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Mental toughness and behavioural perseverance: A conceptual replication and extension

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ABSTRACT

Objectives: The purpose of this study was to conduct a conceptual replication of the proposition that mental toughness is associated positively with behavioural perseverance.
Design: Repeated-measures design.
Methods: In total, 38 male Australian rules footballers took part in this study (age, 21 ± 3 y; mass, 82.7 ± 11.0 kg; height, 1.84 ± .07 m; football experience, 13 ± 4 y). Participants self-reported mental toughness approximately one week prior to their first testing session where we assessed their aerobic capacity via the measurement of peak oxygen consumption ($\dot{V}O_{2peak}$). Approximately one week later, participants completed a 20 m shuttle run test (MST). The final testing session took place approximately one week later, where participants completed a simulated team game circuit (STGC; 60 min) to simulate game-relevant level of fatigue, which was followed immediately by a 20 m MST.
Results: Mental toughness was a salient determinant of the variation in behavioural perseverance under typical circumstances, when prior knowledge from past research was incorporated directly into the estimation process. However, the positive association between mental toughness and behavioural perseverance did not generalise to a performance context in which participants were fatigued.
Conclusions: The results of the current study suggest that mental toughness represents a salient psychological correlate of behavioural perseverance in a discrete physical task that taxes the aerobic energy system in some but not all situations. When fatigued, the effect of mental toughness is outweighed by greater underlying fitness.

1. Introduction

The concept of mental toughness has garnered substantial interest from researchers, practitioners and the general public over the past two decades. Within the academic literature, researchers have proposed several unique definitions and conceptual models of mental toughness.[1] Although these definitions and models differ in their breadth (e.g., unidimensional versus multidimensional structure) and content (e.g., resources considered characteristic of the concept), they share commonality in terms of an overarching conceptualisation of mental toughness as a psychological capacity of individuals that characterises their potential for action towards an objective or purpose. Informed by this conceptual commonality, mental toughness has been defined recently[1] as "a state-like psychological resource that is purposeful, flexible, and efficient in nature for the enactment and maintenance of goal-directed pursuits" (p. 18). Aligned with this definition, there is converging evidence to support the adaptive nature of mental toughness for performance and well-being across a range of performance settings, including sport, education and the workplace.[1,2]

In testing empirically the conceptual features of mental toughness, researchers have honed in on behavioural perseverance as a key behaviour by which this psychological capacity translates potential for action into goal attainment, high performance and well-being. In a sample of adolescent elite cricketers, Bell et al.[3] examined the effect of an intervention to enhance mental toughness via punishment-conditioned stimuli (i.e., consequences for behaviour), administered within a transformational leadership

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climate in which a higher-order vision and purpose transcends short-term goals. Those players who received the intervention (n = 21) improved their mental toughness over a 12-month period when compared with a control group (n = 20). In turn, these improvements in mental toughness were associated with differences in behavioural perseverance (as indexed by enhanced performance in the 20-m multistage shuttle run test [MST]) between the intervention and control groups 12-months after receiving the intervention (d = 1.20). Gucciardi et al.[4] extended this work by examining the link between mental toughness and behavioural perseverance in a field setting, using a sample of adolescent Australian footballers (N = 330). Adopting a cross-sectional design, they found that self-reported mental toughness was a salient correlate of MST performance (β = .24). Collectively, these two studies provide preliminary evidence to support this conceptual proposition of mental toughness (also see Gucciardi et al.,[5] for evidence in educational and workplace settings).

Against this empirical backdrop, this study was designed as a conceptual replication because we aimed to test the theoretical proposition that mental toughness is associated positively with behavioural perseverance using an experimental protocol that addressed methodological shortcomings of this past work.[3,4] First, we incorporated an objective measure of participants' aerobic capacity to examine the salience of mental toughness for behavioural perseverance while accounting for their physical fitness. Second, we separated temporally the assessment of mental toughness and all physical performance tests to minimise concerns associated with a mere measurement effect (i.e., enhanced accessibility of mental toughness for subsequent behaviour[6]). Third, all testing sessions were held at the same time of day to avoid any influence of circadian variation on performance.[7] As such, the first research question in this study sought to examine the extent to which these past findings replicate with a protocol that alleviates methodological concerns of previous research (RQ1).

In addition to this conceptual replication, a second purpose of the current study was to extend past work[3,4] by testing the robustness of the association between mental toughness and behavioural perseverance under circumstances when participants are physically fatigued. This methodological extension speaks to a core proposition reported by athletes and coaches in past qualitative work, namely that athletes with high levels of mental toughness are able to 'push through the pain barrier' when their body is telling them to give up.[8–10] In other words, mental toughness may be most important when the 'going gets tough'. This conceptual proposition has not yet been tested, and therefore, it remains unknown whether or not this post-hoc explanation of mental toughness by athletes and coaches extends to work conducted in the field. As such, the second research question in this study (RQ2) sought to test the degree to which mental toughness explains variation in behavioural perseverance under circumstances when participants are fatigued, while accounting for baseline aerobic capacity and typical MST performance.

2. Methods

Monte Carlo simulations[11] indicated that at least 30 participants would provide sufficient power (>80%) to detect the expected effects of aerobic capacity and mental toughness on behavioural perseverance when incorporating prior beliefs directly into the estimation process (see Table 1); full details of these analyses are provided in the Supplementary material. In total, 38 male Australian rules footballers provided informed consent and took part in this study (age, 21.18 ± 2.82 y; mass, 82.67 ± 11.02 kg; height, 1.84 ± .07 m; football experience, 12.89 ± 4.42 y). Footballers were recruited from clubs within the West Australian Football League (WAFL) and Western Australian Amateur Football League (WAAFL). All players were injury free and engaged in regular training at the time of data collection. The study protocol received approval from the lead author's university ethics committee before participant recruitment.

Using a repeated-measures design, participants completed three testing sessions over a two-week period; each testing session was separated by one week. Approximately one week prior to attending the lab in session one, players self-reported their mental toughness[5] via an online questionnaire (Qualtrics LLC, Utah, USA); participants rated the extent to which eight items were reflective of how they typically thought, felt and behaved as a footballer (e.g., "I strive for continued success" and "I am able to regulate my focus when performing tasks"). Responses were recorded using a 7-point scale (1 = false, 100% of the time to 7 = true, 100% of the time). A total score was created by averaging participants' responses across these eight items (α = .73). In session one, participants completed a laboratory-based graded exercise test (GXT) to assess aerobic capacity via the measurement of peak oxygen consumption ($\dot{V}O_{2peak}$). In session two, footballers completed a stand-alone 20 m MST in an indoor gymnasium on a sprung wooden floor. Finally, in session three, participants first completed a 60 min simulated team game circuit (STGC)[12] on an outdoor grass oval, followed immediately by a MST, again completed in an indoor gymnasium on a sprung wooden floor. The STGC rather than a real match scenario was employed for pragmatic and scientific reasons (i.e., experimental control over the fatiguing protocol). All testing sessions were held at the same time of day to avoid any influence of circadian variation on performance. MST scores (shuttle:level) were converted to a decimal score for ease of analysis and reporting. Fluid intake was restricted to 600 ml of water within each session, in order to control for the influence of consumption variations; for the STGC, participants received a total of 600 ml of Gatorade (carbohydrate: 36 g, energy intake: 618 kJ; Schweppes Australia) consumed during the quarter and half-time breaks interspersed throughout the session. Full details of the experimental protocol and individual tests are provided in the online Supplementary material.

The primary questions were tested with Bayesian regression analysis in M*plus* 8[13] using Markov Chain Monte Carlo (MCMC) simulation procedures with a Gibbs sampler. Within the context of Bayesian estimation, MCMC algorithms "mix" prior beliefs with observed data to produce "an approximation of the joint distribution of all parameters" in a model ([14, p. 334]; for a technical discussion, see Ref. 15). As such, the posterior distribution represents the combination of prior beliefs and the new data at hand. We specified four Markov chains each with a fixed number of 100,000 iterations to describe the posterior distribution, where the initial 50,000 iterations represented the burn-in phase. Model convergence was assessed using statistical (i.e., potential scale reduction factor; PSR < 1.05) and visual criteria (i.e., inspection of trace plots for stability in mean and variance of each chain). Posterior predictive checking is used to assess model fit in Bayesian estimation, where the posterior distribution is compared with the observed data to examine the degree to which the replicated data matches the observed data.[14] The posterior predictive p-value (PPP) and associated 95% credibility interval (CI) is produced in M*plus*; PPP values close to .50 and a symmetric 95% CI centring on zero reflect an excellent fitting model, though typically values greater than .05 are considered acceptable.[14] Parameter estimates were considered credible when the 95% CI excluded zero. An overview of the priors employed for each research question are detailed in Table 1. Readers are referred elsewhere for accessible overviews of Bayesian analysis.[16,17] For RQ1, $\dot{V}O_{2peak}$ and mental toughness were included as predictors of MST performance (decimal). For RQ2, footballers' baseline MST score was added alongside $\dot{V}O_{2peak}$ and mental tough-

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