Mental Toughness as a Psychological Determinant of Behavioral Perseverance in Special Forces Selection

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Gucciardi, D.F., Lines, R.L.J., Ducker, K.J., Peeling, P., Chapman, M.T., & Temby, P.T. (in press). Mental toughness as a psychological determinant of behavioural perseverance in Special Forces selection. *Sport, Exercise, and Performance Psychology*. doi: 10.1037/spy0000208

Abstract

The purpose of this study was to conduct a conceptual replication of past work on the association between mental toughness and behavioural perseverance across multiple tasks over an extended period of time. We utilised a cross-sectional design including assessments of mental toughness and accumulated stress (hair cortisol concentration) prior to a Special Forces selection course spanning three weeks in duration. Participants self-reported their mental toughness and provided a sample of hair (1.5cm) to capture accumulated stress over the six weeks prior to taking part in the selection course. A total of 122 military personnel provided complete data, of which 26 candidates (~21%) passed the selection course. Bayesian structural equation modelling incorporating prior beliefs informed by past empirical work supported the hypothesis, whereby for a one-unit increase in mental toughness we would expect to see roughly a 68% increase in the odds of selection. These findings add to the growing body of research that has provided evidence for the salience of mental toughness for behavioural perseverance in tasks and activities of an enduring and demanding nature.

Keywords: goals; incremental validity; mentally tough; perseverance

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Goals are ubiquitous in modern life. People engage regularly with a variety of goal-directed pursuits within the domains of health (e.g., frequency and duration of exercise), education (e.g., completion of preparatory tasks prior to class), and workplace (e.g., dollar value of sales), just to name a few. During the course of these goal pursuits, it is often the case that people are confronted with stressors or adversities that can impede goal progress. In such circumstances, people can decide to persevere with their efforts towards the goal in an attempt to overcome the obstacles, execute alternative strategies by which to achieve the same goal, substitute the goal with another objective in which there is an increased likelihood of success, or disengage from the goal altogether. None of these options are likely to be preferable for all people in all situations (Heller, Perunovic, & Reichman, 2009); characteristics of the individual and the goal itself are likely to favour one or more strategies over others. In this study, we consider the question of what personal resources foster perseverance towards a valued objective during highly stressful circumstances where feedback about goal progress is withheld, yet continued effort via un/planned strategies is the only means by which to achieve goal success.

Perseverance towards valued goals via effort and commitment is a key determinant of goal attainment (Latham & Locke, 2018). Mental toughness is one personal resource that has received attention in recent years as a key psychological determinant of behavioural perseverance (e.g., Anthony, Gordon, & Gucciardi, 2020; Beattie, Alqallaf, Hardy, & Ntoumanis, 2019; Jones, in press)[1]. Defined as a "state-like psychological resource that is purposeful, flexible, and efficient in nature for the enactment and maintenance of goal-directed pursuits" (Gucciardi, 2017, p. 18), mental toughness reflects a psychological

[1] Interested readers are referred elsewhere for detailed reviews of the literature on mental toughness (e.g., Cowden, 2017; Gucciardi, 2020; Lin, Mutz, Clough, & Papageorgiou, 2017).

capacity of individuals that characterises their potential for action towards an objective or purpose particularly in response to challenging circumstances. This definition offers several points of clarification for the conceptualisation of mental toughness. First, the conceptual theme of mental toughness is characterised by direction and energy towards self-referenced targets, congruency between actions and self-referenced objectives, and adaptation of regulatory processes across stressors or situational demands. Empirical work (i.e., high correlations among core attributes; Gucciardi, Hanton, Gordon, Mallett, & Temby, 2015) and theoretical perspectives (i.e., resource caravans; Hobfoll, 2002) support the conceptualisation of mental toughness as a unidimensional concept where psychological resources coalesce over time because they share the commonality of purpose, efficiency, and flexibility. Second, mental toughness is salient for goal-direct pursuits because resources represent something of value to that which we strive to achieve (e.g., performance, health; Halbesleben, Neveu, Paustian-Underdahl, & Westman, 2014; Hobfoll, 1989). There is an emerging body of evidence to support the centrality of mental toughness for performance across a broad range of achievement contexts, including sport, education, and business (e.g., Bell, Hardy, & Beattie, 2013; Hardy, Bell, & Beattie, 2014; Gucciardi et al., 2015; Mahoney, Gucciardi, Ntoumanis, & Mallett, 2014). Third, the characterisation of mental toughness as a human capacity distinguishes it from the deployment of resources via behaviour or action. As an example, one's desire to learn a new skill and belief in their ability to do so is different from the enactment of behaviours that characterise skill acquisition (e.g., completing physical skill training sessions). Most pertinent to the current study, research has supported the salience of mental toughness as a key determinant of behavioural perseverance within goal-directed pursuits in athletic contexts (e.g., Bell et al., 2013; Giles et al., 2018; Gucciardi, Peeling, Ducker, & Dawson, 2016). Nevertheless, there is a need to examine the robustness of this effect in other achievement settings to shed light on potential boundary conditions of this concept.

Military environments are both physically and psychologically demanding (e.g., fatigue, isolation, ambiguity), often requiring personnel to persevere through "tough times" to complete training or mission objectives. Military personnel are at times placed in extreme and dangerous conditions and therefore require capabilities to cope with the dynamic and complex nature of operations – both during warfare (e.g., combat) and peacetime (e.g., humanitarian) missions (Bartone, 2009). Training and garrison life is also characterised by a broad range of stressors related to work (e.g., task, load, ambiguity), social-interpersonal relationships (e.g., status, conflict), family (e.g., separation, safety), self-identity (e.g., conflict between different types of roles), psychological environment (e.g., hostility, boredom), cultural environment (e.g., unfamiliarity, customs), and physical environment (e.g., deprivation, exhaustion) (Campbell & Nobel, 2009). The increased interest in mental toughness within military contexts in recent years (Arthur, Fitzwater, Hardy, Beattie, & Bell, 2015; Fitzwater, Arthur, & Hardy, 2018) is therefore unsurprising and makes it an ideal context in which to examine the robustness of the association between mental toughness and perseverance.

Behaviourally, perseverance reflects "sustained goal pursuit in the context of opponent forces" (Moshontz & Hoyle, 2018, p. 2). Defined in this way, the operationalisation of perseverance demands the presence of challenging circumstances that represent heightened risk for goal progress or achievement. The majority of past work involving mental toughness as a key determinant has employed a discrete task as a proxy for behavioural perseverance in one continuous episode, namely the 'multistage shuttle run test' (Bell et al., 2013; Giles et al., 2018; Gucciardi et al., 2016). Specifically, the multistage shuttle run test (otherwise referred to as the 'beep test') requires individuals complete a series of 20 m repeated sprints between two ends according to a pre-recorded audio track where the time between beeps decreases as participants progress through to higher levels (Brewer, Ramsbottom, & Williams, 1988). In essence, this test requires that individuals persevere through physical and psychological fatigue to reach the highest level possible, given their aerobic capacity or physical fitness. Importantly, the positive association between mental toughness and behavioural perseverance on the beep test remains, even when controlling for an objective measure of one's physical fitness (Giles et al., 2018). This evidence underscores the potential value of mental toughness as a determinant of behavioural perseverance on a discrete task. However, our understanding of the salience of mental toughness for perseverance across multiple tasks over an extended period of time is limited to two studies to date. First, self-reported mental toughness was positively associated with passing a rigorous 6-week selection course designed to assess a candidate's suitability to undertake Special Forces training (B = 1.25, odds ratio = 3.48), even when controlling for the related construct of hardiness (Gucciardi et al., 2015). Second, informant-reported mental toughness was positively associated with performance on an arduous 1-week selection event for a parachute regiment ($\beta = .26$, $\Delta R^2 = .06$, $p < .01$), even when controlling for an objective measure of fitness (Study 3, Arthur et al., 2015). Collectively, therefore, the available evidence supports the utility of mental toughness as a determinant of behavioural perseverance on discrete tasks, with preliminary support for tasks of an enduring nature.

To examine the robustness of mental toughness as a key determinant of behavioural perseverance across enduring events including multiple tasks over an extended period, we utilised a selection course employed to identify suitable candidates for entry into Special Forces units. Selection tests for entry into elite military units test candidates' psychological, physical, emotional, and cognitive capabilities via the use of isolated (e.g., unrealistic time expectations to complete a task) and enduring (e.g., physical fatigue) challenges, which is an important consideration for the operationalisation of behavioural perseverance (Moshontz & Hoyle, 2018). Perseverance across a selection activity to achieve success requires the joint function of sustaining pursuit despite challenging circumstances in several single-episode tasks, and returning to goal pursuit following the completion of discrete tasks or periods of rest and recovery. Special Forces personnel need to be physically and mentally fit, and therefore numerous psychological and physiological factors are considered as part of the selection process (for a review, see Vos et al., 2012). Baseline physical fitness, for example, is a robust predictor of successful completion of tests designed to select Special Forces candidates (e.g., Beal, 2010; Farina et al, 2019; Hunt, Orr & Billing, 2013; Taylor et al., 2006; Zazanis, Hazlet, Kilcullen, & Sanders, 1999). Psychological factors are also important considerations for passing selection tests into elite military units, with an emerging body of evidence supporting the salience of dispositional hardiness (e.g., Bartone, Roland, Picano, & Williams, 2008; Johnsen et al., 2013). Conceptually and empirically, therefore, selection tests for entry into elite military units represent a meaningful context in which to examine psychological determinants of behavioural perseverance.

The current study represents a conceptual replication of past work on the association between mental toughness and behavioural perseverance across multiple tasks over an extended period of time. Specifically, the objective of this study was to extend this work in a way that provides additional clarification on incremental validity evidence of mental toughness for goal-directed pursuits. Aligned with substantive perspectives of mental toughness (Gucciardi et al., 2015; Hardy et al., 2014), we accounted for a biological marker of accumulated stress over the six weeks prior to candidates taking part in a Special Forces selection course by extracting cortisol concentration from hair samples. Briefly, the hypothalamic-pituitary-adrenal (HPA) axis is activated as part of the stress response, which in turn triggers the release of cortisol by the adrenal cortex; for this reason, cortisol is commonly referred to as the *stress* hormone (Stalder et al., 2017). Given the average growth rates of hair among humans, each 1 cm segment of hair reflects approximately 1 month of accumulated secretion of cortisol prior to sampling (Stalder & Kirschbaum, 2012). This biological marker was chosen for its sensitivity to detect HPA axis activation in response to stressors of intensive physical and mental training (Skoluda, Dettenborn, Stalder, & Kirschbaum, 2012), which is an important consideration for the field test employed in this study as a proxy for behavioural perseverance. As candidates will invest considerable time and effort in preparing physically and mentally for a selection test (e.g., simulating sleep or food deprivation, training for strength and endurance), we considered it important to account for their preparation in the statistical model. We expected the positive association between mental toughness and perseverance to remain, even when controlling for this biomarker of stress.

Methods

Participants

In total, 143 candidates (1 female) aged 20 to 39 years (M = 27.56, SD = 3.67) were available to take part in the study. Participants were from the Australian Army (Private = 57, Lance Corporal = 21, Corporal = 33, Captain = 22, Lieutenant = 1, Sergeant = 3), Royal Australian Navy (Able Seaman = 2, Leading Seaman = 2, Lieutenant = 1), and Royal Australian Air Force (Leading Aircraftman = 1). The intake of candidates for one annual administration of the selection activity determined our sample size for this study. For context, 131 participants provides 90% power to detect an odds ratio as small as 1.86 [$\alpha = .05$, $R^2 = .15$, Pr (Y = 1 | X = 1) HO = .30], which is a conservative estimate based on past research (Gucciardi et al., 2015).

Procedure

The study procedures were first approved by (blinded for peer review) human research ethics committee. Candidates who were panelled on a Special Forces Selection Course were invited to participate in the study. Briefly, this 3-week selection course is designed to test candidates' psychological, physical, emotional, and cognitive aptitude via a range of individual and team activities that closely approximate elements of the harsh and unpredictable nature of combat environments (e.g., sleep and/or food deprivation, unrealistic time expectations, exhaustive physical tasks, zero performance feedback). Upon arrival at the base, candidates were issued with military equipment and a unique identification number for the selection course. The research team subsequently briefed candidates about the nature of the study in groups of approximately 15-20 within a demountable office space. A key aspect of the informed consent process was to ensure candidates were aware that the study was separate to the selection test and that all data was for research purposes only (i.e., their participation in the study would not influence their selection outcome). Consenting candidates first provided a hair sample and then moved to an adjacent demountable office space where they completed a survey package. Once candidates had completed the survey, they handed back their survey and were thanked for their participation.

Measures

Hair cortisol. A scalp hair strand of 1.5cm was taken from the posterior vertex region of the head because this region has the least variation in growth (Cooper, Kronstrand, & Kintz, 2012). Segments of hair were first secured in place using a small wooden peg, and subsequently cut from the root end as close to the scalp as possible with fine medical scissors. All hair samples were wrapped in aluminium foil and stored at room temperature until analysis. We sampled 1.5 cm from the root end to represent cortisol secretion over a period of approximately six weeks prior, which was considered reflective of the extensive physical and mental preparation required for the selection test. Hair samples were analysed in duplicate for cortisol using a validated, commercially available enzyme-linked immunosorbent assay (ELISA; Salimetrics, USA) by Stratech Scientific (intra-assay variability = 4.9%, inter-assay variability = 5.6%).

Mental toughness. We used 8-items to assess participants' self-reported mental toughness (Gucciardi et al., 2015). Participants rated the extent to which each statement (e.g., "I believe in my ability to achieve my goals" and "I strive for continued success") was indicative of how they typically thought, felt, or behaved using a 7-point scale (1 = *false, 100% of the time*; 2 = *false, 85% of the time*; 3 = *false, 60% of the time*; 4 = *50/50*; 5 = *true, 60% of the time*; 6 = *true, 85% of the time*; 7 = *true, 100% of the time*). Past work has supported reliability and validity evidence of this mental toughness inventory in a broad range of achievements contexts including the military (Gucciardi et al., 2015), education, and sport (Cowden, in press; Li, Zhang, & Zhang, 2019).

Behavioural perseverance. As perseverance towards valued goals is conditional on the presence of opponent forces to sustained goal pursuit (Moshontz & Hoyle, 2018), we operationalised behavioural perseverance as whether or not a candidate passed the selection course (i.e., completed the course and were recommended for further training). As previously mentioned, candidates will invest a significant amount of time (e.g., months) preparing physically and mentally for the selection course. If candidates are unsuccessful in completing the course, they may not be allowed to re-attempt the test unless there are extenuating circumstances (e.g., medical or compassionate reasons). Consequently, individual careers can be affected significantly depending on whether they successfully complete the course. Given the stakes involved, all applicants should arguably be highly motivated to achieve this goal. Candidates could fail to complete the selection course at any point for three main reasons: medical (i.e., injury or illness), removal from course for failing to meet performance standards, or voluntary withdrawal. Selection outcome was coded as a dichotomous variable (0 = *fail*, 1= *pass*).

Statistical Analysis

We examined the primary research question using Bayesian structural equation modelling in M*plus* 8 (Muthén & Muthén, 2017) using Markov Chain Monte Carlo (MCMC) simulation procedures with a Gibbs sampler. This analysis integrated both observed scores (age, hair cortisol, selection outcome) with a latent factor (mental toughness). We included age as a covariate in the statistical model because training staff indicated that younger candidates typically are more likely to pass selection than older personnel (e.g., highly demanding physical nature of the course). MCMC within the context of Bayesian estimation enables analysts to mix prior beliefs (e.g., theoretical expectations, empirical data) with new data to produce “an approximation of the joint distribution of all the parameters” in a model (Muthén & Asparouhov, 2012, p. 334). We specified four Markov chains each with 50,000 iterations to produce the posterior distribution. A combination of visual (i.e., stability in mean and variance of each chain via trace plots) and statistical (i.e., potential scale reduction [PSR] factor < 1.05) criteria informed our assessment of model convergence. Model fit was assessed using the posterior predictive *p* value (PPP) and the corresponding 95% credibility interval (CI); a PPP > .05 but preferably close to .50 and a symmetric 95% CI that centres on zero provide evidence of sound model fit (Muthén & Asparouhov, 2012). The credibility of a parameter estimate is supported when the 95% CI excludes zero. We specified an informative prior based on past empirical work (Gucciardi et al., 2015) for the direct effect of mental toughness on selection outcome, with low precision in the variance to reflect uncertainty in this prior due to the single data point (normal distribution with $\mu = 1.25$, $\sigma^2 = .25$); diffuse (noninformative) priors were used for all other parameters. The informative prior was replaced with a noninformative prior in a sensitivity analysis to examine the influence of the prior on the posterior distribution. Latent factor reliability estimates were computed using McDonald's (1970) omega coefficient (ω). All M*plus* output files including analysis syntax are available on the Open Science Framework (http://bit.ly/2OywN1q)[2].

Results

In total, 1 participant denied consent and 17 were unable to provide a hair sample due to insufficient hair length. An additional 3 participants did not complete the survey items for the mental toughness scale. As such, there were a total of 122 responses available for the main analyses, of which 26 candidates (~21%) passed the selection test. There was no missing data at the item level. Visual inspections of trace plots and an examination of the PSR across iterations (i.e., started around 1.1, with ~99% of subsequent iterations below 1.01) supported model convergence with both noninformative and informative priors. Correlations among the study variables approximated zero and inconsistent with a meaningful association (mental toughness ↔ age = -.004 [95% CI = -.17, .16], mental toughness ↔ hair cortisol = .004 [95% CI = -.12, .13], age ↔ hair cortisol = .001 [95% CI = -.12, .12]). Mental toughness scores evidenced satisfactory reliability (ω = .86)[3]. An overview of the findings is detailed in Table 1. Briefly, the results supported our hypothesis, whereby for a one-unit increase in mental toughness we would expect to see roughly a 68% increase in the odds of selection. We found largely equivalent results when we excluded candidates who failed the course for medical reasons (n = 3; see Table 2)[4].

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[2] We are unable to make the raw data open access due to contractual obligations with our funder; researchers interested in obtaining a copy of the raw data can do so by requesting this information from the corresponding author.

[3] Traditional model-data fit indices are unavailable in M*plus* when there is a binary outcome variable (i.e., logistic regression). As such, we ran a confirmatory factor analysis on the 8-item mental toughness index only; the output of the analysis is available at the Open Science Framework (http://bit.ly/2OywN1q). Briefly, the unidimensional representation of the 8-item latent mental toughness factors represented an excellent fit with the data, χ (28) = 31.59, *p* = .29, CFI = .990, TLI = .987, RMSEA = .030 (90% CI = .000, .075).

[4] An alternative way to operationalise behavioural perseverance within the context of the current study is to use the day at which the candidate was removed from course as the outcome variable. We re-analysed the data within a structural equation modelling framework with a robust maximum likelihood estimator (MLR) using day of removal as the dependent variable. In this model, a higher score on day of removal conceptually equates with greater behavioural perseverance (i.e., 1-21, where passing selection is coded as 21). The model-data fit

Discussion

Our goal in this study was to shed light on the association between mental toughness and behavioural perseverance, with a primary focus on incremental validity evidence in terms of accumulated stress prior to taking part in a military selection test requiring candidates to persevere across multiple tasks over a 3-week period. Consistent with substantive perspectives (Gucciardi, 2017; Hardy et al., 2014) and empirical evidence (Arthur et al., 2015; Gucciardi et al., 2015), we found a small-to-moderate association between mental toughness and perseverance, whilst accounting for chronological age and a biological marker of approximately six weeks of accumulated stress.

This study offers three important contributions to the literature on mental toughness. First, we replicated the conceptual expectation that mental toughness is positively associated with behavioural perseverance across multiple tasks over an extended period of time. The incorporation of prior information (Gucciardi et al., 2015) directly into the estimation process means the current finding can be considered an automatic update of the state of affairs with regard to the size of association between mental toughness and behavioural perseverance. The magnitude of this effect in the current study was largely insensitive to the prior information, thereby suggesting stability in this conceptual proposition. Thus, there is converging evidence for the conceptualisation of mental toughness as a psychological resource that underpins one's potential for action. Considered in conjunction with past work (Bell et al., 2013; Giles et al., 2018; Gucciardi et al., 2016), these findings support the salience of mental toughness for perseverance in discrete tasks and activities of an enduring nature.

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was excellent, χ (43) = 56.81, p = .08, CFI = .950, TLI = .937, RMSEA = .051 (90% CI = .000, .085). In this statistical model, age (B = -.38, 95% CI = -.71, -.05), hair cortisol (B = .16, 95% CI = .02, .31), and mental toughness (B = 1.74, 95% CI = .39, 3.10) are meaningful determinants of behavioural perseverance. The M*plus* output file is available on the project page on the Open Science Framework (http://bit.ly/2OywN1q).

Second, we provided evidence for the salience of mental toughness for behavioural perseverance, over and above what is accounted for by age and accumulated stress. This evidence is an important contribution to our understanding of the practical value of mental toughness as a scientific concept. Past research on mental toughness and perseverance across an enduring activity has considered incremental validity evidence with regard to dispositional hardiness (Gucciardi et al., 2015) and physical fitness (Arthur et al., 2015). However, one cannot rule out the possibility that other factors related to one's preparation for the selection test were equally or even more important than mental toughness (Hardy et al., 2017; Rees et al., 2016). Given the arduous nature of the selection test, candidates will invest considerable time and effort in preparing physically and mentally (e.g., simulating sleep or food deprivation, training for strength and endurance). Within the context of this study, therefore, hair cortisol secretion can be considered an accumulation of both physical and psychological stressors in the build up to the selection test (Gerber et al., 2013; Skoluda et al., 2012). The inclusion of this biological marker of accumulated stress within the statistical model indicated that the salience of mental toughness is smaller than previously reported[4] (OR = 3.48), yet remains an important consideration for behavioural perseverance. As hair cortisol concentration and perceived stress are unrelated (Stalder et al., 2017), it may be that mental toughness enables individuals to persevere because they perceive what is at stake as a challenge rather than a threat to their functioning when they have a higher psychological potential for action. Alternatively, the contribution of accumulated stress to behavioural perseverance may be more complex than is captured in a direct effect. Mental toughness might offer the greatest potential for behavioural perseverance when people are highly stressed, for example, because the situation demands a need to draw on this psychological capacity for action (i.e., moderation effect)[5]. There also is the possibility that the association

[5] At the request of a reviewer, we conducted an interaction test (mental toughness x hair cortisol) in an

between accumulated stress and behavioural perseverance is non-linear in nature, such as those captured in cusp catastrophe models of anxiety (Hardy & Parfitt, 1991) or inverted-U dynamics of cumulative adversity experiences (e.g., Seery, Leo, Lupien, Kondrak, & Almonte, 2013). These possibilities represent interesting questions to address in future research that encompasses sufficiently powered design and test combinations for interaction effects.

Third, the study findings are consistent with previous research that has identified the significant contribution that related psychological constructs such as hardiness (Bartone et al., 2008), character strengths (Gayton & Kehoe, 2015), grit, resilience resources, and cognitive abilities (Farina et al., 2019) play in the completion of demanding military selection courses. Considered in combination with past work that has accounted for salient covariates in statistical models (e.g., Arthur et al., 2015; Giles et al., 2018; Gucciardi et al., 2015), the results of the current study underscore the salience of mental toughness because this psychological resource offers unique variance over and above important factors (e.g., hardiness, preparation, aerobic capacity). Thus, these findings highlight the potential value of better understanding the contribution of mental toughness (and related psychological constructs) to selection outcomes in highly demanding contexts, including exploring ways to enhance mental toughness to increase an individual's chances of success via behavioural perseverance (e.g., Bell et al., 2013; Gordon & Gucciardi, 2010).

Conclusions

Key strengths of this study include the use of a biological marker of accumulated stress, modelling of mental toughness as a latent construct with measurement error, and incorporation of prior information directly within the statistical model. Researchers who wish

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exploratory manner for those readers who may be interested in the outcomes of this analysis. It is important to acknowledge that we are likely underpowered to detect an interaction effect because they are typically much smaller than direct effects and therefore require substantially large sample sizes to detect an effect (e.g., see this blog for a nice explanation: https://approachingblog.wordpress.com/2018/01/24/powering-your-interaction-2). The Mplus output files are located on the Open Science Framework (http://bit.ly/2OywN1q).

to extend the work reported here can do so with an appreciation of the study limitations, which include the non-experimental design, single snapshot of mental toughness prior to the selection test rather than multiple assessments during the selection test, binary assessment of selection outcome (i.e., pass/fail), absence of participants' stressor appraisals on the tasks within the selection course, and a focus on male military personnel. More broadly for the science of mental toughness, there is a need to examine conceptually and empirically the utility of self and informant assessments of mental toughness as a psychological resource for the prediction of behaviour (e.g., measurement invariance, incremental validity). Despite these limitations, the findings of this study offer an important contribution to the literature by providing evidence for the robustness of the conceptual proposition that mental toughness is a salient factor for behavioural perseverance across multiple tasks over an extended period of time.

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Table 1. *Unstandardised estimates of competing models including age, hair cortisol, and mental toughness as determinants of pass (1)/fail (0) outcome in a selection test for elite military training*.

	MLR		Bayes (informative)		Bayes (noninformative)	
	B (95% CI)	OR	B (95% CI)	OR	B (95% CI)	OR
Parameter Estimates						
MT → Selection	.69 (.07, 1.30)	1.98 (1.07, 3.68)	.52 (.19, .90)	1.68 (1.21, 2.47)	.42 (.09, .80)	1.52 (1.10, 2.23)
Age → Selection	-.11 (-.24, .03)	.90 (.79, 1.03)	-.06 (-.14, .01)	.94 (.87, 1.01)	-.06 (-.14, .01)	.94 (.87, 1.01)
HCC → Selection	.06 (-.002, .12)	1.06 (.997, 1.12)	.04 (-.001, .09)	1.04 (1.00, 1.10)	.04 (-.001, .10)	1.04 (1.00, 1.10)
Descriptive Statistics						
	M (SD)	Range				
Mental toughness	6.14 (.43)	2.25 – 7.00				
Age	27.37 (3.51)	20.67 – 39.08				
HCC (pg/mg)	5.53 (6.22)	.62 – 61.31				
Model Fit Statistics						
PPP	-		.19		.19	
Δobserved and replicated χ^2 95% CI			-16.40, 42.26		-16.10, 42.47	

Note: OR = odds ratio; HCC = hair cortisol concentration; MLR = robust maximum likelihood estimator; Bayes (informative) = informative prior (normal distribution with $\mu = 1.25$, $\sigma^2 = .25$) on MT → Selection, all other priors were noninformative; Bayes (noninformative) = noninformative priors used for all parameters.

Table 2. *Unstandardised estimates of competing models including age, hair cortisol, and mental toughness as determinants of pass (1)/fail (0) outcome in a selection test for elite military training excluding participants who failed selection for medical reasons*.

	MLR		Bayes (informative)		Bayes (noninformative)	
	B (95% CI)	OR	B (95% CI)	OR	B (95% CI)	OR
Parameter Estimates						
MT → Selection	.68 (.06, 1.30)	1.97 (1.06, 3.67)	.52 (.18, .91)	1.68 (1.20, 2.48)	.41 (.08, .80)	1.51 (1.08, 2.23)
Age → Selection	-.10 (-.24, .04)	.91 (.79, 1.04)	-.06 (-.14, .02)	.95 (.87, 1.02)	-.05 (-.13, .02)	.95 (.88, 1.02)
HCC → Selection	.06 (-.002, .12)	1.06 (.998, 1.12)	.04 (-.001, .09)	1.04 (1.00, 1.10)	.04 (-.002, .09)	1.04 (1.00, 1.10)
Descriptive Statistics						
	M (SD)	Range				
Mental toughness	6.13 (.49)	3.75 – 7.00				
Age	27.20 (3.32)	20.67 – 39.08				
HCC (pg/mg)	5.58 (6.28)	.62 – 61.31				
Model Fit Statistics						
PPP	-		.18		.18	
Δobserved and replicated χ^2 95% CI			-16.52, 42.35		-16.69, 42.35	

Note: OR = odds ratio; HCC = hair cortisol concentration; MLR = robust maximum likelihood estimator; Bayes (informative) = informative prior (normal distribution with $\mu = 1.25$, $\sigma^2 = .25$) on MT → Selection, all other priors were noninformative; Bayes (noninformative) = noninformative priors used for all parameters.