Visla et
669 al., 2016) that have also been supported in the context of elite sport (e.g., emotional and
670 physical exhaustion; Turner & Moore, 2015). Nonetheless, the results indicate that
671 participants did not differ in their behavioral performance (i.e., golf-putting performance) and
672 performance efficiency (i.e., eye gaze data) when adopting an irrational and rational approach
673 towards a real-life competitive task. To explain, REBT theory merely posits irrational beliefs
674 to be associated with maladaptive behaviors common in clinical settings (e.g., increased
675 anger, self-harming, procrastination; Dryden & Branch, 2008). Further, previous research
676 examining the effects of irrational self-statements on behavior is scant and fraught with
677 methodological shortcomings and the precise short-term effects of irrational beliefs remained
678 equivocal. Ultimately, evidence supporting the adverse effects of irrational beliefs on
679 performance is meagre, thus, the notion that for some irrational beliefs may enhance
680 performance is one that should be seriously considered.

681 Contrary to previous research (e.g., Rosin & Nelson, 1983) no differences were
682 reported in pre-performance anxiety, perceived helpfulness of pre-performance anxiety, and
683 accordingly no differences were reported in concentration disruption. Acknowledging the
684 limitations of self-report measures (Williams & Krane, 1992), and in line with previous
685 research (e.g., Harris, Davies, & Dryden, 2006) objective measures of physiological arousal

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686 were used in the present study. Whilst increases in heart rate suggested participants were
687 engaged with the competitive task, results suggest participants did not differ in physiological
688 arousal when adopting irrational and rational self-statement conditions.

689 Researchers proposed irrational beliefs may harbour motivational qualities (Turner &
690 Barker, 2014), subsequently encouraging perseverance in the face of hedonic costs in an
691 attempt to realize long-term ambitions, certainly an important component of adaptive
692 functioning (Williams & DeSteno, 2008). However, in-line with previous research (e.g.,
693 Rosin & Nelson, 1983) the results indicated no differences in task persistence or perceived
694 mental effort between a rational and irrational approach to a competitive performance.
695 Offering a nuanced view researchers have proposed irrational and rational beliefs may differ
696 in the quality of motivation rather than the intensity. The core irrational belief of
697 demandingness (e.g., should, must) has been compared to introjected regulation where actions
698 are self-imposed in an attempt to avoid shame, guilt, and ego enhancement underpinned by
699 the sense they “should” take part. Introjected regulation has been associated with expending
700 greater effort, yet it is also related to higher anxiety, and reduced ability to cope with failure
701 (Turner, 2016). The effects of irrational and/or rational beliefs on motivational quality may
702 offer further insight into the precise effects on performance and warrants further
703 investigation.

704 Based on the findings we suggest for some irrational beliefs may be helpful towards
705 performance. Nevertheless, considering the prevalence of mental health disorders in
706 performance contexts such as elite sport (Hughes & Leavey, 2012) ethically practitioners
707 would not encourage the adoption of irrational beliefs in the pursuit of performance
708 excellence. In addition, no evidence exists to suggest irrational beliefs offer advantages above
709 that of rational beliefs. Ultimately, we put forth a less polarized view as to the effects of
710 irrational and rational beliefs on performance, acknowledging that for some thinking

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711 irrationally may be advantageous in the pursuit of short-term goals, yet detrimental for ones'
712 psychological health in the long-term. REBT theory itself may offer an explanation into the
713 paradoxical effects of irrational beliefs on psychological well-being and performance.
714 Specifically, although rational beliefs are categorized as empirically true, logical, and
715 pragmatic (i.e., helpful; Digiuseppe et al., 2013) REBT theorists have ignored the proposition
716 that irrational beliefs can deny all logic and empirical arguments yet serve a helpful role
717 towards goal achievement (Wilson, 2010). Furthermore, the view that irrational beliefs are
718 wholly detrimental is challenged by the notion that human's beliefs have developed with
719 evolutionary design in response to their environment (Pelusi, 2003). Thus, serving adaptive
720 functions for our ancestors, where the extreme, dogmatic, and drastic responses would have
721 ensured favourable outcomes were met. Most recently, Turner (2016) has put forth the notion
722 of 'double-thinking' that denotes irrational and rational beliefs can exist simultaneously in a
723 transient and stable form. Originally proposed by George Orwell (Orwell, 1949), double
724 thinking is based on the premise that humans are able to hold two contradictory beliefs in
725 one's mind simultaneously whilst accepting both of them. Thus an athlete maybe able to
726 forget any fact or belief that has become inconvenient and to then only draw it back only
727 when it is needed. For example, an endurance runner may harbour rational beliefs about
728 adversity that ensure psychological health, yet during the final sections of a race irrational
729 self-talk (e.g., "I must finish, otherwise it would be terrible") may facilitate goal achievement.

730 **Limitations and Future Directions**

731 It is important to understand the results in terms of its limitations, that if addressed
732 could strengthen the study findings. In this study we examined the effects of irrational and
733 rational self-statements rather than core beliefs. Further, while both self-report and objective
734 measures of heart rate were used to confirm participant's engagement with the study
735 manipulations the content of self-statements were not tailored to irrational and rational beliefs

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736 pertinent to the participants. To offer a more sensitive and accurate examination future
737 researchers may wish to tailor core beliefs relevant to the participant, as well favour the use of
738 objective measures (i.e., pupil dilation as a measure of mental effort; G.Wood et al., 2016).
739 The SGABS provided a reliable and validated measure of total general irrational belief
740 scores. However, future researchers would be prudent to adopt a newly validated measure of
741 irrational beliefs tailored for performance contexts, named the irrational Performance Beliefs
742 Inventory (iPBI; Turner et al., 2016) to provide an accurate measure of performance specific
743 beliefs. Rational beliefs and irrational beliefs are proposed to be dichotomous constructs,
744 whereby low levels in one does not necessarily indicate high levels in the other (Bernard,
745 1998). Thus, future researchers may wish to explore the interplay between irrational and
746 rational beliefs, and the subsequent effects on performance. Research within REBT proposes
747 a unitary model of emotion that are quantitatively distinct (i.e., high vs. low anxiety) and a
748 binary model of emotion that are qualitatively distinct (i.e., anxiety vs. concern; Hyland &
749 Boduszek, 2012). To this end, future researchers are recommended to establish a validated
750 and reliable measure of emotion sensitive to measuring both the functionality and intensity.
751 Finally, the precise mechanisms by which irrational and rational beliefs effect performance
752 appear to be more complicated than previously hypothesised, therefore future researchers
753 may wish to explore role of important psychological factors (e.g., self-efficacy) that may
754 mediate the association between beliefs and performance.

755 **Conclusion**

756 The findings in the present study contrast with previous research indicating that the
757 adoption of irrational self-statements did not lead to adverse effects on performance,
758 performance efficiency, persistence, and psychological outcomes above that of rational self-
759 statements. To this end,³ we suggest irrational beliefs may have both positive and negative
760 effects on performance, highlighting distinctions in both factual and practical rationality that

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761 have been overlooked within the extant literature. The detrimental effects of irrational beliefs
762 for psychological health are established, accordingly understanding the precise effects and
763 mechanisms by irrational and rational beliefs effects ones ability to perform has valuable
764 implications for practitioners utilising REBT within high performance contexts.

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936 **Figure Captions**

937 *Figure 1.* Diagrammatic representation of the data collection protocols for golf-putting task
938 (Experiment 1), hazard perception task (Experiment 2 – phase one), and breath-holding task
939 (Experiment 2 – phase two).

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IRRATIONAL AND RATIONAL SELF-STATEMENTS, AND PERFORMANCE

Table 1.

Mean Scores (\pm SD) for Outcome Measures Collected in Experiment 1 and 2.

	Baseline	Irrational Self-statement	Rational Self-statement
Golf-Putting Task (Experiment 1)			
Golf Putting Performance	57.09 (21.03)	70.06 (17.15)	71.37 (18.39)
Pre-performance Anxiety	1.61 (.36)	1.62 (.47)	1.50 (.36)
Concentration Disruption	1.52 (.66)	1.59 (.72)	1.51(.63)
Hazard Perception Task (Experiment 2)			
Hazard perception performance	30.03 (12.17)	26.63 (10.41)	30.40 (10.48)
Gaze data: Mean fixation duration on the hazard (ms)	10.79 (24.12)	11.15 (27.05)	19.68 (20.50)
Gaze data: Time to fixate the hazard (ms)	375.22 (299.68)	370.83 (276.89)	491.20 (369.09)
Pre-performance anxiety: Intensity	.92 (.60)	.80 (.67)	.66 (.55)
Pre-performance anxiety: Perceived helpfulness	.91 (1.22)	1.26 (1.20)	1.51 (.82)
Physiological arousal (change scores; HR)	3.06 (5.69)	2.35 (4.39)	2.61 (2.49)
Breath Holding Task (Experiment 2)			
Task persistence (seconds)	48.22 (15.40)	52.14 (16.55)	51.67 (16.78)
Perceived mental effort	96.11 (27.89)	102.09 (28.94)	98.26 (21.46)
Pre-performance anxiety: Intensity	1.04 (.70)	.91 (.67)	.79 (.59)
Pre-performance anxiety: Perceived helpfulness	1.00 (1.55)	.74 (1.54)	1.11 (1.08)
Physiological arousal (change scores; HR)	3.96 (7.90)	4.96 (6.54)	4.53 (4.84)

*Note * $p < .05$, ** $p < .001$*