# Perfectionism and motivation in sport: The mediating role of mental toughness

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An extensive body of research has been done on the links between perfectionism and motivation, yet the underlying mechanisms linking these psychological characteristics have been underexplored. In this study, we used an integrative modelling approach to examine associations between dimensions of perfectionism (i.e. personal standards [PSP] and concerns over mistakes [CMP]), mental toughness (MT) and motivational orientations (i.e. self-determined motivation [SDM] and non-self-determined motivation [NSDM]). Based on a sample of 318 male ($n$=218) and female ($n$=100) tennis players ($M_{age}$=17.61, $SD_{age}$=2.41), fit indices derived from structural equation modelling supported a partially mediated model. Residual PSP associated positively with MT (β=0.74) and SDM (β=0.40), and negatively with NSDM (β=-0.22). Conversely, residual CMP associated negatively with MT (β=-0.14) and SDM (β=-0.19), and positively with NSDM (β=0.73). Mental toughness was positively associated with SDM (β=0.28), but was unrelated to NSDM (β=0.07). The relationship between residual PSP and SDM was partially mediated by MT (standardised indirect effect: 95% CI=0.19, 0.46). The findings of this study support research linking dimensions of perfectionism with motivational orientations and offer preliminary evidence on the mediating role of MT in the association between these psychological constructs. With emerging research supporting the capacity to develop MT through targeted interventions, the findings are discussed alongside salient implications.

## Significance:

- Mental toughness partially mediated the association between pure personal standards perfectionism and self-determined motivation.
- Particularly among athletes with higher personal standards of perfectionism, more autonomous forms of motivation may be sustained via efforts that seek to develop athletes' mental toughness.

## Introduction

Perfectionism is generally regarded as a personality trait that involves establishing and striving for exceptionally high personal performance standards and engaging in critical self-evaluation.[1] Although researchers commonly categorise perfectionism into two superordinate dimensions of perfectionistic strivings (PS) and perfectionistic concerns (PC)[2], there is less consensus about the features that comprise each dimension. Conceptual discrepancies are evident within existing measures of perfectionism, with differences in coverage (i.e. broad versus narrow in scope), orientation (i.e. interpersonal versus intrapersonal dimensions), and the extent to which adaptive and maladaptive aspects of perfectionism are distinguished.[3] Given that socially prescribed features of perfectionism may be internalised and form part of a person's self-imposed perfectionism,[4] we sought optimal parsimony in this study by operationalising perfectionism based solely on intrapersonal dimensions. Along these lines, we drew on the work of others[5,6] and focused on a single feature of each superordinate dimension of perfectionism. Specifically, we refer to the notion of setting and evaluating the self against perfectionistic personal performance standards as personal standards perfectionism (PSP), whereas concerns over mistakes perfectionism (CMP) represents concerns over making mistakes and the evaluative consequences that accompany them.[1]

With conceptual ambiguity surrounding both subordinate and superordinate levels of perfectionism[7], researchers have raised concerns over the effect of statistical partialling on the conceptual meaning of the dimensions of perfectionism[8]. Because PS and PC each involve elements of self-evaluation, statistical approaches (e.g. multiple regression) that control for the overlap between them may change the conclusions that are drawn about the relations PS and PC have with outcome variables of interest.[7] Several studies have found that the typically adaptive relations shown by PS, and the maladaptive relations shown by PC, tend to become stronger when the shared variance between them is partialled out.[8,9] These changes in the predictive validity of PS and PC represent suppression effects – instances in which the relations between predictors and an outcome are altered when they are simultaneously included in a model.[2] Although scholars continue to debate the advantages and disadvantages of partialling PS and PC[2,7,8], there is consensus that researchers should clearly distinguish between findings that pertain to overall (i.e. unpartialled effects) and residual (i.e. partialled effects) PS and PC[7]. In line with recent recommendations[2,8], we refer to unique relations of PSP and CMP that occur as a result of partialling as *residual PSP* and *residual CMP*, respectively.

## Perfectionism and motivation

Motivation refers to the underlying causes of human behaviour.[10] While several models of motivation exist, self-determination theory[11] has consistently been applied to the study of perfectionism[12]. Within this framework, motivation is represented by a continuum of motivational subtypes (i.e. intrinsic regulation, integrated regulation, identified regulation, introjected regulation, external regulation and amotivation) that reflect the extent to which basic psychological needs are internalised.[13] The most autonomous forms of motivation (e.g. intrinsic regulation and identified regulation) embody self-determined motivation (SDM), whereas the least autonomous (e.g. external regulation and amotivation) exemplify non-self-determined motivation (NSDM).[6,14]

In their recent review of the literature on perfectionism and motivation, Stoeber et al.[15] concluded that PS are primarily associated with self-determined forms of motivation, whereas PC are largely related to non-self-

determined forms of motivation. These respective associations tend to strengthen when the shared variance between PC and PS is removed. Stoeber and colleagues[15] also noted selected instances in which the effect of partialling resulted in PS associating with less autonomous motivational types (i.e. introjected and external regulation). Although an extensive body of literature exists on the mediating role of motivation in the associations between dimensions of perfectionism and key outcome variables (e.g. burnout), one area that requires further investigation is the mediating mechanism by which perfectionism relates to motivation.

## Perfectionism, mental toughness and motivation

Mental toughness (MT) is a psychological construct linked to success (e.g. achievement) in competitive sport[16], with recent evidence supporting the development of MT through both naturally occurring interactions with the environment and targeted interventions[17]. Despite the obvious appeal to athletes searching for a competitive edge, the growing body of research on MT suggests there are several broader reasons for advocating the development of MT among athletes. For example, MT has been found to be associated with adaptive mental health functioning and well-being, including lower reported stress and depression and better sleep quality[18-20], which is encouraging given athletes' risk for experiencing mental health issues[21]. Taken together, these wider implications of MT are important, particularly to personnel (i.e. parents, coaches and practitioners) involved and invested in athletes' personal development and well-being.

In line with recent conceptualisations, we define MT in this study as a psychological resource that enables athletes to initiate and sustain efforts towards goal-directed endeavours.[22,23] We acknowledge that researchers continue to debate the conceptualisation of MT and approaches to measurement.[22,24] For example, while some have produced models and measures that reflect a multidimensional, trait-like construct[25], others have proposed MT to be unidimensional and state-like[22]. Evidence from behavioural genetic research has supported a combination of heritable and non-shared environmental influences, each of which appear to account for approximately half of the variance in MT.[26,27] Additionally, Gucciardi et al.[23] directly examined the dimensionality of MT by comparing a multidimensional, higher-order model encompassing seven dimensions (i.e. self-belief, attention regulation, emotion regulation, success mindset, context knowledge, buoyancy and optimism) of MT to a unidimensional one. They found support for a unidimensional representation of MT, owing to the substantial overlap (i.e. lack of discriminant validity) among the established dimensions of MT.

Drawing on evidence from qualitative research on MT in sport, MT is likely to exhibit unique relations with PS and PC. Across several studies, athletes and key personnel involved with the development of athletes (e.g. coaches) have described MT as consistently striving to achieve one's best, setting and expecting high standards to be met, being committed to performance excellence and attaining success and pushing physical and mental limits to set oneself apart from competitors.[28-30] Furthermore, both athletes[31] and coaches[32] have suggested that athletes' MT development is predicated on high self- and other-initiated expectations (e.g. coach) and encouraging athletes' pursuit of such ideals.

While many of these descriptions of MT are comparable to aspects of PS outlined in the perfectionism in sport literature, research points to an antithetical association between MT and PC. In a study in which athletes were classified into high and low MT-flow groupings, Jackman et al.[30] found evidence of PC, including anxiety about mistakes and concerns over receiving negative feedback, among athletes classified into the low MT-flow group. These findings support previous research emphasising the capacity to reduce negative thoughts, avoid negative reactions to errors that may be detrimental to performance and the ability to rebound adaptively following mistakes[28,33,34] as features of MT.

Findings from a range of studies indicate that mentally tough athletes are autonomously motivated in their work ethic and drive to succeed.[28,29,33] In studies that have identified contrasting poles of MT[34], descriptions of athletes with lower MT include those motivated principally by external sources and those lacking motivation to work hard. Recent quantitative evidence suggests that associations between motivational orientations and MT have varied according to the degree of autonomy each form of motivation represents. For example, at the extreme ends of the motivational continuum, Schaefer et al.[35] found MT to be associated positively with intrinsic regulation, but negatively with amotivation.

## The present study

In the current study, we examined associations among dimensions of perfectionism (as measured by PSP and CMP), MT and motivational orientations. Further understanding of these interrelationships is important because MT has been found to be amenable to development[17] and therefore might influence the relationships between dimensions of perfectionism and motivational orientations. For example, MT might offer an explanation for the positive associations between features of PS and self-determined forms of motivational orientations found in previous studies.[8] Using an integrative modelling approach, we explored MT as a potential mediator of associations between dimensions of perfectionism and motivational orientations (see Figure 1). It was expected that (1) residual PSP would be positively and residual CMP negatively associated with MT and, in turn, (2) MT would be positively associated with SDM and negatively associated with NSDM. Considering other mediating mechanisms are likely to be involved in the association between dimensions of perfectionism and motivational orientations, we anticipated finding evidence of partial, rather than full, mediation.

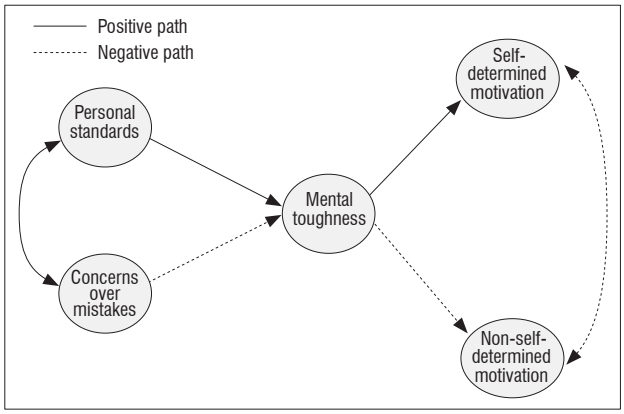



**Figure 1:** Hypothesised model of the relationships between dimensions of perfectionism, mental toughness and motivational orientations.

## Method

### *Participants*

The sample consisted of 318 (male=218, female=100) tennis players aged between 15 and 25 years ($M_{age}$=17.61, $SD_{age}$=2.41). All participants were recruited from one of three nationally sanctioned tournaments in South Africa and were competing in either the U16 ($n$=119), U18 ($n$=93) or Open (i.e. >18 years; $n$=106) age categories.

## Measures

### *Perfectionism*

PSP and CMP were measured using two subscales from the Sport Multidimensional Perfectionism Scale (Sport-MPS)[36]: personal standards (seven items; 'I have extremely high goals for myself in tennis') and concern over mistakes (eight items; 'Even if I fail slightly in tennis, for me, it is as bad as being a complete failure'). Participants responded to the items using a five-point response scale anchored at 1 (Strongly disagree) and 5 (Strongly agree). Dunn et al.[36] found support for factorial and convergent validity, while findings from several other studies support the construct validity of the Sport-MPS.[5,6] Previously reported internal consistency estimates have ranged from 0.70 to 0.89.[5,6,36]

### *Mental toughness*

Participants completed Gucciardi et al.'s[23] eight-item Mental Toughness Inventory. Items (e.g. 'I believe in my ability to achieve my tennis goals') are rated on a seven-point response scale (1=False, 100% of the time; 7=True, 100% of the time). Associations between scores on the Mental Toughness Inventory, performance outcomes (positive), behavioural intentions (positive) and stress (negative) have been in the expected direction, offering support for the construct validity of the measure.[23,37] Several studies have reported internal consistency estimates >0.80.[23,35,37]

### *Motivation*

Motivational orientations were assessed using selected subscales from the Sport Motivation Scale II (SMS II).[13] These included intrinsic ('…Because it gives me pleasure to learn more about tennis'), integrated ('…Because participating in tennis reflects the essence of whom I am'), external ('…Because people around me reward me when I do') and amotivated ('I don't know anymore; I have the impression that I am incapable of succeeding in tennis') regulation. Similar to Gaudreau and Antl's[14] item-level modelling approach, the two most autonomous (i.e. intrinsic and integrated regulation) and the two least autonomous (i.e. external regulation and amotivated regulation) forms of motivation were used to model SDM and NSDM, respectively. Pairs of items on the intrinsic and integrated motivation subscales (e.g. $SDM_1$=intrinsic $regulation_1$ + $integrated\ regulation_1$) were aggregated to model SDM, whereas pairs of items on the external and amotivation subscales were summed for NSDM (e.g. $NSDM_1$=$external\ regulation_1$ + $amotivated\ regulation_1$).[14] This resulted in three items for each dimension.

The 12 SMS II items used in this study were rated on a seven-point response scale from 1 (Does not correspond at all) to 7 (Corresponds completely). Anticipated associations with life satisfaction, vitality, task- and ego-oriented goals, and burnout have provided evidence of the construct validity of the instrument. Internal consistency estimates for the SMS II subscales have ranged from 0.70 to 0.83, and test-retest reliability values over a 1-week interval have been between 0.70 and 0.89.[13,38] Although the subscales included in this study were modified before further use, omega point estimates ranged from 0.80 to 0.84 for the subscales of intrinsic, identified, extrinsic and amotivated regulation.

## Procedure

The study was granted ethical approval from the Humanities and Social Sciences Research Ethics Committee at the University of KwaZulu-Natal and all procedures adhered to the Declaration of Helsinki principles. At the tennis tournaments from which the participants were recruited, athletes were approached to determine their willingness to participate in the study. Informed consent was obtained from all adult participants. Parental consent was obtained on behalf of all legal minors (i.e. <18 years of age) who indicated their interest in participating. A team of experienced research assistants trained in standardised survey administration procedures administered the questionnaire in an individualised, face-to-face format to each participant, which occurred between participants' matches and at their convenience.

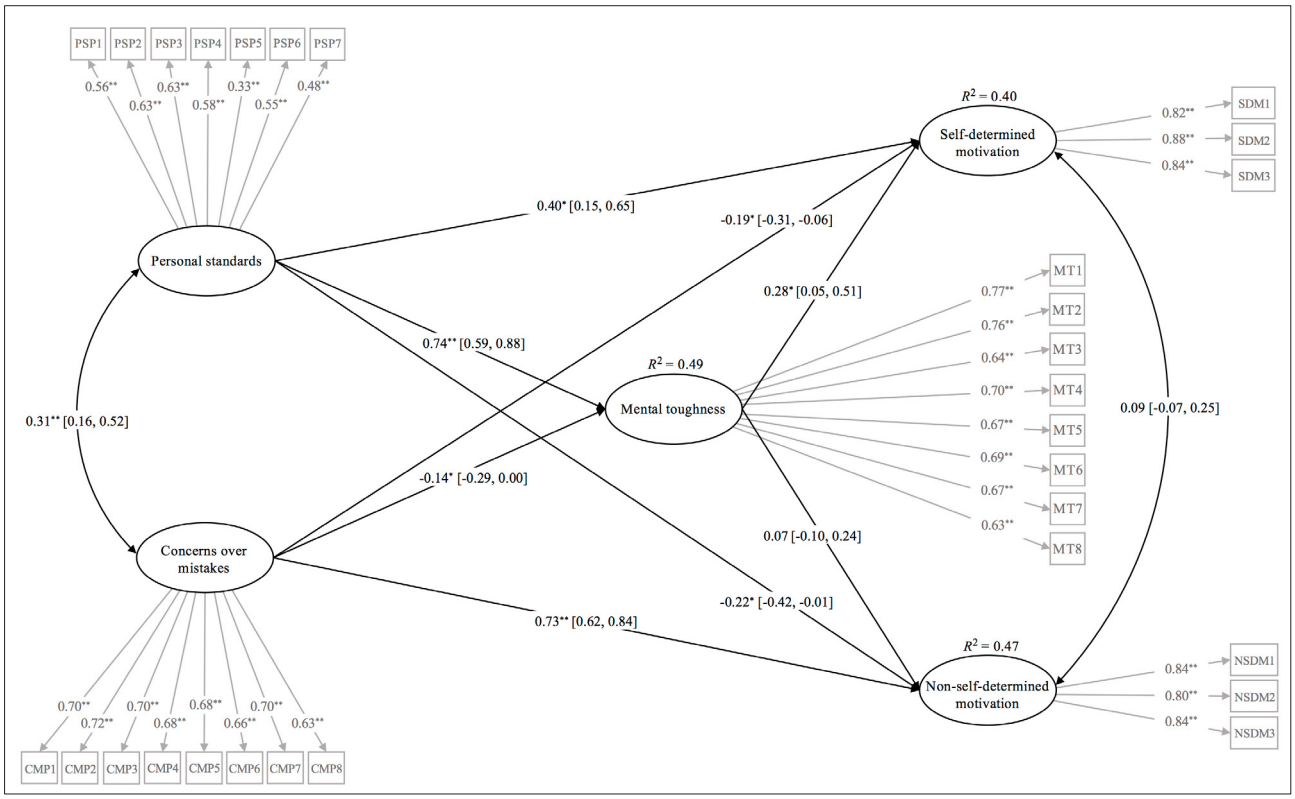
## Statistical analyses

### *Preliminary analyses*

All statistical analyses were computed in R.[39] The data set was first screened for missing values, which were replaced using an iterative random forest technique.[40] Standardised values ($\leq \pm 3.29$) and Mardia's multivariate normality test (i.e. $p>0.05$) were used to examine item-level univariate and multivariate normality, respectively.[41] Internal consistency was estimated using omega, which is liberal in its assumption of tau-equivalence.

### *Primary analyses*

Latent structural modelling was performed using maximum likelihood estimation with robust standard errors – a preferred technique when data contain ordinal response categories.[42] Model fit was estimated using $\chi^2$,




*p<0.05, **p<0.001

**Figure 2:** Final partial mediation model for relations between dimensions of perfectionism, mental toughness and self-determined motivation (standardised coefficients and 95% confidence intervals reported).

along with the robust comparative fit index (CFI), the standardised root mean square residual and the robust root mean square error of approximation. Noting criticisms levelled against the stringent application of fit index criteria[43], we used cut-off values of ≥0.90 for CFI, ≤0.10 for the standardised root mean square residual and ≤0.10 for the root mean square error of approximation[44,45]. A preliminary confirmatory factor analysis was used to determine the appropriateness of the hypothesised measurement model and associations among the latent variables were estimated using Pearson correlations. Preliminary associations among the study variables, age and sex (0=male, 1=female) revealed a single significant association between age and SDM ($r$=0.13, 95% CI [0.02, 0.24], $p$=0.016), prompting the inclusion of age as a covariate in each of the structural models. A full mediation model (see Figure 1) was tested first, which was followed by a partial mediation model. Support for the less restrictive, partial mediation model is obtained if there are substantial improvements in model fit.[46] Model comparisons were performed using the scaled difference chi-square test.[47] To establish mediating effects, model parameters were deconstructed into direct and indirect effects. Mediation is most often classified into complementary (partial) mediation (i.e. presence of both a direct and indirect effect, each in the same direction) and indirect-only (full) mediation (i.e. presence of an indirect, but not a direct effect).[48] Indirect effects were estimated using a bias-corrected bootstrapping procedure (10 000 repetitions), with statistical significance interpreted according to 95% bootstrap confidence intervals.

## Results

### *Preliminary analyses*

The quantity of missing values was negligible (0.26%) and replaced (proportion falsely classified=0.27) using random forest imputation (10 000 repetitions). The univariate (≤±3.29) and multivariate skewness ($b_{1,p}$=15.09, $p$=0.407) and kurtosis ($b_{2,p}$=49.43, $p$=0.726) estimates indicated the data were approximately normal in distribution. Internal consistency estimates were >0.70 for all study variables.

### *Primary analyses*

The measurement model yielded an acceptable level of fit to the data (see Table 1). Standardised item-factor loadings were each statistically significant ($p$<0.001). Pearson correlations among the study variables are reported in Table 2. MT was positively associated with PSP, CMP and SDM, but was unrelated to NSDM.

Fit indices for the fully and partially mediated structural models are reported in Table 1. Collective evaluation of fit indices for the fully mediated model revealed a weak level of fit, whereas a reasonable level of fit was found for the partially mediated model. The scaled difference chi-square test was statistically significant ($p$<0.001), favouring the partially mediated model.

The standardised path coefficients for the partially mediated model are reported in Figure 2. Residual PSP was positively associated with MT ($p$<0.001), whereas residual CMP associated negatively with MT ($p$=0.047). While residual PSP ($p$=0.005) and MT ($p$=0.018) were positively associated with SDM, residual CMP was negatively associated with SDM ($p$=0.005). Residual PSP associated negatively ($p$=0.044) and residual CMP positively ($p$<0.001) with NSDM, although MT was unrelated to NSDM ($p$=0.427). There was an indirect effect linking residual PSP with SDM (standardised indirect effect: 95% CI=0.19, 0.46), but not NSDM (standardised indirect effect: 95% CI=-0.08, 0.21), via MT. Residual CMP was not associated with SDM (standardised indirect effect: 95% CI=-0.09, 0.01) or NSDM (standardised indirect effect: 95% CI=-0.06, 0.02) via MT.

**Table 1:** Measurement and structural model fit indices

| | Overall fit indices | | | | Comparative fit index |
|---|---|---|---|---|---|
| | $\chi^2$ (df) | CFI | RMSEA [90% CI] | SRMR | $\Delta\chi^2$ (df)[c] |
| 1. Measurement model | 602.26* (367) | 0.928 | 0.045 [0.039, 0.051] | 0.067 | - |
| 2. Full mediation[a] | 783.51* (397) | 0.881 | 0.055 [0.050, 0.061] | 0.107 | - |
| 3. Partial mediation[ab] | 654.85* (393) | 0.919 | 0.046 [0.040, 0.051] | 0.066 | 150.18* (4) |

*CFI, comparative fit index; RMSEA, root mean square error of approximation; SRMR, standardised root mean square residual.*

*p<0.001

[a]*Models controlled for age.*

[b]*Direct paths added from (1) personal standards perfectionism to self- and non-self-determined motivation and (2) from concerns over mistakes perfectionism to self- and non-self-determined motivation.*

[c]*Scaled difference chi-square test.*[47]

**Table 2:** Descriptive statistics and bivariate associations among study variables

| Variable | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| (1) Personal standards perfectionism | 0.73 | | | | |
| (2) Concerns over mistakes perfectionism | 0.34** [0.24, 0.43] | 0.87 | | | |
| (3) Mental toughness | 0.56** [0.48, 0.63] | 0.11* [0.00, 0.22] | 0.88 | | |
| (4) Self-determined motivation | 0.41** [0.32, 0.50] | -0.02 [-0.12, 0.10] | 0.48** [0.39, 0.56] | 0.88 | |
| (5) Non-self-determined motivation | 0.11 [-0.00, 0.21] | 0.58** [0.50, 0.65] | 0.01 [-0.10, 0.12] | -0.02 [-0.13, 0.09] | 0.87 |
| M (SD) | 24.29 (4.57) | 26.45 (6.60) | 39.70 (8.60) | 30.24 (7.38) | 25.32 (7.73) |

*Note: 95% confidence intervals presented in brackets; diagonal contains internal consistency estimate.*
*p<0.05, **p<0.001

## Discussion

In this study, an integrative modelling approach was used to examine associations between perfectionism, MT and motivational orientations. The findings from the multivariate structural modelling analysis indicated that PSP and CMP each have unique relations with MT and motivational orientations. Residual PSP was positively associated, whereas residual CMP was negatively associated, with MT. Residual PSP and MT were both positively associated with SDM, while residual CMP was negatively related to SDM. Support was obtained for a partial mediation effect of MT, as an indirect effect was found linking residual PSP with SDM via MT. Conversely, residual PSP was negatively associated with NSDM, while residual CMP was positively related to NSDM. MT was unrelated to NSDM. Taken together, the findings offered mixed support for the hypotheses.

There are several noteworthy implications based on the findings of this study. The residualised and unresidualised associations between dimensions of perfectionism, MT and motivational orientations are consistent with concerns that have been raised over the effects of partialling on the conclusions that are drawn about perfectionism.[7] For example, compared to the unpartialled effects, when the common variance between PSP and CMP was statistically controlled, the positive association between PSP and MT was strengthened and the association between CMP and MT inverted from positive to negative. Although these findings appear contradictory, when evaluated alongside each other they offer complementary information about the features that are unique and shared among PSP and CMP. That is, if one compares two players, the one with higher CMP and PSP will, on average, report higher MT. However, if one compares two players who have the same PSP scores, the one with higher CMP will, on average, report lower MT.[2] Our findings are also consistent with previous research in that residual PSP yielded more adaptive, while residual CMP obtained more maladaptive, associations with MT, SDM and NSDM than did the unpartialled variables of each perfectionism dimension.[8] Although researchers have yet to agree on the common features that are shared among the general dimensions of PS and PC,[2,7] the present findings are important because they further demonstrate the distinctiveness and overlap between components of perfectionism.

The direction of associations among residual PSP, residual CMP and MT were largely consistent with existing literature on MT in sport. Specifically, MT has often been associated with setting exceedingly challenging performance expectations and maintaining commitment towards reaching such standards.[28,30] These descriptions represent efforts mentally tough athletes direct towards achieving subjective markers of performance and outperforming competitors, which align closely with characterisations of perfectionistic strivings. There is also a self-to-other comparative component to PSP, as athletes who strive for perfection tend to believe they have higher performance standards and achievement goals than their competitors.[36] Likewise, mentally tough athletes are highly competitive, thrive on competitive situations and believe in their ability to outperform their competitors.[28] However, there are potential negative consequences linked to the relentless pursuit of exceedingly high personal standards, particularly when there are barriers impeding the attainment of the performance targets set. Past research has associated MT with overtraining and a willingness to train despite injury or the prospect of incurring a more severe injury,[29] suggesting that an unremitting persistence to achieve could lead to adverse physical or psychological consequences.

The association with residual CMP conforms with the tendency for athletes with higher mental toughness to experience less anxiety about committing errors and negative other-evaluations linked to making mistakes.[30] The positive bivariate relation between CMP and MT, however, may signify the heightened levels of introspection in which mentally tough athletes engage,[49] which may be accompanied by self-criticism when mistakes or underperformance occurs. Although mentally tough athletes may not be impervious to critical self-evaluation, they do appear adept at recovering and sustaining goal-directed efforts by rebounding quickly from mistakes and not dwelling on errors when they occur.[33] This characterisation is likely facilitated by the repertoire of skills (e.g. learned resourcefulness, coping strategies) that enable mentally tough athletes to successfully avoid or minimise the effects of debilitative cognitive-emotional experiences on performance.[50]

Residual PSP associated positively with SDM and negatively with NSDM. In contrast, residual CMP associated negatively with SDM and positively with NSDM. These findings align with those of several studies that have reported more adaptive relations between features of PS (and more maladaptive relations between features of PC) and autonomous forms of motivation.[15,51] While residual PSP has a favourable effect on athletes' self-determined motives, residual CMP is accompanied by less desirable, non-self-determined motives. There was also evidence of an indirect effect linking residual PSP with SDM via MT, providing preliminary support for the partial mediating mechanism of MT. This finding highlights the influence of both residual PSP and MT on the self-determined motivational orientations of athletes. An indication of the unique roles of each construct is captured in the features that distinguish MT from PSP. In particular, a central function of MT is psychological buoyancy[23] – a general term used to describe the ability of mentally tough athletes to remain unaffected by disappointments, respond more adaptively (i.e. cope better) to stress (e.g. underperformance) and bounce back (e.g. regain focus) from setbacks.[28,29,33] Whereas PSP seems fundamental to initiating autonomous forms of motivation that are linked to subjective performance standards, MT may play a more pertinent role in maintaining SDM when athletes face obstacles that impede their ability to achieve the perfectionistic standards which they set.

The findings of this study indicate that MT is unrelated to NSDM, although prior research in this area has been mixed. Some studies have reported positive associations between MT and external regulation[52], whereas others have reported a negligible relationship between the two constructs[35]. Given recent evidence suggesting that expressions of MT may differ across situations,[53] there may be periodic changes in athletes' MT that could affect their motivational orientations. There are also a number of instances in which elite athletes recognised for their MT have experienced phases of disinterest, dejection and a lack of desire to participate in their respective sports.[54] Thus, MT may involve being able to consistently prioritise more (over less) autonomous forms of motivation, as well as the capacity to recover more autonomous forms of motivation.

## Practical implications, limitations and future research directions

Based on the findings of this study, we speculate that PSP may be involved in initiating, whereas MT may be central to maintaining, SDM. Efforts directed towards enhancing MT, which have been successful in the past, may have fruitful benefits for maintaining athletes' SDM. In one study, Bell et al.[17] reported improvements in MT following an intervention that coupled progressive exposure to pressurised performance situations with a supportive and encouraging sporting environment. Thus, MT development stemmed from improvements in athletes' capacity to withstand adversity. By creating training environments that mirror high-pressure competitive performance contexts and providing athletes with the necessary psychological skills to deal with such demands, developments in certain aspects of athletes' MT (e.g. self-efficacy) may increase the likelihood that sustained SDM will be exhibited when performance-related challenges (e.g. errors) occur. Such an approach to MT development might be supplemented by cultivating autonomy-supportive environments[31] that encourage athletes to establish sport performance standards that closely align achievement with fulfilment of their athletic potential. Similarly, coaches and practitioners ought to emphasise self-comparative (as opposed to other-comparative) appraisal processes when assisting athletes with setting performance expectations and evaluating performance outcomes,[55] creating sporting climates that focus on demonstrating self-referenced competencies and maximising one's athletic potential.

The present findings should be considered alongside relevant methodological limitations. Firstly, the sample consisted of competitive athletes participating in tennis – an individual, non-contact sport. Consequently, caution should be applied when generalising the findings to other subpopulations of athletes. Secondly, we used a cross-sectional design, and assumptions about causality would need to be clarified

through the use of experimental types of design. Thirdly, selected findings may be indicative of contextual or temporal changes in selected constructs (e.g. MT) that were not directly measured in this study. To explore this further, researchers might consider longitudinal designs with multiple measurement points. Fourthly, all variables were measured using self-report ratings provided by the athletes, which may have resulted in self-report bias and socially desirable responding. Future research could employ a multi-pronged measurement approach, such as the use of other-informant ratings or observations.

## Conclusion

This study provides insight into the associations between unique dimensions of perfectionism, MT and motivational orientations in competitive athletes. Residual PSP yielded more adaptive relations with MT and motivational orientations compared with residual CMP. The findings offer preliminary support for MT as a mechanism underlying the link between residual PSP and SDM. As evidence accumulates in support of the developmental aptitude of MT, targeted MT training programmes might provide a useful avenue for maintaining self-determined forms of motivation among athletes with exceptionally high personal performance standards, particularly when there are barriers (e.g. underperformance) to achieving such standards.

## Authors' contributions

All authors developed the study concept and contributed to the study design; R.G.C. coordinated data collection, performed the data analyses and drafted the manuscript; L.C., P.C.J. and T.R.D. provided critical revisions to the manuscript. All authors approved the final version of the manuscript for publication.

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