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5 Development and Validation of a Military Training Mental Toughness Inventory

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Abstract

Three studies were conducted in order to develop and validate a mental toughness instrument for use in military training environments. Study 1 ($n = 435$) focused on item generation and testing the structural integrity of the Military Training Mental Toughness Inventory (MTMTI). The measure assessed ability to maintain optimal performance under pressure from a range of different stressors experienced by recruits during infantry basic training. Study 2 ($n = 104$) examined the concurrent validity, predictive validity, and test-retest reliability of the measure. Study 3 ($n = 106$) confirmed the predictive validity of the measure with a sample of more specialized infantry recruits. Overall, the military training mental toughness inventory demonstrated sound psychometric properties and structural validity. Furthermore, it was found to possess good test-retest reliability, concurrent validity, and predicted performance in two different training contexts with two separate samples.

Key Words: mental toughness, military, measure

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48 Mental toughness has been identified by coaches and athletes as one of the most
49 crucial attributes underpinning performance excellence (e.g., Connaughton, Wadey, Hanton,
50 & Jones, 2008; Coulter, Mallet, & Gucciardi, 2010; Jones, Hanton, & Connaughton, 2002).
51 Indeed, Gould, Hodge, Peterson, and Petlichkoff (1993) reported that 82% of coaches cited
52 mental toughness as *the* most important psychological attribute which determined success in
53 wrestling. The research literature on mental toughness has been dominated by qualitative
54 approaches which have significantly shaped our understanding of mental toughness (e.g.,
55 Bull, Shambrook, James, & Brooks, 2005; Connaughton et al., 2008; Coulter et al., 2010;
56 Gucciardi Gordon, & Dimmock, 2009a; Jones et al., 2002). However, some researchers have
57 argued that qualitative methods have become overused (e.g., Andersen, 2011), while others
58 have urged researchers to develop reliable and valid measures of mental toughness (e.g.,
59 Sheard, Golby, & van Wersch, 2009). Further, Hardy, Bell and Beattie, (2013) argue that one
60 of the limitations of adopting qualitative methods is that researchers are unable to
61 differentiate between the causes of mental toughness, processes, outcomes, and other
62 behaviors that are more likely to be correlates associated with mental toughness.

63 There are however some notable exceptions to the qualitative approaches, with
64 several quantitatively derived mental toughness measures having been developed (e.g., the
65 Mental Toughness Inventory (MTI; Middleton, Marsh, Martin, Richards, & Perry, 2004;
66 2005); the Sport Mental Toughness Questionnaire (SMTQ; Sheard et al., 2009); the Mental
67 Toughness Questionnaire -48 (MTQ-48; Clough, Earl, & Sewell, 2002); the Cricket Mental
68 Toughness Inventory (CMTI; Gucciardi & Gordon, 2009). Whilst these various measures of
69 mental toughness have significantly contributed to the mental toughness literature and have

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70 gone some way to alleviating the over reliance on qualitative approaches, they are not
71 without their critics (see for example, Gucciardi, Hanton, & Mallet, 2012). Hardy et al.
72 (2013) argued that whilst the above measures capture a wide array of values, attitudes,
73 cognitions and affect, they do not explicitly capture mentally tough behavior. They further
74 argue that psychological variables may influence mental toughness, or be correlates of it, but
75 that the primary focus of such measures should be on *assessing* the presence or absence of
76 mentally tough behavior. Hardy and colleagues also argue that the use of self-report measures
77 in assessing behaviors may be questionable due to social desirability and self-presentation
78 confounds. To this end, Hardy et al. (2013) developed an informant rated behavior based
79 Mental Toughness Inventory (MTI) in an elite sport context that was underpinned by the
80 following definition, “the ability to achieve personal goals in the face of pressure from a wide
81 range of different stressors” (p. 5). This definition of mental toughness was used to underpin
82 the current research.

83 It is important to note that researchers into the concept of mental toughness are not
84 alone in attempting to solve the dilemma of ameliorating the potential harmful effects of
85 exposure to stress. Several similar, yet subtly different constructs associated with stress
86 exposure have been proposed, defined and operationalized. These include the concepts of
87 hardiness, resilience, and grit. Hardiness is viewed as a relatively stable personality
88 characteristic, which involves courage, adaptability and the ability to maintain optimal
89 performance under exposure to stress. It has been conceptualized as a combination of three
90 attitudes; commitment, control, and challenge, which provide an individual with existential
91 courage and motivation to appraise stressful situations as opportunities for growth (Kobasa,
92 1979; Maddi, 2006; 2007). Hardiness and its core components of, commitment, control and
93 challenge are viewed as fundamental to another similar concept, resilience (Maddi, 2007).
94 Resilience is characterized by the ability to recover from negative emotional experiences and

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95 the ability to adapt to stressful situations. Another similar psychological construct proposed
96 by Duckworth, Peterson, and Mathews (2007) which involves striving toward challenges and
97 maintaining effort and persistence despite adversity, setbacks and failure is termed ‘grit,’ .
98 They define grit as, “*perseverance and passion for long-term goals*” (Duckworth et al., 2007,
99 p. 1087), with the emphasis on long-term stamina, rather than short-term intensity. Kelly et
100 al. (2014) suggest that the concept of grit has obvious utility in the military domain in that it
101 is synonymous with fortitude or courage and the essence of officer cadet development in
102 military academies. Whilst all these psychological concepts describe psychological
103 characteristics that are undoubtedly important in a military context, they differ from the
104 current construct of mental toughness in that, the current research is specifically examining
105 mentally tough ‘behavior’. That is, the ability to maintain goal focus and high levels of
106 performance in the face of different stressors. The concepts of hardiness, resilience and grit
107 are described as a constellation of personality characteristics and are as such typically
108 measured at this level. However, mental toughness in the current research is measured and
109 conceptualized at the behavioral level. That is, whilst the behaviors will be to some extent
110 underpinned by personality, the level of measurement is not personality per se. This is an
111 important distinction that will help to further the mental toughness literature by offering a
112 means by which the personality and behavior relationship can be examined. Indeed, Hardy et
113 al. (2013) demonstrated that the current definition of mental toughness was underpinned by
114 Gray & McNaughton’s (2000) revised Reward Sensitivity Theory (rRST).

115 Hardy et al.’s. (2013) MTI has been shown to have good psychometric properties,
116 strong test-retest reliability and successfully discriminate between professional and non-
117 professional athletes. A particular strength of the MTI (which sets it apart from other
118 conceptualizations of mental toughness), is that it was conceptualized within a
119 neuropsychological theoretically driven framework, namely Gray & McNaughton’s (2000)

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120 revised Reward Sensitivity Theory (rRST). rRST was used as it has the potential to offer a
121 neuropsychological explanation of the maintenance of goal directed behavior in the face of
122 stressful stimuli. Hardy et al. were successful in examining the prediction of mental
123 toughness from rRST personality traits. In a further study, the MTI was used to evaluate the
124 efficacy of a successful mental toughness training intervention (Bell, Hardy & Beattie, 2013)
125 that was underpinned by Hardy et al.'s findings.

126 The MTI and the use of rRST (Gray & McNaughton, 2000) appears to offer some
127 promise in furthering our understanding of mentally tough behavior in elite sport.
128 Consequently, based on Hardy et al.'s findings, there is a need to develop contextually
129 relevant measures of mentally tough behaviors for other settings. One particular context
130 where mental toughness is undoubtedly important is within the military. However, to date
131 there appears to have been little or no empirical research conducted on mental toughness in
132 the military domain, although there is evidence to suggest that it has recently started to be
133 explored (e.g., Hammermeister, Pickering, & Lennox, 2011).

134 Military action requires soldiers to perform under intense pressure in highly stressful
135 environments, characterized by fear, fatigue, and anxiety largely caused by risk to one's life.
136 Typical combat stressors include, for example: exposure to enemy fire and improvised
137 explosive devices, armed combat, and seeing colleagues killed or seriously injured. To
138 demonstrate this, one soldier recently defined mental toughness as, "...gearing yourself up to
139 go on a patrol in Afghanistan, outside the wire, the day after you lost a member of your squad
140 to a sniper, and you know the sniper is still out there" (Lt Col. Burbelo; cited in
141 Hammermeister et al., 2011, p. 4). The purpose of the present study was to develop a
142 behaviorally based measure of mental toughness in a military training environment based
143 upon Hardy et al.'s (2013) definition and measure. Four independent samples, drawn from

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144 general and specialized infantry training platoons from a UK-based Army training
145 establishment were employed in the study.

146 **Study 1: Developing the Measure**

147 **Method**

148 **Stage 1: Item Development**

149 Item development was underpinned by the behaviorally based approach adopted by
150 Hardy et al. (2013). Environmental stressors were identified by conducting focus groups with
151 recruit instructors and senior military personnel. An item pool representative of typical
152 stressors experienced by recruits in training (e.g., feeling fatigued, being reprimanded,
153 pressure to perform well, etc.) was developed by the authors, which were then presented back
154 to the recruit instructors for further refinement. This resulted in a 15 item pool.

155 **Participants and Procedure**

156 A total of 279 infantry recruits ($M_{age} = 21.45$, $SD = 3.16$) who were between 5 and 24
157 weeks of training ($M = 14.18$ weeks, $SD = 7.11$) were reported on by 41 male infantry recruit
158 instructors who had served for an average of 9.03 years in the Army ($SD = 2.35$) and had
159 spent an average of 11.78 months as an instructor ($SD = 5.89$). In order for the instructors to
160 accurately assess the recruits, a minimum of 5 weeks supervision was set for inclusion
161 criteria ($M = 11.73$ weeks, $SD = 6.84$ weeks).

162 Infantry recruit instructors are responsible for training infantry recruits through a 26
163 week Combat Infantryman's Course (CIC). They are all experienced section corporals who
164 are selected to serve a 24 month tenure at a training establishment before returning to their
165 parent unit. The aim of the CIC is to train infantry recruits to the standards required of an
166 infantry soldier to operate as an effective member of a platoon in extremely hostile
167 environments. Infantry training is therefore designed to be both physically and mentally
168 demanding with the majority of instruction and training taking place outdoors and on field

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169 exercises. The consequences of failing to meet the required standards at any point in training
170 result in being reallocated to an earlier point in training with another training platoon.

171 After receiving institutional ethical approval, instructors and recruits were verbally
172 solicited to take part in the study, informed of the nature of the study and the inclusion
173 criteria. Confidentiality was assured and once the inclusion criteria were satisfied, informed
174 consent was obtained. The same conditions for recruitment, participation and assurance of
175 confidentiality were applied to all of the studies in this research program.

176 The instructors were asked to complete the 15 items that were retained from stage 1 for
177 each recruit in their section and asked to rate how well they were able to maintain a high level
178 of personal performance when confronted with different stressful situations in training
179 (example items included “*when the conditions are difficult*” and “*when he has been*
180 *reprimanded or punished*”). Responses were based on a 7-point Likert scale that ranged
181 from 1 (never) to 7 (always), with a midpoint anchor of 4 (sometimes).

182 **Results**

183 Confirmatory factor analysis (CFA) using LISREL 8.80 (Jöreskog & Sörbom, 2006)
184 was used in an exploratory way to refine the item pool. The fit statistics for the 15 item
185 model was poor ($\chi^2(90) = 511.23, p < 0.01$; RMSEA = .10, CFI = .97, NFI = .96, SRMR =
186 .06, GFI = .80). Post-hoc item refinement was conducted using the standardized residuals,
187 modification indices for theta delta and theoretical rationale. This process identified a
188 number of items that had considerable conceptual overlap with other items, were
189 ambiguously worded, or referred to environmental conditions that may not be a universal
190 stressor. Removal of these items resulted in a six item scale that demonstrated a good fit to
191 the data ($\chi^2(9) = 17.95, p = .04$; CFI = .99, RMSEA = .03, SRMR = .02, NFI = .99, NNFI =
192 .99, GFI = .98). The mean mental toughness score was 4.17 ($SD = 1.30$) with an internal

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193 consistency (Cronbach's alpha) of .89. Factor loadings ranged from .72 to .81 (see Table 1
194 for items and descriptives).

195 **Stage 2: Structural Validity**

196 The purpose of stage 2 was to confirm the factor structure of the MTMTI on a separate
197 sample.

198 ***Participants and Procedure***

199 A total of 156 recruits ($M_{age} = 21.33$, $SD = 2.90$) between weeks 7 and 23 of training
200 ($M = 14.77$ weeks, $SD = 6.49$) were reported on by 23 instructors ($M_{age} = 26.87$, $SD = 2.09$)
201 who had served for an average of 8.48 years in the Army ($SD = 2.27$) and had spent an
202 average of 13.30 months as an instructor ($SD = 5.46$) training recruits. Instructors completed
203 the 6-item MTMTI developed in stage 1.

204 **Results**

205 CFA revealed that the fit statistics for the six-item model demonstrated an acceptable
206 fit to the data ($\chi^2(9) = 21.89$; $p < .01$; CFI = .99, RMSEA = .07, SRMR = .03, NNFI = .98,
207 NFI = .98). The mean mental toughness score was 4.11 ($SD = 1.25$) with an internal
208 consistency (Cronbach's alpha) of .91. Factor loadings ranged from .72 to .88.

209 **Study 2: Test-retest Reliability, Concurrent and Predictive Validity**

210 **Method**

211 **Participants**

212 104 recruits ($M_{age} = 22.07$, $SD = 3.92$) took part in Study 2. They were reported on by
213 15 different instructors ($M_{age} = 26.61$, $SD = 2.12$) who had served for an average of 8.70 years
214 in the Army ($SD = 2.08$) and had spent an average of 12.17 months as an instructor ($SD =$
215 5.93). The recruits had been under the supervision of the reporting instructors for an average
216 of 17.95 weeks ($SD = 5.83$).

217 **Instruments**

218 **MTMTI**. The MTMTI developed and validated in Study 1 was used.

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219 Concurrent validity of the MTMTI was tested by selecting variables that are theorized
220 to correlate with mentally tough behavior (e.g., self-report mental toughness, self-confidence,
221 and resilience measures). Predictive validity was tested by assessing the extent to which the
222 MTMTI predicated performance.

223 ***Sport Mental Toughness Inventory.*** The sport mental toughness questionnaire (SMTQ;
224 Sheard et al., 2009) is a 14-item measure that consists of three subscales; confidence,
225 constancy and control. These subscales can be combined to create a global measure of
226 mental toughness. The scale is measured on a 4-point Likert scale anchored at 1 (not at all
227 true) to 4 (very true). Example items include, “*I have what it takes to perform well under*
228 *pressure*” (confidence); “*I am committed to completing the tasks I have to do*” (constancy);
229 and, “*I worry about performing poorly*” (control; reverse scored). CFA has been shown to
230 provide good support for the 3-factor model (Sheard et al., 2009).

231 ***Self-Confidence.*** Self-confidence was measured using a 5-item scale that was
232 developed and validated by Hardy et al. (2010) in a military training context by asking,
233 “*compared to the most confident recruit you know, how would you rate your confidence in*
234 *your ability to....* (e.g., “*...meet the challenges of training*”). The response format is rated on
235 a 5-point Likert scale anchored at 1 (low) to 5 (high). This scale has been shown to have
236 good psychometric and predictive validity in a military training context (Hardy et al.).

237 ***Resilience Scale.*** Resilience was measured using a 4-item resilience scale developed
238 specifically for use in a military training context by Hardy et al. (2010). The stem and
239 response format used was the same as the self-confidence scale. Example items include,
240 “*...adapt to different situations in training and be successful*”. This scale has been shown to
241 have good psychometric and predictive validity in a military training context (Hardy et al.,
242 2013).

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243 **Performance.** Performance was determined by the recruits' end of course final grades,
244 based on their weekly reports and grades throughout the CIC. This grade is awarded by the
245 platoon commander (Lieutenant or Captain) and ranges from 0 (fail) to 6 (excellent).

Procedure

247 To assess test-retest validity, the MTMTI was administered at weeks 20 and 23 of
248 training. The self-report SMTQ, resilience and confidence scales were administered during
249 week 23 of training, and the performance data was collected at the end of training (week 26).

Results

251 Descriptive statistics and correlations for all study variables are displayed in Table 2.
252 The MTMTI demonstrated a good fit to the data ($\chi^2(9) = 6.81, p = .66$; RMSEA = .00, NNFI
253 = 1.00, CFI = 1.00, SRMR = .01), although this result should be interpreted with caution due
254 to the small sample size.

Test-Retest Reliability

256 The mean mental toughness score at week 20 was 4.95 ($SD = 1.34$), and the mean score
257 at week 23 was 4.89 ($SD = 1.36$). A paired sample t-test revealed that these means were not
258 significantly different ($t(103) = 0.63, p = > .05$). The test-retest reliability for the MTMTI
259 was .72.

Concurrent Validity

261 Table 2 demonstrates that the MTMTI significantly correlated with the global SMTQ (r
262 = .43), the separate subscales of the SMTQ (confidence $r = .37$, constancy $r = .40$, and
263 control $r = .24$), and Hardy et al's. (2010) subscales of resilience ($r = .35$), and confidence (r
264 = .33).

Predictive Validity

266 Regression analysis revealed that mental toughness significantly predicted individual
267 course performance ($R^2 = .31; \beta = .56, p = < .01$). Furthermore, hierarchical regression

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268 analyses revealed that the MTMTI accounted for a significant proportion of variance in
269 course performance (Block 2: $\Delta R^2 = .19$; $\beta = .48$, $p < .01$) over and above that accounted for
270 by the SMTQ (Block 1: $R^2 = .15$; $\beta = .19$, $p < .01$). We also tested whether the MTMTI
271 accounted for variance in performance after controlling for all the self-report variables used
272 in the current study. The results revealed that the MTMTI accounted for a significant
273 proportion of variance in performance (Block 2: $\Delta R^2 = .18$; $\beta = .48$, $p < .01$) over and above
274 that accounted for by all the self-report measures (Block 1: $R^2 = .17$, $p < .05$).

Study 3: Further Test of Predictive Validity

276 Study 2 demonstrated the test re-test reliability, concurrent and predictive validity of
277 the MTMTI. Furthermore the MTMTI was shown to predict performance after controlling
278 for self-reported mental toughness. The aim of Study 3 was to further test the predictive
279 validity of the MTMTI in a specialized infantry context, namely the Parachute Regiment
280 (Para).

281 While initial training for the infantry is necessarily arduous and demanding, initial
282 training for Para recruits is widely regarded by the British Army as being the most physically
283 and mentally demanding of all Infantry regiments in the British Armed Forces (Wilkinson,
284 Rayson, & Bilzon, 2008). Their specialist role requires them to operate at a higher intensity
285 than the regular infantry, carrying heavy loads for longer distances, at a faster pace as well as
286 withstanding the hardships of operating independently in the field for long periods under
287 harsh environmental conditions (Wilkinson et al., 2008). To determine their suitability for
288 this role, at week 20 of the CIC Para recruits are required to undergo a pre-Para selection test-
289 week (PPS), known colloquially as P-Company. P-Company consists of a series of
290 physically demanding team and individual events that involve carrying personal equipment
291 weighing 20kg or more for distances of up to 32km over severe terrain with time constraints,
292 a steeplechase assault course and aerial confidence course. Two team events require the

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293 participants to run with a 60kg log and 80kg stretcher for 2.5km and 8km respectively. Pass
294 rates typically range between ~40-70%.

295 Furthermore, the nature of the military performance indicators is such that they tend to
296 be very physical in nature. However, whilst a specific level of fitness is required for military
297 service, the various tests are designed to assess recruits abilities to perform under stressful
298 and arduous conditions. That is, it is not just fitness that determines the quality of a Para
299 recruit but the ability to maintain a high level of performance in stressful and arduous
300 conditions. Success on P-Company entitles a recruit to wear the coveted maroon beret and
301 pass out of training into a Parachute Regiment unit. Conversely, failure results in the recruit
302 being reallocated to a platoon earlier in the training cycle or transfer to another infantry
303 regiment. The recruits have been training for this test week for the preceding 20 weeks.

304 It is hypothesized that fitness will predict performance on P-Company but, more
305 importantly, mental toughness will predict variance in performance on P-Company after
306 controlling for fitness.

307 **Method**

308 **Participants**

309 Participants for Study 3 were 134 Para recruits ($M_{age} = 19.95$, $SD = 4.14$) who were
310 reported on by 20 different Para recruit instructors ($M_{age} = 28.71$ years, $SD = 2.92$) who had
311 served for an average of 10.65 years in the Army ($SD = 2.63$) and had spent an average of
312 10.95 months as an instructor ($SD = 4.87$). The recruits had been under the supervision of
313 their respective instructors for between 7 and 20 weeks ($M = 15.31$ weeks, $SD = 4.06$).

314 **Instruments**

315 *Mental Toughness*

316 The MTMTI was used to measure mental toughness.

317 *Performance*

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318 During P-Company, participants can achieve a maximum of 70 points, determined by
319 their performance on each event (i.e., up to 10 points for each of the 7 events; the aerial
320 confidence course is a pass or fail test). Most of the points are awarded objectively based on
321 time to complete or completion of an event and are awarded by P-Company staff who are
322 independent of the recruits' regular training team. Performance scores in the current sample
323 ranged from 10-70 ($M = 49.95$, $SD = 15.07$).

324 Fitness

325 An objective measure of fitness was used to control for individual fitness. During
326 training, recruits are required to complete physical assessments to measure progression in
327 individual fitness. One of these assessments is a two-mile loaded run in less than 18 minutes,
328 carrying a 16 kg pack and rifle. Another assessment is a timed run over a steeplechase
329 assault course consisting of several dry and water obstacles. Each event generates an
330 individual time. Two-mile loaded times for this cohort ranged from 15 minutes and 30's to
331 22 minutes and 47's ($M = 18:39$, $SD = 1:37$). The steeplechase times ranged from 18
332 minutes 30's to 22 minutes 26's ($M = 20:19$, $SD = 1:08$). In order to create an overall
333 indication of fitness these times were standardized within event and were then combined to
334 create an overall score. We then multiplied the overall score by -1 so that a higher score was
335 indicative of better performance.

336 Procedure

337 The fitness tests were conducted during week 18 of training and the MTMTI was
338 administered at the end of week 19 of training. P-Company was conducted at week 20 of
339 training.

340 Results

341 Descriptive statistics and correlations for all study variables are displayed in Table 2.
342 Consistent with Studies 1 and 2, the MTMTI demonstrated a good fit to the data ($\chi^2(9) =$

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343 14.07, $p = 0.12$; RMSEA = .06, NNFI = .99, CFI = 1.00, SRMR = .03). The mean mental
344 toughness score was 4.94 ($SD = 1.02$) with an internal consistency (Cronbach's alpha) of .87.
345 Factor loadings were all above .63.

346 Regression analysis revealed that mental toughness significantly predicted individual P
347 Company performance ($R^2 = .14$; $\beta = .36$, $p < .01$). Moreover, hierarchical regression
348 analysis revealed that MTMTI predicted variance in performance (Block 2: $\Delta R^2 = .06$, $\beta =$
349 $.26$, $p < .01$) over and above that accounted for by the fitness measure (Block 1: $R^2 = .15$, β
350 $= .30$, $p < .01$).

351 Discussion

352 The purpose of the present series of studies was to develop and validate a measure of
353 mentally tough behavior in a military training environment. Study 1 found good support for
354 the structural validity of the MTMTI, while Study 2 found support for the concurrent,
355 predictive, and test retest reliability. The predictive validity of the MTMTI was further
356 supported in a specialized infantry sample. Moreover, the predictive validity tests
357 demonstrated that the MTMTI predicted objective performance while controlling for another
358 measure of mental toughness (SMTQ in Study 3) and fitness (in Study 4). Overall, the
359 MTMTI demonstrated good psychometric properties across 4 separate samples and the
360 predictive validity was supported in two separate samples. Consequently, these results
361 provide some further support for Hardy et al.'s (2013) proposal that mental toughness should
362 be assessed via observer rather than self-report ratings.

363 The current research is an important first step in developing a valid measure of mental
364 toughness in a military context. Having a valid scale that stands up well to both
365 psychometric and predictive testing allows researchers to examine mental toughness both
366 from applied and theoretical perspectives that will help to further our understanding of
367 mentally tough behavior. For example, the current measure will allow for further exploration

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368 of the neuropsychological underpinnings of mentally tough behavior across contexts.
369 Namely, whether Hardy et al. (2013) counter intuitive finding that mentally tough behavior
370 was related to high levels of punishment sensitivity and low levels of reward sensitivity in
371 cricketers (see Gray & McNaughton, 2000 for a review of reward and punishment sensitivity,
372 and Hardy et al., for a description of how reward and punishment sensitivities might be
373 related to mental toughness). It would seem prudent to examine these results across different
374 contexts.

375 Based on the findings from Hardy et al. (2014), Bell et al. (2013) developed a
376 successful multimodal intervention that was designed to impact mental toughness in elite
377 level cricketers. Consequently, the MTMTI could potentially be used to conduct similar
378 interventions to evaluate mental toughness in a military training environment. The
379 intervention contained three main components; exposure to punishment conditioned stimuli,
380 coping skills training, and was delivered in a transformational manner. Whilst the results of
381 the intervention indicated that it was successful in developing mental toughness by the
382 authors own admission, no attempt was made to measure the separate effects of the
383 punishment conditioned stimuli, the transformational delivery, or the efficacy of the coping
384 skills. Thus, no conclusions can be inferred regarding which aspects of the intervention
385 contributed most to the observed change in mental toughness, or indeed, whether these
386 aspects interacted to impact the observed change in mental toughness. Consequently, further
387 research is needed to delineate more precisely the effects that punishment conditioned
388 stimuli, transformational delivery, and coping skills has on the development of mental
389 toughness.

390 Whilst the current measure has been demonstrated to perform well in the standard
391 tests of measurement efficacy it is noted that the scale is one-dimensional, that is, all the
392 stressors fall under one global aspect. It is suggested that it might be possible to delineate the

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393 stressors into clusters. For example, some of the stressors identified in the MTMTI may fall
394 under physical stress (e.g., tiredness) whilst others about threats to ego (e.g., punishments).
395 Further investigation of this would seem warranted. For example, all of the social pressure
396 items (e.g., “he is not getting on with other section members”) were deleted at stage 1 due to
397 inadequate fit. Indeed, the inclusion of a multidimensional aspect to the measurement of
398 mentally tough behavior will allow for a closer examination of the construct of mental
399 toughness. This would allow for more in-depth questions around mental toughness to be
400 examined, such as, whether some individuals are better able to cope with certain types of
401 stressors than other types of stressors (e.g., social stressors, threats to ego, physical stressors
402 etc.). Furthermore, the role that underlying personality dimensions have in determining
403 individual differences in ability to cope with different types of stressors would also be a
404 worthwhile area of future research. However, in order to test these and other related questions
405 one would need to develop a multidimensional measure of mentally tough behavior. A further
406 limitation and area worthy of future research is to explore the possibility of whether the
407 current anchors should be more reflective of behaviors rather than a Likert type scale.

408 To sum up the current series of studies have gone some way toward developing and
409 validating a measure of mental toughness in a military training environment that will
410 hopefully stimulate further theoretical and applied research in this area.

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Table 1.
Standardized factor loadings, means and standard deviations for retained items.

4		Study 1a (<i>n</i> = 279)		Study 1b (<i>n</i> = 156)		Study 2 (wk 20) (<i>n</i> = 104)		(Study 2 wk 23)		Study 3 (<i>n</i> = 134)	
		FL	M (SD)	FL	M (SD)	FL	M (SD)	FL	M (SD)	FL	M (SD)
1	His recent performances have been poor.	0.72	4.23(1.50)	0.82	4.08(1.52)	0.64	4.57(1.82)	0.86	4.95(1.40)	0.63	4.81(1.26)
2	He is in pain (e.g., associated with high levels of physical effort).	0.77	4.06(1.78)	0.74	3.98(1.59)	0.75	4.86(1.76)	0.87	4.89(1.60)	0.66	4.78(1.48)
3	The conditions are difficult (e.g., on exercise).	0.80	4.22(1.55)	0.88	4.12(1.49)	0.82	5.05(1.55)	0.90	4.91(1.58)	0.87	5.00(1.22)
4	He has been reprimanded/punished	0.81	4.06(1.68)	0.75	4.41(1.61)	0.82	5.11(1.56)	0.83	4.90(1.51)	0.69	5.06(1.19)
5	He has not had much sleep	0.74	4.04(1.51)	0.82	3.87(1.36)	0.85	4.95(1.50)	0.85	4.79(1.52)	0.80	4.78(1.24)
6	He is under pressure to perform well (e.g., assessments, test conditions)	0.73	4.41(1.62)	0.72	4.22(1.53)	0.79	5.23(1.65)	0.84	4.88(1.58)	0.75	4.92(1.36)
	Total Mental Toughness		4.17(1.30)		4.11(1.25)		4.95(1.34)		4.89(1.36)		4.89(1.01)

Note. FL is the standardized factor loading

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Table 2. Means, SDs, and inter-correlations between variables in studies 2 and 3 with alpha coefficients in parentheses

	Mean	SD	1	2	3	4	5	6	7	8	9
Study 2 (n = 104)											
1 Mental Toughness (wk 20)	4.95	1.34	(.90)								
2 Mental Toughness (wk 23)	4.89	1.36	.72**	(.94)							
3 SMTQ	2.98	0.40	.33**	.43**	(.78)						
4 SMTQ-Confidence	3.08	0.48	.27**	.37**	.83**	(.66)					
5 SMTQ-Constancy	3.38	0.45	.31**	.40**	.75**	.51**	(.45)				
6 SMTQ-Control	2.42	0.61	.20*	.24*	.74**	.33**	.40**	(.62)			
7 Resilience	3.94	0.70	.32**	.35**	.68**	.62**	.52**	.46**	(.81)		
8 Self-confidence	4.12	0.63	.25**	.33**	.71**	.72**	.52**	.38**	.75**	(.85)	
9 Final Course Grade	4.05	1.57	.33**	.56**	.39**	.33**	.39**	.23*	.33**	.35**	
Study 3 (n = 134)											
	Mean	SD	1	2	3						
1 Mental Toughness	4.89	1.01	(.87)								
2 P Company Score	47.25	17.63	.36**								
3 Fitness Score	0.03	0.74	.43**	.42**							

** $p < .01$ * $p < .05$

Appendix A

Military Training Mental Toughness Questionnaire – MTMTI

Please think about each recruit and how he **GENERALLY** performs during training. The following questions ask you to rate how often the recruit is able to maintain a high level of **personal performance**, even when he is faced with demanding situations during training. Please consider each scenario individually and circle the number you think is most appropriate.

Student Army Number. _____ **Weeks under your Instruction:** _____

HE IS ABLE TO MAINTAIN A HIGH LEVEL OF PERSONAL PERFORMANCE, EVEN WHEN:

		Never		Sometimes			Always	
1	His recent performances have been poor	1	2	3	4	5	6	7
2	He is in pain (e.g., associated with high levels of physical effort).	1	2	3	4	5	6	7
3	The conditions are difficult (e.g., on exercise).	1	2	3	4	5	6	7
4	He has been reprimanded/punished	1	2	3	4	5	6	7
5	He has not had much sleep	1	2	3	4	5	6	7
6	He is under pressure to perform well (e.g., critical assessments/being observed)	1	2	3	4	5	6	7