

1 Running head: PSYCHOLOGICAL SKILLS AND MILITARY ENDURANCE

2

3

4

5

6

7

8

9

10 Psychological skills and “the Paras”:

11 The indirect effects of psychological skills on endurance

12

13 Date submitted: 28.02.2017

14 Date resubmitted:

15

16

17

18

19 Accepted for publication in *Journal of Applied Sport Psychology* by Taylor and Francis

20

21

22

23

24

25

26
27
28
29
30
31
32
33
34
35
36
37

Abstract

We examined the indirect effects of basic psychological skills (PS) on military endurance through enhanced advanced PS, whilst controlling for fitness. British Army recruits (n = 159) participated in three endurance events for Parachute Regiment selection and completed an adapted Test of Performance Strategies questionnaire (Hardy et al., 2010). Following confirmatory factor analyses, the multiple mediation regression analyses using PROCESS (Hayes, 2013) suggested that goal-setting, imagery and relaxation all had positive indirect effects on endurance via activation, with goal setting also impacting on endurance via negative thinking. These data provide some support for basic PS influencing endurance via advanced PS.

38 **Psychological skills and the Paras: The indirect effects of psychological skills on endurance**

39 Sport psychology research has application that reaches beyond the sporting domain into
40 military training and combat contexts (Goodwin, 2008). Indeed, there are a number of parallels
41 between sports teams and military units including: (a) they both operate in dynamic and complex
42 environments; (b) they require effective utilization of perceptual, cognitive, and motor skills; (c)
43 they necessitate performance under stressful conditions; and (d) they both seek tactical advantages
44 over opponents (Ward et al., 2008). Furthermore, many sports events have evolved from military
45 tasks such as: marksmanship (e.g., rifle shooting, archery), overcoming physical obstacles or
46 defences (e.g., pole vault, high jump and cross country running), and navigation (e.g., orienteering,
47 sailing; Goodwin, 2008). Given the similarities between sport and military performance, the
48 application of sport psychology in the military is increasingly being recognized (e.g., Adler et al.,
49 2015).

50 Over the past 40 years, numerous studies have demonstrated that psychological skills (PS)
51 benefit athlete well-being and performance (e.g., Hayslip, Petrie, MacIntyre, & Jones, 2010;
52 Thelwell & Greenlees, 2003) and initial research has linked PS training and military performance
53 (Hammermeister, Pickering, McGraw, & Ohlson, 2010). One recent longitudinal experiment
54 (Adler et al., 2015) revealed improvements in self-confidence and performance on a 20m aerial
55 obstacle task for soldiers completing PS training in comparison to soldiers in an active control
56 condition. However, it remains unclear exactly how such effects emerged. Indeed, in a broader
57 sense, within sport related research, the mechanisms via which PS impact on performance are still
58 not fully understood and the conceptualization of the term 'PS' remains ambiguous (cf. Tremayne
59 & Newberry, 2005).

60 **Conceptualization of psychological skills**

61 Despite the plethora of research investigating PS in sport, **a functional definition of PS is far**
62 **from agreed upon** and researchers often fail to provide clear distinctions between mental skills (e.g.,

63 imagery, goal setting) and mental qualities (e.g., confidence, motivation; cf. Holland, Woodcock,
64 Cumming, & Duda, 2010). As such, multiple PS frameworks and questionnaires (e.g., Vealey,
65 1988; Durand-Bush, Salmela, & Green-Demers, 2001; Smith, Schutz, Smoll, & Ptacek, 1995)
66 present inconsistencies in relation to the definition of ‘psychological skill’ and include concepts
67 which we would not consider to be PS. As Tremayne and Newberry (2005) highlighted typically
68 ‘skill’ refers to either an act/task being performed or an indicator of the standard of performing a
69 task, and a central feature of a ‘skill’ is that improvement is possible with practice (Magill, 1993).
70 Therefore, whilst there are relevant subscales within inventories such as the Ottawa Mental Skills
71 Assessment Tool (OSMAT 3) and Athletes Coping Skills Inventory-28 (ACSI-28; e.g., goal setting,
72 imagery, relaxation, focusing), some subscales (e.g., confidence, commitment, achievement
73 motivation) are not skills as they do not describe specific activities or abilities. Rather, we deem
74 them to be the psychological outcomes which are likely to arise from using PS. For instance, it is
75 difficult to conceive carrying out “confidence” or being good at “achievement motivation”. Indeed,
76 more detailed scrutiny is warranted regarding the rationales proposed for PS measures. As an
77 example in the development of the ACSI-28, there is little to no definition of coping skills and little
78 reference to the extensive theoretical basis of coping to inform the inclusion of certain subscales.
79 Indeed whilst some PS, such as goal setting and concentration, are measured within the ACSI-
80 other PS (e.g., self-talk) are not included.

81 In light of such inconsistency, we argue that the Test of Performance Strategies (TOPS;
82 Thomas, Murphy, & Hardy, 1999) and the more recent TOPS-2 (Hardy, Roberts, Thomas, &
83 Murphy, 2010) offers more conceptual clarity and is more appropriately aligned with the two
84 possible meanings of the word skill. Within the TOPS, basic skills (goal-setting, imagery,
85 relaxation and self-talk) have been outlined as acts or tasks that can be performed and practised,
86 and advanced skills (automaticity, emotional control, attentional control, reduced negative thinking,
87 activation) are indicators of the level of ability. The TOPS authors suggest that performers who

88 regularly practise using basic PS will eventually improve their ability with the more advanced PS,
89 which will ultimately influence performance. As such, we believe the TOPS has the most
90 appropriate conceptualization of PS and provides a clear and testable model of PS scales, which we
91 endeavoured to assess.

92 Multiple investigations have reported correlations between scores from the TOPS/ TOPS-2
93 and levels of athletic performance (Hayslip et al., 2010), flow experience (Jackson, Thomas, Marsh,
94 & Smethurst, 2001), anxiety responses (Fletcher & Hanton, 2001), and most recently, military
95 performance (Adler et al., 2015). More broadly, the TOPS scales have been frequently cited, used
96 as a measurement tool in a wide range of studies and are readily advocated as an assessment tool
97 (e.g., Burton & Raedeke, 2008). However, there has yet to be a test of the indirect effect proposed
98 by Hardy, Thomas and colleagues (1996; 1999; 2010) and empirical evidence regarding its
99 conceptual validity is needed. That is, goal setting, relaxation, self-talk, and imagery influence
100 performance via an increased ability to control one's emotions and attentional focus, perform
101 automatically (without over-thinking), resist negative thinking and ready oneself to perform
102 (activation). In the present study, we provide the first empirical test of this theorizing and examine
103 the indirect effects of basic PS on performance using a military context.

104 **Psychological skills and Endurance**

105 Traditional views of endurance (the ability to sustain aerobic exercise over prolonged periods)
106 place a central relevance on muscle fatigue as the major contributing factor to sustained
107 performance or exhaustion (e.g., Allen, Lamb, & Westerblad, 2008). However, more contemporary
108 perspectives also consider the psychological contributing factors. Recently, McCormick, Meijen,
109 and Marcora, (2015) conducted a systematic literature review of psychological interventions
110 targeting aerobic endurance and concluded that the basic PS of goal setting, imagery, and self-talk
111 as well as PS training packages all enhanced endurance. They also noted the lack of research
112 regarding the psychological mechanisms underlying these improvements (hampering researchers'

113 ability to refine these interventions) and also a need for more psychology oriented endurance
114 studies to be conducted in ecologically valid contexts. Furthermore, the effects of PS use over and
115 above pre-existing physical fitness have not yet been isolated. Therefore, we investigated the
116 mechanisms (advanced PS) explaining the relationship between the strategic use of basic PS and
117 endurance whilst controlling for pre-existing fitness levels. The endurance tasks utilized within the
118 study were part of a genuine military assessment for acceptance into the British Parachute
119 Regiment (an elite branch of infantry soldiers); therefore, all participants were high level
120 performers who experienced real consequences as a result of their performance helping to assure
121 the ecological validity of the data.

122 Given the evidence provided thus far, it seems reasonable to suggest that soldiers' use of the
123 four basic PS (i.e., goal-setting, relaxation, self-talk, and imagery) would enhance their endurance.
124 With regards to the mechanisms or advanced PS (attentional control, emotional control, negative
125 thinking, activation, and automaticity) through which use of each basic PS might impact on
126 endurance, it is necessary to consider the psychological demands of endurance tasks (Taylor, 1995)
127 and how using each specific PS could assist athletes to deal with such demands.

128 In the present case, while initial training for the infantry is necessarily arduous, training for
129 Parachute Regiment (Para) recruits is widely regarded by the British Army as the most physically
130 and mentally demanding of all its infantry regiments (Wilkinson, Rayson, & Bilzon, 2008). The
131 Paras' specialist role as elite soldiers requires them to operate at a higher intensity than the regular
132 infantry, carrying heavy loads for longer distances, at a faster pace, as well as withstanding the
133 hardships of operating independently in the field for long periods under harsh environmental
134 conditions (Wilkinson et al., 2008). In order to take part in the Para selection process, recruits are
135 required to pass multiple military selection tests and undertake specific Para selection training.
136 Thus, only the highest performing recruits are invited to undergo Para selection which involves a
137 series of very demanding individual and team events. For example, individual tasks involving

138 carrying personal equipment weighing 20kg or more for distances of up to 32km over severe terrain
139 with time constraints, and team events requiring participants to run with an 80kg stretcher for 8km
140 are commonplace within selection.

141 Therefore to be successful, Para recruits need to effectively deal with the psychological
142 demands of pain and fatigue with appropriate PS use. Specifically, they are required to counter the
143 effects of fatigue and associated negative thoughts to exert attentional and emotional control to
144 maintain an appropriate intensity for sustained periods. Indeed, negative thinking, attentional focus
145 on negative cues and experiencing negative emotions are thought to be related to lower pain
146 tolerance (Meagher, Arnau, & Rhudy, 2001) and poorer endurance (Brewer, Van Raalte, & Linder,
147 1996). We therefore expected that the advanced PS of attentional control, emotional control,
148 negative thinking, and activation would all correlate with endurance. On the contrary, whilst the
149 advanced PS of automaticity (i.e., the ability to perform motor tasks without consciously thinking
150 about the movements) has been implicated in the execution of fine motor tasks (cf. Masters, 1992),
151 there is little evidence endorsing its relevance in endurance-oriented tasks. Consequently we
152 thought it unlikely that automaticity would be related to endurance, also negating any indirect
153 effects of basic PS on endurance via automaticity.

154 When formulating specific hypotheses concerning the indirect effects of soldiers' use of each
155 basic PS on endurance, multiple advanced PS should apply to each basic PS. For instance, goal
156 setting can increase perceptions of control (Locke & Latham, 2002), direct attention towards to the
157 specific task, and reduce negative emotions (Kingston & Hardy, 1997). Furthermore, the setting of
158 challenging, specific, and results driven goals ought to increase the effort and intensity at which
159 tasks are completed (Locke & Latham, 2002). Past endurance-specific research reveals that
160 individuals completing triathlon events perceive goal setting to beneficially impact on their
161 attentional focus, mood states, and positive thinking (Thelwell & Greenlees, 2003). Accordingly,
162 we hypothesized indirect effects of goal setting on soldiers' endurance via enhanced activation,

163 attentional and emotional control, and reduced negative thinking.

164 Imagery and self-talk have been found to be effective “psyching up” techniques for athletes
165 (e.g., Burhans, Richman, & Bergey, 1988). Imagery and self-talk can also aid physiological
166 activation when nearing fatigue by reducing perceived stress (Hatzigeorgiadis, Zourbanos, &
167 Theodorakis, 2007; Jones, Bray, Macrae, & Stockbridge, 2002), and encouraging facilitative
168 perceptions of the body’s response to stress (e.g., Cumming, Olphin, & Law, 2007). Therefore, we
169 expected that activation and emotional control would be relevant to understanding both imagery
170 and self-talk’s indirect effects on endurance. Furthermore, the use of imagery and self-talk can
171 serve an affirmatory purpose thus assisting performance by reducing levels of negative thinking
172 (Mace & Carroll, 1986). Previous research has also reported that imagery and ST use can enhance
173 athletes’ attentional control (Calmels, Berthoumieux, & D’Arripe-Longueville, 2004;
174 Hatzigeorgiadis et al., 2007) and so could assist to block out irrelevant stimuli, such as pain.
175 Indeed, upon completing endurance tasks, performers reportedly use imagery and self-talk to help
176 prepare and cope with pain and fatigue aiding their attentional focus (Thelwell & Greenlees, 2003).
177 Therefore we hypothesized that imagery and self-talk would indirectly impact upon the soldiers’
178 endurance through improved activation, attentional and emotional control, and reduced negative
179 thinking.

180 Finally, relaxation strategies in combination with other techniques have been shown to
181 enhance endurance related measures (e.g., Caird, McKenzie, & Sleivert, 1999) but comparatively
182 less research with an exclusive emphasis on relaxation has been conducted. Relaxation strategies
183 are thought to impact on athletes’ arousal state, tension and readiness to perform, and breathing
184 techniques can assist attentional focus on goals and appropriate sensations (e.g., steady breathing)
185 rather than pain (Thelwell & Greenlees, 2003). Hence, soldiers’ use of relaxation strategies should
186 have indirect effects on endurance by aiding activation, emotional and attentional control and
187 reducing negative thinking (e.g., anxiety-provoking thoughts and tension, see Fletcher & Hanton,

188 2001).

189 As presented, there is a range of literature which supports the proposed relationships between
190 basic PS, advanced PS and performance. However, few of these studies test mediating relationships
191 and there is yet to be an empirical test of all such relationships in a single study, using endurance
192 tasks. Indeed, the collective volume of research on PS is a rather disparate mass of literatures that
193 tends to focus on single PS and tend to ignore multiple possible mechanisms via which PS use
194 influence outcomes in concert. Although most researchers forward mechanistic reasons why their
195 PS of choice should influence performance, mediation effects are rarely formally evaluated. In fact,
196 there is a large body of literature that collects qualitative (e.g., social validity) data that is not
197 capable of providing meaningful insight into this important aspect (e.g., Thelwell & Greenlees,
198 2003). When researchers have focused on mediation they tend of employ a very narrow approach
199 (e.g., Short, Tenute & Feltz, 2005), yielding very focussed (and partial) but not a comprehensive
200 understanding regarding possible mediators. As a result, empirical data concerning PS and their
201 associated mechanisms could still offer more guidance to practitioners. Furthermore, given that the
202 PS literature is founded on the premise of modelling lesser skilled athletes' use of PS on how elite
203 performers utilize these mental skills, it is unfortunate that much of the available findings are not
204 commonly gleaned from elite samples. Indeed, numerous researchers (e.g., Greenspan & Feltz,
205 1989; Hardy, Begley, & Blanchfield, 2015) have previously argued that the effects of PS for
206 novices (e.g., Thelwell & Greenlees, 2003), might not apply to higher level performers (e.g., Para
207 recruits). The vast majority of existing research is also ambiguous with regard to the context (e.g.,
208 practice or competition) within which PS are being examined and there are relatively few studies
209 involving endurance; those that do have not controlled for pre-existing fitness levels. Finally, while
210 previous research has acknowledged that there is a variety of PS relevant for performance, very few
211 studies have examined how these ought to be meaningfully conceptualized to develop a coherent
212 appreciation of their effectiveness.

213 We believe that the present investigation addresses the aforementioned limitations, as the first
214 quantitative assessment of multiple indirect effects of PS use within an ecologically valid
215 endurance setting with elite military recruits. We draw from Hardy and colleagues' (1996; 2010;
216 Thomas et al., 1999) previously untested theorizing regarding the indirect effects of basic PS on
217 performance via advanced PS. Specifically, we hypothesized that after controlling for pre-existing
218 fitness levels, elite infantry soldiers (i.e., Para recruits) reporting strategic use of the four basic PS
219 (goal setting, relaxation, self-talk, and imagery) would have facilitatory indirect effects on their
220 endurance, via increased levels of advanced psychological functioning, specifically via enhanced
221 attentional control, emotional control, activation, and reduced negative thinking. We did not expect
222 any of the basic PS to have an indirect effect on endurance via automaticity.

223 Method

224 Participants

225 We recruited 192 male British Army Parachute Regiment (Para) recruits ($M_{\text{age}} = 21.04$, SD
226 $= 3.62$) to take part in the study. Nine (5%) were removed due to injury and six (3%) due to non-
227 completion of the Pre Para selection event. Therefore, a total of 183 participants completed the Pre
228 Para selection event, however 24 failed to complete the 2-mile run prior to Pre Para selection
229 (which we used as a covariate, see Measures). Thus, we ran all analyses on data from 159
230 participants. All participants had passed a rigorous selection protocol involving initial Army
231 selection, followed by a further screening process known as the Parachute Regiment Aptitude
232 Course (PRAC). Participants were currently undergoing a 28-week Combat Infantryman's Course
233 (CIC), designed to create trained soldiers who were physically and mentally robust enough to
234 operate in hostile environments. During the CIC, there are a number of critical tests (e.g., shooting,
235 fitness) which have to be passed in order to progress. Failure to meet the required standards at any
236 point in training results in a recruit being reallocated to another platoon at an earlier stage of
237 training. Thus, this training is necessarily stressful and designed to produce high performing

238 recruits. The training staff also stated that the recruits had not received any PS specific education as
239 part of their official military training.

240 **Endurance – “P Company”**

241 Before being able to pass the CIC and progress onto parachute training, recruits are required
242 to successfully complete a Pre-Para Selection test week (PPS; colloquially known as P- Company)
243 at Week 20 of the CIC. The purpose of P Company is predominantly to test the physical fitness and
244 mental robustness of potential Parachute Regiment soldiers, in order to confirm their suitability to
245 serve in an airborne unit. During P Company, participants complete a series of eight arduous tests;
246 six different endurance events (two team tasks and four individual tasks), an aerial confidence test
247 and a physical combat task. A maximum of 10 points can be achieved for their performance on
248 each task (the aerial confidence task is pass/fail thus a total of 70 marks are available). Points are
249 awarded for each task by P Company staff, who are independent from the recruits’ regular training
250 team, based on time to complete or completion of an event. In the current sample, scores ranged
251 from 11 to 68 out of a possible 70 points ($M = 52.21$, $SD = 10.29$).

252 To create a measure of endurance that was not confounded by attrition, we selected three of
253 the first four endurance events. That is, the 2-mile loaded run, the 3 km steeplechase assault course,
254 and the team log race. The 2-mile loaded run requires each recruit to carry 20 kg of equipment
255 (including rifle) and is to be completed in less than 18 minutes to achieve the maximum of 10
256 points. Subsequently, one point is deducted for every 30 second period over the 18 minutes. The
257 steeplechase assault course is a 3 km run over undulating terrain, through water obstacles and over
258 assault course features. Participants achieve 10 points if the task is completed in 19 minutes or less,
259 with one point being deducted for every 30 second period over 19 minutes. Finally, the team log
260 race requires teams of eight recruits to carry a 60 kg log over a taxing 2.8 km course. This task is
261 particularly arduous and recruits often withdraw from carrying their log mid-task due to fatigue.
262 For completion of the course, recruits are awarded six points. If they reach particular stages before

263 withdrawing (yet do not complete the course) recruits are awarded two or four points. Up to four
264 more points may be awarded by PPS staff for effort, determination and teamwork, thus achieving a
265 maximum of 10 points. We created a composite measure of endurance by calculating a mean score
266 from each of the three events.

267 **Measures**

268 **Test of Performance Strategies.** The TOPS questionnaire was originally designed to
269 measure athlete's use of a wide range of PS in practise and competition. Hardy et al. (2010)
270 subsequently developed an updated version, the TOPS-2, and presented support for the measure's
271 psychometric credentials and established strong convergent and factorial validity
272 ($\chi^2(436) = 695.16$, RMSEA = 0.05, CFI = 0.97, TLI = 0.97, and SRMR = 0.06). In their paper,
273 Hardy et al. (2010) recommended a limited number of improvements that they felt would further
274 enhance the measure. Specifically, they advised the editing of an item in the automaticity
275 (competition) subscale to remove the double negative meaning, and the replacement of the
276 distractibility (competition) scale with an attentional control in competition scale. These
277 suggestions along with the editing of an emotional control (training) item resulted in the TOPS-3.

278 In the present study, we used a slightly modified version of the TOPS-3 to assess recruits'
279 use of PS during P Company. Here we only used the 36 competition TOPS-3 items and we adjusted
280 the phrasing of the items to better reflect the nature of the current context (i.e., PS use during P
281 Company as opposed to general use in competition). The items divide into nine subscales; goal-
282 setting (e.g., *During PPS I set specific goals for each event*), self-talk (e.g., *I said things to myself*
283 *during PPS to help my performance*), relaxation (e.g., *I used relaxation techniques during PPS to*
284 *improve my performance*), imagery (e.g., *I visualized each event on PPS going exactly the way I*
285 *wanted it to go*), attentional control (e.g., *I was able to control distracting thoughts during PPS*)
286 emotional control, (e.g., *I had difficulty with my emotions during PPS*), activation (e.g., *I was able*
287 *to get myself physically and mentally ready to perform each event on PPS*), automaticity (e.g., *I was*

288 *able to perform on PPS without having to consciously think about it*), and negative thinking (e.g., *I*
289 *imagined failing some events during PPS*). Responses were on a 5-point Likert scale that ranged
290 from 1 (*never*) to 5 (*always*), with a midpoint of 3 (*sometimes*).

291 To ensure that wording changes did not alter the factor structure of the TOPS-3, we used
292 LISREL and PRELIS 8.80 (Jöreskog & Sörbom, 2006) to conduct single factor confirmatory factor
293 analyses (CFA) for each scale followed by a nine-factor analysis (cf. Jöreskog, 1993). Results
294 revealed that, with the removal of one item from the negative thinking and attentional control
295 scales, the model fit for the nine factor model was acceptable, $\chi^2(428) = 827.56, p < .001$, RMSEA
296 = 0.07, TLI= 0.94, CFI = 0.95, SRMR = .09.¹

297 **Fitness.** As a standard part of training, recruits are required to complete a 2-mile loaded run
298 (as described above) at week 18 of the CIC to determine their readiness to attempt P Company. We
299 used the time each recruit took to complete this run as an objective measure of aerobic fitness and
300 included this as a covariate in all analyses.

301 **Procedures**

302 Following institutional ethical approval, the second author collected fitness data in the two
303 weeks before P Company. Three days prior to the beginning of P Company the recruits were
304 informed of the nature of the study and invited to participate, following which each individual
305 completed a consent form.

306 The eight P Company events took place during a single week for each platoon, with the
307 team log race and steeplechase assault course taking place on the second day and the 2-mile run
308 taking place on the morning of the third day. After these events, recruits who were not able to
309 achieve a pass due to insufficient points obtained were removed from the course, while some had
310 been withdrawn due to injury. On completion of the last event on the fifth day, once the recruits had
311 showered and changed, all participants received standardized instructions regarding the completion
312 of the TOPS-3. The instructions included a written and verbal explanation of the different PS and

313 anti-social desirability instructions explaining the data would be kept confidential and encouraging
314 honestly at all times. The recruits were specifically asked to recall and focus on their psychological
315 state and strategies used during P Company, rather than being overly focussing on their resultant
316 performances. Participants then completed the TOPS-3 in a classroom type environment. At this
317 point, participants had no knowledge of how they had performed on P Company, and whether they
318 had passed or failed. Thus, although questionnaire completion followed completion of all P
319 company events, any bias relating to knowledge of performance was likely to be minimal. P
320 company staff only made the recruits aware of their P Company performance scores, and whether
321 they had passed or failed Pre Para Selection, when all questionnaires were complete.

322 **Data analysis**

323 We tested the hypotheses concerning the indirect effects of each basic PS on endurance via
324 the advanced PS (activation, attentional control, automaticity, emotional control, negative thinking)
325 using PROCESS (Hayes, 2013) with 10,000 bootstrap samples. PROCESS is a flexible regression
326 based package that is able to test, amongst other things, multiple mediators simultaneously. A
327 strength of PROCESS is that it employs bootstrapping and confidence intervals to assess the size
328 and significance of any effects produced. Bootstrapping is superior to a normal theory approach as
329 it is more powerful, produces more accurate results when applied to conditional indirect effects, and
330 is not based on distributional assumptions (MacKinnon, Lockwood, and Williams, 2004). Lower
331 and upper bound 95% confidence intervals that do not encompass zero indicate significance at the
332 .05 level. PROCESS provides the total indirect effect and the separate indirect effects through each
333 mediator whilst controlling for effects of all the other mediators via bootstrapping. Within multiple
334 mediation models, a significant total indirect effect is not necessary in order to examine specific
335 indirect effects (Hayes, 2013). In addition, PROCESS allows for the inclusion of covariates (in our
336 case fitness) in the model. As part of this multiple mediator strategy, we tested the indirect effects
337 of each basic PS on endurance individually, therefore conducted four analyses in total.

Results

338

339 Preliminary analyses

340 Means, standard deviations, composite reliability, and correlations for the variables
341 measured in this study are displayed in Table 1. All use of basic PS (imagery, relaxation, self-talk,
342 and goal setting) were significantly correlated with each other, however, of the basic PS, only self-
343 talk correlated with endurance. All the advanced PS (activation, attentional control, emotional
344 control, negative thinking, and automaticity) were also significantly correlated with each other and
345 with endurance. Of the advanced PS, activation and attentional control were also significantly
346 correlated with all basic PS (except for attentional control and relaxation) and automaticity was not
347 correlated with any basic PS. Fitness (quicker times on a 2-mile run) was correlated with all
348 advanced PS as well as endurance.

349 Main Analyses

350 Figure 1 and Table 2 show the results of the regression analyses including the
351 unstandardized bootstrap estimates of the total and specific indirect effects together with bias
352 corrected and accelerated 95% confidence intervals. Model One (goal setting as the predictor
353 variable and fitness as a covariate) explained 54.57% of the variance in endurance, $F(2, 156) =$
354 $33.09, p < .001$. Goal setting was positively related to activation and attentional control, and
355 activation, attentional control and negative thinking all predicted endurance. Of more interest, a
356 significant and positive indirect effect of goal setting on endurance via activation was evident, with
357 the positive indirect effect through negative thinking also being significant.

358 Model Two (imagery as the predictor variable and fitness as a covariate) explained 54.61%
359 of the variance in endurance, $F(2, 156) = 33.15, p < .001$. Imagery was significantly and positively
360 related to activation and attentional control; more importantly, a positive indirect effect involving
361 activation was evident. Model Three (relaxation as the predictor and fitness as a covariate)
362 explained 54.47% of the variance in endurance, $F(2, 156) = 32.90, p < .001$. Relaxation's only

363 significant (and positive) indirect effect on performance was via activation. Finally, model four
364 (self-talk as the predictor and fitness as a covariate) explained 56.92% of the variance in endurance,
365 $F(2, 156) = 37.39, p < .001$. In contrast to the preceding analyses, no significant indirect effects
366 emerged, although a significant total effect of self-talk on endurance was apparent, $B = .36, (SE$
367 $.14), p = .01$.

368 **Discussion**

369 The purpose of the study was to examine the indirect effect of basic PS on endurance via
370 advanced PS. The results partially supported the hypotheses, as soldiers' use of goal-setting,
371 imagery and relaxation was indirectly related to their endurance via their perceived levels of
372 activation. Further, use of goal setting was also positively related to endurance via a perceived
373 improved ability to reduce negative thinking. The indirect effects of PS were modest; however this
374 was to be expected as the effects emerged to predict performance in a complex applied environment
375 after controlling for the recruits' pre-existing fitness. Indeed although modest, the effects suggest
376 that PS use is related to endurance over and above soldiers' physical attributes. Interestingly, whilst
377 the self-reported levels of advanced skills of emotional control, attentional control, and automaticity
378 did not mediate the relationship between basic PS use and endurance, all of these three variables
379 were correlated with endurance along with negative thinking. As the first mediational analysis of
380 the indirect effects of multiple PS use on endurance, the results augment previous findings (e.g.,
381 Thelwell & Greenlees, 2003) to progress understanding regarding PS and the influential
382 mechanisms during endurance tasks with high level performers (cf. McCormick et al., 2015).
383 Alongside the relative lack of investigation into PS mechanisms in endurance settings, the current
384 research is a long awaited investigation of Hardy et al.'s (1996; 2010; Thomas et al., 1999)
385 conceptualization of PS adopted within the TOPS questionnaire. Indeed, the TOPS questionnaire is
386 a measurement tool used in many research studies (e.g, Adler et al., 2015, Fletcher & Hanton, 2001,

387 Hayslip et al., 2010, Jackson et al., 2001) and is readily available to practitioners (e.g., Burton &
388 Raedeke, 2008) thus empirical evidence regarding its conceptual validity is pertinent.

389 The current findings indicate that activation, conceptualized as a holistic ability to adopt a
390 readiness to perform (Hardy et al., 2010) was the key factor via which basic PS use were related to
391 endurance. In the present context, such a finding makes conceptual sense. P Company entails
392 considerable pressure to perform, taking place after 20 weeks of training, with a notoriously low
393 pass rate, resulting in membership of the elite Parachute Regiment. The pressurized and arduous
394 nature of P Company means that the soldiers' ability to be psychologically and physiologically
395 ready to perform is likely to be of central importance. Indeed, the results support the notion that the
396 ability to create an ideal performance state and optimal arousal levels promote feelings of flow
397 (Jackson et al., 2001) and assist endurance (Houston, Dolan & Martin, 2011).

398 The indirect effect of goal setting via negative thinking is consistent with the view that goal
399 setting can aid performance through increases in mood and positive thinking (Thelwell &
400 Greenlees, 2003). However, somewhat surprisingly, no other hypothesized indirect effects
401 emerged for the other advanced PS. Indeed, although goal setting, imagery, self-talk and relaxation
402 have been linked to reduced negative thinking, and attentional and emotional control (e.g., Calmels
403 et al., 2004; Hatzigeorgiardi et al., 2007; Kingston & Hardy, 1997), it seems that in relation to
404 endurance at least, these mechanisms are less relevant. Also, notably self-talk did not have a direct
405 or indirect effect on endurance although it had a total effect. The total effect ignores the role of
406 mediators or covariates thus suggesting that ST is associated with endurance however it exerts its
407 effects via mechanisms other than advanced PS.

408 The importance of activation relative to the other advanced PS could be due to the nature of
409 both endurance tasks and the specific advanced skills. Indeed, many sporting activities are
410 intermittent in nature, with opportunities for emotional highs and lows based on performance
411 fluctuations. Similarly, many sporting activities require complex techniques and decision making,

412 whereby specific attentional foci can be highly advantageous (Wulf & Shea, 2002). It follows that
413 in comparison to these intermittent, technically oriented sports, during endurance events
414 participants experience fewer sudden shifts in emotions and attentional focus, and have to maintain
415 a constant performance, so have fewer pauses and opportunities to use PS mid-task. Thus, during
416 endurance tasks the relationship between basic PS use and emotional and attentional control could
417 be minimal. As such, whilst Hardy (1996; 2010) and Thomas et al.'s (1999) hypothesis that basic
418 PS have facilitatory effects on performance via enhanced emotional and attentional control, may
419 hold true in other sporting activities, it is perhaps not entirely accurate in an endurance context.

420 As an alternative explanation, it is possible that the notion of using strategies to ready
421 oneself to perform is likely to be something discernible even to relatively inexperienced performers.
422 However, using basic PS to effectively impact on one's negative thinking, emotional and
423 attentional control requires a degree of self-awareness and understanding of emotions and ideal foci
424 of attention (Wulf & Shea, 2002). Therefore, as new recruits without relevant PS military training,
425 the impact of using basic PS on these advanced PS could be limited. Whilst negative thinking,
426 emotional and attentional control were correlated with endurance, given the task and the limited
427 experience of the recruits, they were not salient mechanisms via which the recruits influenced their
428 performances using basic PS.

429 In contrast, automaticity and its correlation with endurance was unanticipated and runs
430 contrary to our original hypothesis that operating on 'automatic pilot', would not be relevant to
431 endurance. Nevertheless, some existing research does offer support to the endurance benefits of not
432 attending to the mechanics of task execution during aerobic tasks (e.g., Tenenbaum, 2001).
433 Considering the associations between all of the advanced PS and endurance, there are possible
434 gains to be had in developing alternative means of improving performers' ability in these PS other
435 than through the use of basic PS (e.g., simulation training, mindfulness training etc.).

436 **Study limitations**

437 Despite the interesting results, it is important to note that when distinguishing between types
438 of PS and specific effective PS practices, the use of the TOPS is limited. Although the TOPS-3 is a
439 comprehensive measure of PS use, it examines basic PS use at a broad level (e.g., to what extent
440 does someone use goal setting?) and does not make distinctions between particular aspects of PS,
441 such as process, performance and outcome goals, visual and kinesthetic imagery modalities, and
442 instructional and motivational self-talk. Thus, such a broad coverage of each of the basic PS may
443 preclude precise mechanisms becoming apparent. For example, motivational self-talk may exert its
444 effects via emotional control whereas instructional self-talk does not. Indeed, the total effect of self-
445 talk on endurance may have been due to soldiers referring to either instructional or motivational
446 self-talk when completing questions about their use of self-talk during P Company. Both of these
447 types of statements can enhance performance (see Blanchfield, Hardy, De Morree, Staiano, &
448 Marcora, 2014; Hatzigeorgiardi et al., 2007), yet are likely to work through very different
449 mechanisms that may not have been measured in the present study. We would encourage
450 researchers who are interested in the mechanisms underlying PS to consider each PS in detail when
451 developing hypotheses, as different mechanisms will likely be relevant for different aspects of PS.
452 However, it is important to note that whilst the TOPS precludes such detailed investigation, there is
453 no single questionnaire that measures all aspects of PS and validated measures have not been
454 established for each aspect of specific PS which could be of interest (e.g., process, performance,
455 outcome goals). Moreover, while the CFA analysis suggested that the adapted TOPS-3 nine factor
456 model was factorially valid and the composite reliability of all but one of the subscales was
457 acceptable ($>.70$), further validation work on the TOPS-3 is required in order to better understand
458 the validity and reliability of the measure.

459 As well as the suggested measurement issues, another consideration relevant to the current
460 data is the study design from which they originate. In particular, PS are commonly employed as a
461 form of intervention and the investigation's retrospective design limits causal inferences that an

462 experimental design would allow. In particular, the administration of the TOPS-3 following
463 completion of the all performance tasks presents clear limitations to the proposed temporal nature
464 of the relationships found and issues with the retrospective recall of PS use. However, alternative
465 administration of the TOPS-3 was not possible given that we were investigating PS use during a
466 one-off genuine military assessment; so capturing PS use prior to the completion of events was not
467 possible. Furthermore, whilst it would have been preferable to collect PS data during or
468 immediately after each P Company event, this was not possible due to the career implications of P
469 Company performance and the need to rest and protect recruits from disruption of any kind.
470 Therefore, given the unique environment and ecological validity of the study, its design and timing
471 of measurement were necessary.

472 **Implications and future directions**

473 Keeping in mind the current findings, future experiments examining possible mediatory
474 pathways of PS in a longitudinal fashion are warranted. Crucially, further investigation is required
475 regarding the effective application of PS in military settings to extend the evidence base from
476 which practitioners might draw from. In particular, Adler et al.'s (2015) finding that PS training
477 only improved certain military activities further highlights the need to extend knowledge regarding
478 the mechanisms via which PS affect different military tasks (e.g., team and individual endurance
479 tasks). Furthermore, findings that females may benefit more from PS training (cf. Adler et al.,
480 2015), emphasize the need for future investigation of individual differences such as gender and
481 personality traits might moderate the impact of PS use (see Roberts & Woodman, 2015).

482 The results highlighted that the use of basic PS could improve endurance and basic PS
483 training is likely to assist athletes' endurance by promoting optimal states of activation. In
484 particular the results suggest that PS training could be appropriate in an applied military setting and
485 could help to increase pass rates and thus reduce attrition. Given the resource intensiveness and
486 typically low (40-70%) pass rates for military assessments such as P Company, alongside current

487 slow recruitment and austerity measures, bolstering recruits' use of PS might result in much needed
488 financial savings. Indeed, continuing the current attrition rates in Parachute Regiment training could
489 lead to the P-Company standards being lowered, thereby negatively impacting on the quality of
490 elite combat troops in the Army and the UK's ability to conduct successful combat operations in the
491 future. Conversely, given the lack of relationships between basic and the other advanced PS,
492 practitioners may be wise to question the utility of teaching basic PS and investigate alternative
493 methods of improving recruits and athletes' abilities in areas such as attentional control and
494 automaticity when undertaking endurance tasks. The present findings (e.g., CFA results) might also
495 help to improve the quality of future PS research in military contexts, whilst ensuring practitioners'
496 faith in military TOPS-related data. We continue to believe that the TOPS instrument can play a
497 useful role in educating clients about their PS usage, however further validation work on the TOPS-
498 3 is required.

499 This study makes a much needed contribution to the study of the psychological mechanisms
500 of PS use in endurance tasks (cf. McCormick et al., 2015). It is also a long over-due test of Hardy,
501 Thomas and colleagues' (1996; 1999; 2010) proposition that could reignite discussion regarding the
502 conceptualization of PS. Indeed, progress regarding the conceptualization of PS has stalled in
503 recent years and we hope this paper compels further mediational investigation, for example the
504 longstanding proposal informing The Ottawa Mental Skills Assessment Tool (OMSAT-3; Durand-
505 Bush et al., 2001) that foundation skills are necessary before developing psychosomatic and
506 cognitive skills remains untested. The results suggest that practitioners in both sport and military
507 environments would be advised to encourage their charges to systematically use the basic PS in
508 order to improve their psychological state and readiness to perform, leading to improved endurance
509 performances. Nonetheless, many of the hypothesized indirect effects of Hardy (1996; 2010) and
510 Thomas et al.'s (1999) hierarchal model of PS were not supported and as such the TOPS model
511 requires further investigation in both endurance and fine motor tasks. Moreover, the nuances

512 evident within the current set of findings illustrate that PS are not a performance-oriented panacea,
513 but reinforce the importance of skilled analysis of task demands and continued empirical
514 investigation, especially with regard to endurance tasks.

515

516
517
518
519
520
521
522
523
524
525
526
527
528
529
530
531
532
533
534
535
536
537
538
539
540

References

- Adler, A. B., Bliese, P. D., Pickering, M. A., Hammermeister, J., Williams, J., Harada, C., Csoka, L., Holliday, B., & Ohlson, C. (2015). Mental skills training with basic combat training soldiers: A group-randomized trial. *Journal of Applied Psychology, 100*, 1752-1764. doi: 10.1037/apl0000021
- Allen D. G., Lamb G. D., & Westerblad, H. (2008). Skeletal muscle fatigue: Cellular mechanisms. *Physiological Review, 88*, 287-332. doi:10.1152/physrev.00015.2007
- Blanchfield, A. W., Hardy, J., De Morree, H. M., Staiano, W., & Marcora, S. M. (2014). Talking yourself out of exhaustion: the effects of self-talk on endurance performance. *Medicine and Science in Sport and Exercise, 46*, 998-1007. doi: 10.1249/MSS.0000000000000184
- Brewer, B. W., Van Raalte, J. L., & Linder, D. E. (1996). Attentional focus and endurance performance. *Applied Research in Coaching and Athletics Annual, 11*, 1–14. Retrieved from <http://www.americanpresspublishers.com>
- Burhans, R. S., Richman, C. L., & Bergey, D. B. (1988). Mental imagery training: Effects on running speed performance. *International Journal of Sport Psychology, 19*, 26-37.
- Burton, D., & Raedeke, T. D. (2008). *Sport psychology for coaches*. Human Kinetics, USA, IL.
- Caird, S. J., McKenzie, A. D., & Sleivert, G.G (1999). Biofeedback and relaxation techniques improve running economy in sub-elite long distance runners. *Medicine & Science in Sports and Exercise, 31*, 717-722. doi: 10.1097/00005768-199905000-00015
- Calmels, C., Berthoumieux, F., & D'Arripe-Longueville, F. (2004). Effects of an imagery training program on selective attention of national softball players. *The Sport Psychologist, 18*, 272-296.
- Cumming, J., Olphin, T., & Law, M. (2007). Self-reported psychological states and physiological responses to different types of motivational general imagery. *Journal of Sport & Exercise Psychology, 29*, 629-644.

541 Durand-Bush, N., Salmela, J.H., & Green-Demers. (2001). The Ottawa mental skills assessment
542 tool (OMSAT-3). *The Sport Psychologist*, 15, 1-19.

543 Fletcher, D., & Hanton, S. (2001). The relationship between psychological skills usage and
544 competitive anxiety responses. *Psychology of Sport and Exercise*, 2, 89-101.
545 doi:10.1016/S1469-0292(00)00014-5

546 Greenspan, M.J., & Feltz, D.L. (1989). Psychological interventions with athletes in competitive
547 situations: A review. *The Sport Psychologist*, 3, 219-236.

548 Goodwin, G. (2008). Psychology in sports and the military: Building understanding and
549 collaboration across disciplines. *Military Psychology*, 20 (Suppl.), S147-S154.
550 doi:10.1080/08995600701804897

551 Hammermeister, J. J., Pickering, M., McGraw, L., & Ohlson, C. J. (2010). Relationship between
552 psychological skill profiles and soldier physical fitness performance. *Military Psychology*,
553 22, 399-411. doi:10.1080/08995605.2010.513238

554 Hardy, J., Begley, K., & Blanchfield, A.W. (2015). It's good but it's not right: Instructional self-
555 talk and skilled performance. *Journal of Applied Sport Psychology*, 27, 132-139.
556 doi:10.1080/10413200.2014.959624

557 Hardy, L., Jones, G. & Gould, D. (1996). *Understanding the psychological preparation for Sport:*
558 *Theory and practice of elite performers*. Chichester: Wiley.

559 Hardy, L., Roberts, R., Thomas, P. R., & Murphy, S. M. (2010). Test of performance strategies
560 (TOPS): Instrument refinement using confirmatory factor analysis. *Psychology of Sport and*
561 *Exercise*, 11, 27-35. doi:10.1016/j.psychsport.2009.04.007

562 Hatzigeorgiadis, A., Zourbanos, N., & Theodorakis, Y. (2007). The moderating effects of self-talk
563 content on self-talk functions. *Journal of Applied Sport Psychology*, 19, 240-251. doi:
564 10.1080/10413200701230621

565 Hayes, A.F. (2013). *Introduction to mediation, moderation and conditional process analysis: A*
566 *regression-based approach*. NY, USA: The Guilford Press.

567 Hayslip Jr, B., Petrie, T. A., MacIntire, M. M., & Jones, G. M. (2010). The influences of skill level,
568 anxiety, and psychological skills use on amateur golfers' performance. *Journal of Applied*
569 *Sport Psychology*, 22, 123-133. doi: 10.1080/10413200903554281

570 Holland, M. J. G., Woodcock, C., Cumming, J., & Duda, J. L. (2010). Mental qualities and
571 employed mental techniques of young elite team sport athletes. *Journal of Clinical Sport*
572 *Psychology*, 4, 19-38. Retrieved from <http://journals.humankinetics.com/jcsp>

573 Houston, M., Dolan, S., & Martin, S. (2011). The impact of physical, nutritional and mental
574 preparation on triathlon performance. *The Journal of Sports Medicine and Physical Fitness*,
575 51, 583-594.

576 Jackson, S. A., Thomas, P. R., Marsh, H. W., & Smethurst, C. J. (2001). Relationships between
577 flow, self-concept, psychological skills and performance. *Journal of Applied Psychology*,
578 13, 129-153. doi: 10.1080/104132001753149865

579 Jones, M. V., Bray, S. R., Mace, R. D., Macrae, A.W., & Stockbridge, C. (2002). The impact of
580 motivational imagery on the emotional state and self-efficacy levels of novice climbers.
581 *Journal of Sport Behavior*, 25, 57-73.

582 Jöreskog, K. G. (1993). Testing structural equation models. In K. A. Bollen, & J. S. Long
583 (Eds.), *Testing structural equation models* (pp. 294–316). Newbury Park, CA: Sage.

584 Jöreskog, K. G. & Sörbom, D. (2006). *LISREL 8.80 for Windows* [Computer Software].
585 Lincolnwood, IL: Scientific Software International, Inc.

586 Kingston, K., & Hardy, L. (1997). Effects of different types of goals on processes that support
587 performance. *The Sport Psychologist*, 11, 277-293.

- 588 Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task
589 motivation: A 35 odyssey. *American Psychologist*, *57*, 705-717. doi: 10.1037/0003-
590 066X.57.9.705
- 591 Mace, R. D., & Carroll, D. (1986). Stress inoculation training to control anxiety in sport: Two case
592 studies in squash. *British Journal of Sports Medicine*, *20*, 139-141.
593 doi:10.1136/bjism.20.3.115
- 594 MacKinnon, D. P., Lockwood, C. M., & Williams, J. (2004). Confidence limits for the indirect
595 effect: Distribution of the product and resampling methods. *Multivariate Behavioural*
596 *Research*, *39*, 99-128. doi: 10.1207/s15327906mbr3901_4
- 597 Masters, R. S. W. (1992). Knowledge, knerves and know-how. The role of explicit versus implicit
598 knowledge in the breakdown of a complex motor skills under pressure. *The British Journal*
599 *of Psychology*, *83*, 343-358. doi: 10.1111/j.2044-8295.1992.tb02446.x
- 600 McCormick, A., Meijen, C., & Marcora, S. (2015). Psychological determinants of whole-body
601 endurance performance. *Sport Medicine*, *45*, 997-1015. doi: 10.1007/s40279-015-0319-6.
- 602 Meagher, M. W., Arnau, R. C., & Rhudy, J. L. (2001). Pain and emotion: Effects of affective
603 picture modulation. *Psychosomatic medicine*, *63*, 79-70.
- 604 Roberts, R., & Woodman, T. (2015). Contemporary personality perspectives in sport psychology.
605 In S. Hanton & S.Mellalieu (Eds.). *Contemporary advances in sport psychology: A review*
606 (pp. 1-28). Oxford UK: Routledge.
- 607 Smith, R. E., Schutz, R. W., Smoll, F. T., & Ptacek, J.T. (1995). Development and validation of a
608 multidimensional measure of sport-specific psychological skills: The Athletic Coping Skills
609 Inventory-28. *Journal of Sport and Exercise Psychology*, *17*, 379-398.
- 610 Short, S.E., Tenute, A., & Feltz, D. (2005). Imagery use in sport: Mediational effects for efficacy.
611 *Journal of Sport Sciences*, *23*, 951-960.

612 Taylor, J. (1995). A conceptual model for integrating athletes' need and sport demands in the
613 development of competitive mental preparation strategies. *The Sport Psychologist*, 9, 339-
614 357.

615 Tenenbaum, G. (2001). A social-cognitive perspective of perceived exertion and exertion
616 tolerance. In R. N. Singer, H. A. Hausenblas, & C. Janelle (Eds.), *Handbook of sport*
617 *psychology* (pp. 810-822), NY: Wiley.

618 Thelwell, R.C., & Greenlees, I. A. (2003). Developing competitive endurance performance using
619 mental skills training. *The Sport Psychologist*, 17, 318-337.

620 Thomas, P. R., Murphy, S. M., & Hardy, L. (1999). Test of Performance Strategies: development
621 and preliminary validation of a comprehensive measure of athletes' psychological skills.
622 *Journal of Sport Sciences*, 17, 697-711. doi: 10.1080/026404199365560

623 Tremayne, P., & Newberry, G. (2005). Mental skill training program for children. In D. Hackfort,
624 J. Duda & R. Lidor (Eds.) *Handbook of Research in Applied Sport and Exercise*
625 *Psychology: International Perspectives*. (pp.93-106). USA: Fitness Information
626 Technology.

627 Vealey, R. S. (1988). Future directions in psychological skills training. *The Sport Psychologist*, 2,
628 318-336.

629 Ward, P., Farrow, D., Harris, K., Williams, M. A., Eccles, D., & Ericsson, K. (2008). Training
630 perceptual-cognitive skills: Can sport psychology research inform military decision
631 training? *Military Psychology*, 20 (Suppl.), S71-S102. doi: 10.1080/08995600701804814

632 Wilkinson, D. M., Rayson, M. P., & Bilzon, J. L. J. (2008). A physical demands analysis of
633 the 24- week British Army Parachute Regiment recruit training syllabus. *Ergonomics*,
634 51, 649–662. doi:10.1080/00140130701757367

635 Wulf, G., & Shea, C. H. (2002). Principles derived from the study of simple skills do not generalize
636 to complex skill learning. *Psychonomic Bulletin & Review*, 9, 185-211. doi:
637 10.3758/BF03196276
638
639
640

¹ The item removed from negative thinking subscale was: “My self-talk during PPS was negative.”. The item removed from attentional control subscale was “My attention wandered on events during PPS.”. For a copy of the adapted TOPS-3 used in the current study email ross.roberts@bangor.ac.uk