Mental Toughness: Taking Stock and Considering New Horizons

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Mental Toughness: Taking Stock and Considering New Horizons

Few concepts within sport and exercise contexts evoke as much interest as that of mental toughness. Performers (e.g., athletes) and those people and organisations charged with their development (e.g., coaches, sport psychologists) strive to attain and sustain high levels of mental toughness or catalyse these efforts. Authors of popular press articles or books often proclaim to know the secrets of mental toughness and how it can be developed (e.g., Kuehl, Kuehl, & Tefertiller, 2005; Wakefield, 2008). Scientists aim to generate the necessary evidence upon which to clarify the theoretical features of mental toughness and its operationalisation for measurement and manipulation in empirical studies. Given the widespread interest, it is unsurprising that scholarly work on mental toughness has increased substantially over the past decade, such that the concept has been acknowledged as among the most prevalent within the broader field of positive psychology (Rusk & Waters, 2013).

Suffice to say, researchers, practitioners and the lay public have embraced mental toughness, and therefore the interest in this concept is both broad and encompassing.

In this chapter, I focus on the scientific interest to take stock of the accomplishments within the past two decades of theoretical and empirical research on mental toughness, and consider new horizons for the study and conceptual evolution of this concept in future work. The overarching structure and flow to this chapter is that which starts broad and then delves into specific considerations regarding the scientific study of mental toughness. I begin the chapter with a bibliometric analysis of the mental toughness literature to provide readers with an overall sense of trends within this body of work. This bibliometric information also provides an important foundation upon which to consider specific areas of work on mental toughness in subsequent sections. Of particular interest in the middle sections of this chapter are the primary ways by which researchers have conceptualised, defined and operationalised mental toughness within sport and exercise contexts. Scholarly work on mental toughness has
been linked closely with application; however, readers interested in these applied and
developmental considerations are referred elsewhere (Anthony, Gucciardi, & Gordon, 2016).
I close the chapter by sketching theoretical and methodological considerations for the
scientific study of mental toughness in future work.

**Bibliometric Analysis of the Literature on Mental Toughness**

Bibliographic mapping is a well-established (Waltman, van Eck, & Noyons, 2010)
and widely adopted approach (e.g., Lindahl, Stenling, Lindwall, & Colliander, 2015;
Markoulli, Lee, Byington, & Felps, 2017) for the quantification and evaluation of the
cumulative intellectual structure and its evolution within a body of work (Börner, Chen, &
Boyack, 2003; van Eck & Waltman, 2010). For the purpose of this chapter, the overarching
aim was to obtain a broad overview of the peer-reviewed outputs of research on mental
toughness in sport and exercise contexts, with an emphasis on publication and citation
metrics alongside their evolution (e.g., influential researchers and papers) and associations
with each other (e.g., co-citations). In the following sections, I describe the bibliometric
method employed and the results of this search.

**Data Collection**

A search was conducted in Web of Science™ for documents published since 1950
with the exact terms “mental toughness” or “mentally tough” in the title, abstract, author
keywords, or keywords plus®. The search was executed on August 11th 2017 and identified
269 articles in total. Proceedings papers (n = 17), conference abstracts (n = 15), book reviews
(n = 6), and corrections (n = 2) were excluded. Full-texts (or abstracts when full-texts were
inaccessible) of the remaining 246 documents were screened manually to retain only those
articles where mental toughness was reported a priori as the primary focus or a key construct
conceptually (e.g., as the target concept or as part of a broader theoretical model) or
empirically (e.g., measured variable) within sport or physical activity settings (including
menta toughness. In total, 93 papers were excluded as a result, leaving 111 articles for bibliometric analysis; full reference details of these retained papers is located in Appendix A on the Open Science Framework (https://osf.io/zn87q/).

**Publication and Citation Metrics and Evolution**

The yearly output of peer-reviewed manuscripts on mental toughness and their total sum of annual citations is depicted in Figure 1. There has been a steady increase in the number of peer-reviewed publications since 2002, when Jones, Hanton and Connaughton (2002) published their seminal article on elite sport performers’ perceptions of mental toughness. It was around the same time when Clough, Earle and Sewell (2002) published a book chapter where they proposed the 4Cs model of mental toughness and its operationalisation via the Mental Toughness Questionnaire-48 (MTQ48) together with an 18-item version (MTQ18). Two exceptions to this general linear growth in new articles are observed in 2009 and 2016, that is, outlying years where a greater number of papers were published than others (13 and 24 new papers, respectively; see Figure 1). The majority of published work on mental toughness in sport and physical activity contexts has involved researchers located in England (n = 46; 41.44%), Australia (n = 40; 36.04%), USA (n = 17; 15.32%), Wales (n = 12; 10.81%), Switzerland (n = 6; 5.41%), and South Africa (n = 5; 4.51%). To date, the most published researchers on the study of mental toughness in sport and/or physical activity contexts include: Daniel Gucciardi (n = 27), Lee Crust (n = 14), Clifford Mallett (n = 11), Sheldon Hanton (n = 10), Peter Clough (n = 9), and Sandy Gordon (n = 9). The primary outlets in which researchers have published their work on mental toughness include: *Personality and Individual Differences* (n = 13), *Sport Psychologist* (n = 11), *Journal of Applied Sport Psychology* (n = 10), *Journal of Sports Sciences* (n = 9), *Perceptual and Motor Skills* (n = 9), *Journal of Sport and Exercise Psychology* (n = 6), *Sport,
In total, the 111 articles on mental toughness in sport and physical activity contexts retained for bibliometric analysis have been cited 1733 times (or 822 without self-citations) by 526 articles (or 425 without self-citations). The linear growth of the total sum of citations largely mirrors the number of peer-reviewed manuscripts published each year. Excluding self-citations, this work on mental toughness has been cited primarily within the research fields of psychology (n = 231, 60.31%), sport sciences (n = 154, 40.21%), and social sciences (n = 125, 32.64%) by researchers from England (n = 113, 20.50%), the USA (n = 63, 16.45%), and Australia (n = 50, 13.06%). The 20 most cited published papers on mental toughness in sport and/or physical activity contexts within Web of Science are detailed in Table 1. Unsurprisingly, one of the first published papers on mental toughness (Jones et al., 2002) has been the most widely cited articles in this field both in terms of total citations and average cites per year. It is also evident that the most cited papers on mental toughness are those that were published at least 7 years ago. An inspection of the equal top five papers in terms of total cites and average cites per year indicates that 83% of these articles were qualitative in nature. The high citation numbers of these papers likely reflects the formative stage of development of the field of mental toughness, with this earlier work taking a primarily inductive approach to uncover new information about the concept rather than confirm hypotheses. The exception here is the study by Nicholls et al. (2008) who examined cross-sectional associations between mental toughness, optimism, pessimism, and coping among athletes. There are at least two primary reasons for the high citation numbers of the publication by Nicholls and colleagues. First, it was among one of the initial peer-reviewed manuscripts to employ the MTQ48 as a measure of mental toughness, thereby introducing this measurement tool to the broader scientific community who may not have read or had
access to the original chapter by Clough et al. (2002). Second, the study by Nicholls et al. encompassed four broad psychological concepts thereby having greater reach beyond the field of mental toughness alone.

**Visualisation of Bibliometric Networks**

VOS viewer software (van Eck & Waltman, 2010) was used to depict graphically key findings of the bibliometric analysis, where nodes capture the inputs of the constructed network (e.g., authors, papers) and the edges encompass the strength of association between nodes (van Eck & Waltman, 2014). For all analyses, bibliometric networks were constructed and visualised using the fractional counting methods because it produces field-normalised results (Waltman & van Eck, 2015). With the fractional counting method, a total weight of 1 is apportioned equally among the number of authors on a paper (e.g., a weight of .20 is assigned to each co-author on a paper with 5 authors) thereby ensuring that all papers are weighted equally; this approach contrasts with the full counting method where each co-author on a paper is assigned a value of 1 regardless of the number of co-authors (i.e., a paper with 5 co-authors is counted five times instead of once) (Perianes-Rodriguez, Waltman, & van Eck, 2016). The visualisation outputs of all analyses reported in the following sections are available on the Open Science Framework (https://osf.io/zn87q/).

Two analyses examined the associations among the bibliometric networks on the mental toughness literature. The first analysis performed was designed to understand interactions among researchers and the overall structure of the research community via co-authorship relations (van Eck & Waltman, 2014). In total, 207 unique authors were identified of which 27 authors with at least three publications were retained in the co-authorship analysis to maximise interpretability of the solution. Larger fonts for the names of authors of a bibliometric analysis highlight the centrality of that scholar for the network. In terms of co-authorship structure, there are three primary and two secondary nodes. With regard to the
primary nodes, the most central researchers are Lee Crust with co-authors Earle, Levy, Nicholls, Perry, Polman and Swann; Serge Brand with co-authors Bahmani, Clough, Gerber, Holsboer-Trachsler, Kalak, Lemola, and Pühse; and Daniel Gucciardi with co-authors Dimmock, Gordon, Mahoney, Mallett, and Ntoumanis. Peter Clough represents a visible link between the nodes of Crust and Brand most likely because of his contributions to the development of the MTQ48 and MTQ18, which have been central to the survey work of these groups of researchers (e.g., Brand et al., 2017; Crust & Clough, 2005). The secondary nodes encompass Connaughton, Hanton and Jones in one cluster, and Golby and Sheard in another cluster. Sheldon Hanton represents a visible link to the node of Daniel Gucciardi owing to their recent collaborative work on mental toughness in sport (e.g., Gucciardi, Hanton, & Mallett, 2012; Gucciardi, Hanton, Gordon, Mallett, & Temby, 2015). These findings support the existence of five productive research groups within the literature on mental toughness in sport and/or physical activity contexts, who share collaborations with one but not multiple other teams.

A co-citation analysis was performed on cited references to provide insight into the knowledge base of the mental toughness literature. The focus in this analysis is on those references that are jointly co-cited by a third publication, such that stronger co-citation relations between two papers exist when several papers cite both articles concurrently (van Eck & Waltman, 2014). In total, 2720 cited references were identified of which 51 references with at least 10 citations were retained in the co-citation analysis. The entire network was divided into 3 co-citation clusters. The largest cluster included 21 items where references by Jones et al. (2007), Gucciardi, Gordon and Dimmock (2008), and Connaughton, Wadey, Hanton and Jones (2008) and were central to this node. Overall, the publications in this node have in common a focus on the developmental factors associated with mental toughness including qualitative (e.g., Connaughton, Wadey et al., 2008) and intervention work (e.g.,
Bell, Hardy & Beattie, 2013), as well as reviews of the literature (e.g., Connaughton & Hanton, 2009). The second largest cluster included 17 items and was characterised primarily by references from Jones et al. (2002), Bull, Shambrook, James and Brooks (2005), and Thelwell, Weston and Greenless (2005). This node contained a broad range of publications including work on the conceptualisation (e.g., Fourie & Potgieter, 2001) and measurement of mental toughness (e.g., Middleton et al., 2004) and its association with the related construct of hardiness (e.g., Golby & Sheard, 2004). Although this node was the broadest of the three in terms of the substantive features, it seems that foundational work on the conceptualisation of mental toughness was central to this work. Finally, the smallest cluster included 13 items and included references by Clough et al. (2002), Crust (2008), and Nicholls et al. (2008) were central to this node. This cluster draws heavily from the 4Cs model of mental toughness and its operationalisation via the MTQ48 (Clough et al., 2002) and therefore encompassed work that was primarily survey-based.

**Discussion of Bibliometric Findings**

Several key findings can be gleaned from this bibliometric analysis of the peer-reviewed literature on mental toughness in sport and physical activity contexts. First, the beginnings of contemporary research on mental toughness can be traced back to the start of the 21st century around the time when Jones et al. (2002) published their qualitative study, and Clough et al. (2002) published their book chapter on the 4Cs model of mental toughness. Since that time, there has been steady growth in research activity on mental toughness primarily by scholars in Western society (e.g., England, Australia, USA). Nevertheless, the reliance on the Web of Science database for this bibliometric analysis means that research by scholars from less developed nations was not identified because the journals where they have published their research are not indexed in this database (e.g., Hagag & Ali, 2014; Omar-Fauzee et al., 2012). Given the focus on sport and physical activity contexts in this
bibliometric analysis, it is unsurprising that researchers have published their work on mental toughness in these contexts in journals that are multidisciplinary in nature (e.g., *Journal of Sports Sciences*) or focus solely on the psychological aspects of these activity settings (e.g., *Journal of Sport & Exercise Psychology*).

A second key finding is that academic work on mental toughness is fragmented across several research groups and thematic streams. One possible reason for this fragmentation is that researchers have defined and operationalised mental toughness in different ways across studies, which in turn has resulted in preferred operationalisations of the concept via self-report instruments. For example, two of the three primary research groups have adopted the 4Cs model of mental toughness and its MTQ48/18 (Clough et al., 2002) as the framework by which to study this concept in sport (e.g., Crust) and exercise settings (e.g., Brand).

Researchers have sought to identify similarities and differences among these alternative definitions and conceptualisations (e.g., Gucciardi, 2017; Lin, Mutz, Clough, & Papageorgiou, 2017), yet the outputs of these efforts have had little time to influence theory and research on mental toughness.

A final key finding identified via the co-citation analysis is the existence of broad themes that reflect the key research areas within the mental toughness literature, as viewed by the broader scientific community. Although research activity is ongoing across these nodes, the most cited publications come primarily from work focused on the conceptualisation of mental toughness (e.g., Bull et al., 2005; Jones et al., 2002) and its measurement via the MTQ48 (e.g., Clough et al., 2002; Nicholls et al., 2008), or from recent perspectives that have challenged dominant conceptualisations of mental toughness as a multidimensional concept (e.g., Gucciardi et al., 2015) or an observable behaviour underpinned by neuropsychological theory (e.g., Hardy, Bell & Beattie, 2014). Citations are of course one way to assess the quality of an article, yet should not form the only basis from which to make
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such judgments because of their many limitations (e.g., temporal and culture bias, authors’ knowledge of the literature; Bornmann & Daniel, 2008; De Bellis, 2009). Context is an important consideration for the interpretation of citations because a highly cited article may not equate with quality or influence; for example, an article may receive numerous citations as it represents an example of poor substantive or methodological issues. Of particular relevance for the field of mental toughness, research indicates that a citation time window of at least 4 years is sufficient for an assessment of the general influence of an article, yet at least 9 years is required for an evaluation of those contributions in the top 10% for the long-term (Wang, 2013). With the majority of work published in the last decade, it is likely too early to offer definitive conclusions regarding which of these papers will shape the next frontier of mental toughness research and theory. Having an understanding of the strengths and weaknesses of existing conceptual and measurement work is therefore a prerequisite for those researchers whose goal is to offer meaningful contributions to the science and practice of mental toughness.

Conceptualising and Operationalising Mental Toughness

Several conceptual or theoretical models have informed what we currently know about mental toughness in sport and exercise contexts. As forecasted in the bibliometric analysis reported in the preceding section, the majority of work to date has been guided by one of two conceptual models or frameworks of mental toughness. In this section of the chapter, I review both of these influential models with the view to provide readers with an understanding of the definition, conceptualisation and operationalisation of mental toughness in each.

**The 4Cs: Control, Commitment, Challenge and Confidence**

**Conceptualisation and definition.** The 4Cs model of mental toughness (Clough et al., 2002) traces its roots to Kobasa and Maddi’s hardiness theory (Kobasa, 1979; Maddi &
Kobasa, 1984) in which they proposed a stable, personality trait that protects individuals against the ill effects of stress on health and performance. Personality hardiness is characterised by three core attitudes or beliefs that reflect one’s commitment towards experiences in life and work during stressful times, sense of control over their experiences, and view of stressful situations as challenges that are normal and important for growth and development (Maddi, 2004). Meta-analytic evidence of cross-sectional data supports the protective nature of personality hardiness (Eschleman, Bowling, & Alarcon, 2010). For this reason, the grounding of a conceptual model of mental toughness in established psychological theory on hardiness represents a key strength. With regard to the proposal of the 4Cs model of mental toughness, hardiness theory was adapted to “capture the unique nature of the physical and mental demands of competitive sport” (Clough et al., p. 38) based on information that was grounded in anecdotal and intervention work in applied sport psychology. To this end, Clough et al. added confidence as a fourth ‘C’ because of its salience for sport performance. The addition of confidence to the three hardy attitudes of commitment, challenge and control as an important component for sport performance is supported by meta-analytic evidence in sport settings (Moritz, Feltz, Fahrbach, & Mack, 2000; Woodman & Hardy, 2003) and formative research on mental toughness (e.g., Gucciardi et al., 2008; Jones et al., 2002). Against this conceptual backdrop, Clough et al. (2002, p. 38) offered the following definition:

Mentally tough individuals tend to be sociable and outgoing; as they are able to remain calm and relaxed, they are competitive in many situations and have lower anxiety levels than others. With a high sense of self-belief and an unshakeable faith that they control their own destiny, these individuals can remain relatively unaffected by competition or adversity.

As is evident in the results of the current bibliometric analysis and a systematic review of the literature (Lin et al., 2017), the 4Cs model has been the most preferred conceptual framework for the study of mental toughness in sport and physical activity
settings to date, particularly in recent years (Gucciardi, 2017). Such is the popularity of the 4Cs model that researchers have adopted this conceptual framework for the study of mental toughness in areas beyond sport and physical activity contexts, such as education (e.g., McGeown, St Clair Thompson, & Clough, 2016), business (e.g., Clough, Earle, & Strycharczyk, 2008), and the general population (e.g., Brand et al., 2015).

**Operationalisation.** Clough and his colleagues (2002) operationalised the 4Cs model and definition of mental toughness into measurable concepts via the development of the MTQ48 (and its shortened version, the MTQ18). As described in their original book chapter, survey items were written based on a literature review and opinions of end users including athletes, coaches, and sport psychologists to capture the 4Cs of control, commitment, challenge and confidence. This process resulted in the development of 48 items, hence the name MTQ48. In terms of the development sample, it was noted that the MTQ48 was “completed by more than 600 athletes from a range of sports and it has been found to be highly reliable, with a reliability coefficient of 0.9” (Clough et al., 2002, p. 39). Additional validity evidence of test scores was offered in terms of salient associations with hypothesised related constructs (e.g., optimism, life satisfaction); differences in perceived physical demands at higher workloads between those individuals with varying degrees of mental toughness; and better cognitive planning for individuals with higher levels of mental toughness, regardless of the type of feedback provided (positive or negative). Based on these findings, Clough et al. (2002, p. 41) concluded “the MTQ48 measure of mental toughness appears to be an accurate, fair and useful way of evaluating this key concept in sport psychology.”

Since the original development work of Clough et al. (2002), the MTQ48 and its short version (MTQ18) have been used widely to examine mental toughness in sport and physical activity contexts. The majority of this work has utilised the MTQ48 within sport settings to
examine associations with psychosocial factors such as flow (Crust & Swann, 2013), psychological strategies (Crust & Azadi, 2010), beliefs, pain and adherence in sport injury rehabilitation (Levy et al., 2006), and emotional intelligence, resilience, self-efficacy, and motivation (Nicholls et al., 2015). In recent years, researchers have applied the 4Cs model of mental toughness within physical activity contexts to examine associations between self-reported mental toughness and physical activity (e.g., Brand et al., 2017; Gerber, Kalak, Lemola, Clough, Pühse et al., 2013), subjective sleep, and psychological functioning (Brand, Kalak, et al., 2017), and exercise barriers (Stamp, Crust, Swann, & Perry, 2017). Suffice to say, much of what is currently known about mental toughness in sport and physical activity contexts has been informed by work that has utilised the MTQ48 (Lin et al., 2017).

**Empirical evaluations.** A key reason for the popularity of the MTQ48 is that it provides researchers with a gateway to the 4Cs model of mental toughness and therefore a conceptual framework upon which to interpret results of a scientific investigation. The central hypothesis of the 4Cs model is the multidimensional nature of mental toughness, which is characterised by dimensions pertaining to control, commitment, challenge and confidence (Clough et al., 2002). Although a 4-factor structure is consistent with the original 4Cs model of mental toughness proposed by Clough et al. (2002), researchers have adopted an alternative 6-factor representation of the 4Cs (e.g., Crust & Azadi, 2010; Nicholls et al., 2008). In this model, the control factor is further decomposed into aspects relating to emotions and life, whereas the confidence factor is separated into dimensions concerning abilities and interpersonal issues. Factor analyses are the primary mechanism by which to test hypotheses regarding the theoretical structure of psychological concepts in empirical data (Zumbo, 2006).

The first psychometric examination of the MTQ48 occurred approximately seven years after its initial publication. Horsburgh, Schermer, Veselka, and Vernon (2009) studied
the behavioural genetic basis of mental toughness and personality among 152 pairs of monozygotic and 67 pairs and dizygotic twins ($N = 438$). They conducted “exploratory and confirmatory factor analyses…to test the presence of the four factors that the scale was developed to measure” (p. 102). Scree plots based on the results of an exploratory analysis of data from one of the twins supported the presence of four factors. The replicability of this 4-factor solution was tested via confirmatory factor analysis on the second twin’s data and compared with a unidimensional model. Horsburgh et al. found that the “four-factor solution provided a better fit to the data than did a single factor” (p. 102) and that pattern of intended factor loadings were good. However, as there was insufficient information regarding the data analyses performed and results obtained (e.g., statistical information regarding model-data fit indices, strength of intended and non-intended factor loadings), readers are unable to verify the accuracy of these conclusions.

In a subsequent study, my colleagues and I tested the factorial validity and internal reliability evidence of test scores obtained with the MTQ48 among a sample of athletes ($N = 686$) and employees ($N = 639$; Gucciardi et al., 2012); the latter decision being an important consideration as the 4Cs model was founded in hardiness theory, which was born out of research within occupational settings. Using multiple criteria to assess model-data fit across two types of analyses – namely confirmatory factor analysis (CFA) and exploratory structural equation modelling (ESEM; Asparouhov & Muthén, 2009) – we found that the hypothesised 4-factor multidimensional structure of the MTQ48 did not replicate in these samples (Gucciardi et al., 2012; see also, Gucciardi, Hanton, & Mallett, 2013). Factor loadings of the ESEM solution supported this interpretation. In the athlete sample, out of the 48 items contained in the MTQ48, there were 41 cases of poor loadings on the intended factor ($\leq .30$), and 43 instances of salient cross-loadings on unintended factors ($\geq .30$). In the workplace sample, there were 30 cases of poor loadings on the intended factor ($\leq .30$), and 39 instances
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of salient cross-loadings on unintended factors ($\geq .30$). Similar findings were reported by Birch, Crampton, Greenlees, Lowry, and Coffee (2017) in their study of the MTQ48 among two independent samples of competitive athletes ($N_{\text{study1}} = 480$ and $N_{\text{study2}} = 1184$).

Specifically, model-data fit indices and factor loading estimates obtained from a CFA of the MTQ48 showed that the hypothesised correlated 4- and 6-factor models were inadequate representations of the data within both athlete samples. Nevertheless, it is important to acknowledge that the overly restrictive assumptions of CFA (e.g., zero cross-loadings) mean it is often suboptimal for the assessment of complex, multidimensional measurement instruments (for a review, see Marsh, Morin, Parker, & Kaur, 2014). Therefore, caution is urged when interpreting the findings of Birch and colleagues.

Research by Perry, Clough and their colleagues has provided further insight regarding the degree to which the hypothesised conceptualisation of mental toughness as encapsulated in the 4Cs model is represented adequately via test scores obtained with the MTQ48. In a study focused primarily on this objective, Perry et al. (2013) examined the factor structure of the MTQ48 among senior managers ($n = 4342$), lower and middle managers ($n = 1440$), clerical or administrative workers ($n = 1004$), athletes ($n = 442$), and students ($n = 978$). They used both CFA and ESEM to test the viability of both the 4- and 6-factor models, with a unidimensional structure as a comparison. In terms of model-data fit indices for analyses involving the total sample ($N = 8207$), both CFA and ESEM revealed mixed support for the viability of the 1-factor, 4-factor and 6-factor models tested when considering typical interpretation guidelines (e.g., Marsh, Hau, & Grayson, 2005). Similar findings regarding model-data fit were observed for the CFA of the 6-factor solution among the individual samples, and the ESEM of the athlete sample. In contrast, model-data fit indices of the ESEM analyses provided support for the 6-factor solution among senior managers, lower and middle managers, clerical or administrative workers, and students. Although overall model fit was
acceptable, an inspection of the pattern of factor loadings indicated substantial inconsistencies with the hypothesised theoretical structure in terms of the magnitude of intended and non-intended factor loadings. Specifically, 18 items loaded poorly on their intended factor ($\leq .30$), with 19 instances of salient cross-loadings on unintended factors ($\geq .30$).

In a study focused on the appropriateness of model-data fit indices for factor analyses of six tools commonly used within sport and exercise psychology, Perry, Nicholls, Clough, and Crust (2015) included the MTQ48 as one of their targeted instruments. Factorial validity analyses of responses to the MTQ48 provided by a sample of 407 athletes revealed mixed support for the 6-factor structure via CFA and ESEM in terms of model-data fit indices when considering typical interpretation guidelines (e.g., Marsh et al., 2005). An inspection of item-level parameter estimates produced by the CFA indicated that 68.75% and 85.42% of intended factors were greater the .50 and .40, respectively. With regard to the results of ESEM, 93.75% of items loaded significantly ($p < .01$) on their intended factor, 20.83% of items evidenced significant cross-loadings, and 35.42% of items demonstrated greater loadings on a non-intended factor when compared with their intended factor. However, ESEM data regarding the magnitude of these factor loadings was unavailable and therefore it is impossible to ascertain the degree to which these parameter estimates were meaningful.

**Conclusion.** The ongoing evaluation of the construct validity of test scores obtained with psychometric tools, particularly their internal structure, is critical because the number of latent factors or loading patterns of a scale may differ across samples, populations and settings (Flora & Flake, 2017). Despite being the measure of choice for most mental toughness researchers, accumulating evidence has cast doubt on the enthusiasm for the operationalisation of the 4Cs model of mental toughness via the MTQ48 both in terms of global (i.e., model-data congruence) and local (i.e., pattern of factor loadings) misfit (for a
psychometric assessment in student populations see also Gerber, Kalak, Lemola, Clough, Perry et al., 2013). In particular, findings of inadequate factor loadings are concerning because latent constructs are inferred from item indicators, such that the four or six latent dimensions may not reflect accurately the hypothesised components of mental toughness thus having implications for the interpretation of relations with external variables (Flake, Pek, & Hehman, in press). As psychometric assessments within single sample studies are susceptible to sampling and measurement errors (e.g. unconventional features of a research setting or sample), it is important to consider in future research statistical syntheses of existing work that has utilised the MTQ48 as a measure of mental toughness via item-level meta-analytic techniques (Carpenter, Son, Harris, Alexander, & Horner, 2016).

A Contextual Framework of Mental Toughness

Conceptualisation and definition. The work of Jones et al. (2002, 2007) is among the most influential within the field of mental toughness (see Table 1). Their research was sparked by a dissatisfaction with the conceptual ambiguity and disagreement among the available literature on mental toughness at the time, which was based primarily on practitioners’ experiences working with and observing athletes and coaches in practice. In contrast to the ‘theory grounding’ approach of Clough et al. (2002), Jones and his colleagues implemented an inductive method to clarifying the definition of mental toughness and the essential attributes that characterise the concept. In their first study, they purposefully sampled 10 athletes who had represented and competed for their country at international events (e.g., Olympic or Commonwealth Games) to participate in focus group or 1-1 interviews. During these interviews, participants brainstormed a definition of mental toughness and the fundamental attributes of the ideal mentally tough performer. Jones et al. reported the following definition from this process:

Mental toughness is having the natural or developed edge that enables you to: (i) generally, cope better than your opponents with the many demands
Mental toughness (competition, training, lifestyle) that sport places on a performer; (ii) specifically, be more consistent and better than your opponents in remaining determined, focused, confident, and in control under pressure.

Jones et al. (2002, p. 211) also reported 12 distinct characteristic attributes of mental toughness and ranked them in descending order of importance, as rated by the participants: an unshakable self-belief in your ability to achieve your competition goals; an unshakable self-belief that you possess unique qualities and abilities that make you better than your opponents; an insatiable desire and internalised motives to succeed; bouncing back from performance set-backs as a result of increased determination; thriving on the pressure of competition; accepting that competition anxiety is inevitable and knowing that you can cope with it; not being adversely affected by others’ good and bad performances; remaining fully-focused in the face of personal life distractions; switching a sport focus on and off as required; remaining fully-focused on the task at hand in the face of competition-specific distractions; pushing back the boundaries of physical and emotional pain, while still maintaining technique and effort under distress (in training and competition); and regaining psychological control following unexpected, uncontrollable events (competition-specific).

In a follow-up study, Jones et al. (2007) purposefully sampled eight performers, three coaches, and four sport psychologists to take part in a focus group or 1-1 interview. Athletes were chosen because of their ‘superelite’ status, that is, they had achieved the ultimate prize at the highest levels of competition (i.e., 7 Olympic gold medals, 11 world-championship titles). Participants approved the definition of mental toughness reported by Jones et al. (2002), with an average agreement of 9.33 (SD = 1.05) out of 10. They also reported 30 attributes as characteristic of mentally tough athletes, which were categorised deductively by the researchers into four dimensions. The first category reflected a general attitude of mentally tough performers characterised by themes of belief and focus (i.e., attitude/mindset dimension). The other three categories reflected the broad temporal phases of competitive
sport. During the *training phase*, athletes high in mental toughness were characterised as using long-term goals to fuel their motivation, controlling their environment, and pushing themselves to the limits. The *competition phase* was characterised by six core themes including handling pressure, belief, regulating performance, staying focused, controlling the environment, and remaining aware and in control of thoughts and feelings. Finally, during the *post-competition phase*, individuals high in mental toughness were characterised by their ability to handle both failures and successes.

**Operationalisation.** The work of Jones and colleagues (2002, 2007) has been instrumental in evolving scholarly conceptualisations of mental toughness via the perceptions and experiences of key stakeholders (e.g., athletes, coaches). Yet to date, Madrigal, Hamill, and Gill (2013) are the only researchers who have attempted to operationalise Jones and colleagues’ conceptualisation of mental toughness via a self-report tool. Specifically, they created 32 items directly from the description of key attributes reported by Jones et al. (2007), and an additional 22 statements via consultations with four athletes and coaches. Exploratory factor analyses of these 54 items were conducted on 271 athletes’ responses. Several multidimensional models were tested including 2-factor, 3-factor, and 4-factor solutions, yet the factor loadings across of these models indicated that items loaded strongly on a single factor. Items were considered for removal if they loaded on the general factor by a value that was lower than .55; this criterion resulted in 11 items being retained for the unidimensional factor and referred to as the Mental Toughness Scale (MTS). In addition to adequate internal reliability ($\alpha = .86$), initial concurrent validity evidence was provided in the form of meaningful correlations with dispositional flow, shyness, and social desirability. In a follow-up study of 143 college basketballers, a CFA supported the unidimensional structure, internal reliability ($\alpha = .86$) and magnitude of factor loadings ($> .40$). Additional concurrent validity evidence was provided in terms of salient correlations with related constructs such as
Mental toughness, dispositional flow, self-efficacy, self-esteem, and overall measure of mental toughness. However, contrary to expectations, the association between mental toughness and free throw performance among a sub-sample of 44 starting basketballers was small and non-significant. Support for the internal structure, reliability, and convergent validity evidence (i.e., hardiness, optimism, coping) was provided with an independent sample of 570 college athletes (Madrigal, Gill, & Willse, 2017).

**Empirical evaluations.** Direct support for Jones and colleagues’ (2002) definition of mental toughness has been provided by Thelwell et al. (2005) in a two-study qualitative investigation. In their first study, Thelwell and colleagues interviewed six male professional soccer players with international honours to examine their perceptions of the definition of mental toughness and the essential characteristics as they pertained to their sporting context. Overall, the soccer players’ perceptions of mental toughness resembled those reported by Jones et al. (2002), with one minor difference in the definition; specifically, the soccer players suggested that athletes high in mental toughness always (rather than generally) cope better than their opponents do with the various sporting demands. In the second study, 43 male professional soccer players rated their degree of agreement (1 = totally agree, 10 = totally disagree) with the definition of mental toughness from the first study. Overall, players agreed with the definition of mental toughness ($M = 2.2$, $SD = 1.4$).

Indirect support for the characteristics at the core of the mental toughness framework also exists. Inspired by the work of Jones and colleagues (2002, 2007), several research groups have generated conceptualisations of mental toughness using an inductive approach in which they have drawn from the experiences and perceptions of athletes, coaches, exercisers and other support personnel. Broadly speaking, these investigations have focused on identifying the essential characteristics of mental toughness that generalise across sports by sampling a broad range of participants (e.g., Cook, Crust, Littlewood, Nesti, & Allen-
Collinson, 2014; Slack, Butt, Maynard, & Olusoga, 2014; Weinberg, Butt, & Culp, 2011) or are contextually salient for individuals sports such as cricket (Bull et al., 2005; Gucciardi & Gordon, 2009), Australian football (Gucciardi et al., 2008), soccer (Coulter, Mallett, & Gucciardi, 2010), and ultramarathon (Jaeschke, Sachs, & Dieffenbach, 2016). Although the specific terms used to describe the individual attributes may vary across studies, themes concerned with belief, focus, motivational drive, control, and regulation of the self (e.g., thoughts, feelings) during training, competition and in relation to the sporting outcomes are all prevalent among this body of work.

**Conclusion.** Few scholars would deny the influence of the work of Jones and colleagues (2002, 2007) to the scientific study of mental toughness. Their research together with others (e.g., Cook et al., 2014; Slack et al., 2014; Weinberg et al., 2011) has generated important building blocks for what we know about mental toughness in sport and physical activity contexts. Inductive research is important in fields where there is insufficient theory to drive scientific inquiry (Locke, 2007), as was the case for the field of mental toughness around the turn of the 21st century (see Figure 1). The findings of the bibliometric analysis reported in this chapter support this assertion, with a substantial percentage of the most influential papers to date being inductive in nature (see Table 1). However, as most researchers have aimed to collect new primary data, important findings of these inductive investigations remain largely unintegrated. Reflective of the fragmented state of this literature, any psychological attribute that is important for high performance can potentially be considered characteristic of mental toughness. This substantive limitation has motivated some researchers to question the legitimacy of mental toughness as a scientific concept (Andersen, 2011). As such, there is a need to evaluate, interpret and integrate findings from past qualitative work on mental toughness across various samples and contexts systematically.
to clarify our understanding of this concept (for guidance on conducting a meta-synthesis, see Williams & Shaw, 2016).

**Moving Forward: Toward a Renewed Research Agenda**

Twenty years ago, the nascent field of mental toughness was characterised primarily by speculations, opinions, and personal experiences rather than empirical evidence informed by systematic research. Looking back at the road travelled so far, scholars have provided important progress towards alleviating such concerns. Both of the conceptual frameworks detailed in the preceding section and the associated research within these areas has shaped what we know of mental toughness in sport and physical activity contexts. Yet the conceptual shortcomings that characterise the literature on mental toughness prompt a number of questions and shine a spotlight on several unexplored areas of theory and research. In the following sections, I detail what I see as the core questions and primary research needs that may inform renewed efforts for the science of mental toughness in sport and physical activity contexts in future work.

**What Exactly is Mental Toughness?**

Quite aptly, Jones and colleagues (2002) posed this critical question in the title of their seminal paper; specifically, what is this thing called mental toughness? Several scholars – including myself – have devoted much of the past two decades towards investigating mental toughness with this primary question in mind. Despite the scientific progress since the influential work of Jones and colleagues, ongoing enthusiasm for the concept of mental toughness among researchers, practitioners, and the lay public coexists with substantial confusion and imprecision regarding its definition and conceptualisation. Suffice to say, the substantive details regarding mental toughness across this work are incomplete, incoherent, or in many cases both. This characteristic of the literature on mental toughness is concerning, as precision regarding the substantive features of a concept (e.g., theoretical and operational
Mental toughness underpin the construct validity enterprise (Loevinger, 1957) and theory development (Shepherd & Suddaby, 2017). As such, the key priority for future work is to reconceptualise mental toughness in a way that provides clarity on the essential and necessary attributes that characterise the nature of the concept and distinguish it from others.

Podsakoff, MacKenzie, and Podsakoff (2016) provided guidelines for researchers interested in defining new concepts or redefining existing definitions. First is the need to specify the essential property or nature of the concept and the entity to which it applies. In this sense, a concept definition is clear about the nature of the phenomenon (e.g., thought, feeling, behaviour) and to what object or event it applies (e.g., person, process, culture). A second important feature of concept definitions is that they encapsulate the necessary (i.e., essential that all exemplars must possess) and sufficient (i.e., unique features of the exemplars) attributes of the phenomenon. In other words, a high-quality definition should be both inclusive and exclusive in terms of the conceptual theme. Third, it is important that researchers are clear about the dimensional properties of the concept. For multidimensional concepts, clarity regarding the property, entity and conceptual theme is also required for each individual dimension of the overarching concept. Fourth is the need to stipulate the temporal (i.e., time), contextual (i.e., situations or contexts), and entity (i.e., cases) factors that speak to the stability of the concept. For example, dispositional traits are considered relatively stable across time and context but not people (Caspi, Roberts, & Shiner, 2005), whereas emotions are transient and dynamic across all three of these dimensions (Ekman, 2003). Finally, it is important that researchers delineate how the core conceptual theme differs from related concepts, and if possible, provide an initial description of the nomological network (e.g., antecedents, outcomes).

Over the past 15 years, researchers have proposed over a dozen definitions of mental toughness (see Table 2). An evaluation of these definitions of mental toughness – including
those my colleagues and I have proposed – against the criteria proposed by Podsakoff et al. (2016) indicates that many of these statements are suboptimal in one or more ways. First, several of these definitions prioritise exemplars of key attributes of mental toughness (e.g., control, confidence) at the expense of their commonality or the conceptual theme (e.g., Clough et al., 2002; Madrigal et al., 2013). In contrast to such degrees of specificity are definitions where researchers have alluded to the conceptual theme yet have done so in a manner that is too broad (e.g., Cowden et al., 2016; Gucciardi et al., 2008). Second, several researchers have defined mental toughness in terms of its hypothesised outcomes (e.g., Gucciardi et al., 2008; Hardy et al., 2014; Jones et al., 2002) and therefore excluded any information about the nature of the “capacity”, “quality” or “ability” that determines such outcomes. Conflating the conceptual theme of mental toughness with its determinants or outcomes means that the concept cannot be falsified because it is true by definition (MacKenzie, 2003). Third, the focus on exemplars or characterisation of mental toughness by its outcomes means that several of these definitions are silent or ambiguous with regard to dimensionality or stability information.

Cognisant of these definitional limitations – including deficiencies present in my own work (e.g., Gucciardi et al., 2008, 2015) – I recently redefined mental toughness in a way that leveraged from Podsakoff et al.’s (2016) guidelines and synthesised findings from past work (Gucciardi, 2017). It was apparent from existing work that mental toughness is concerned broadly with a psychological resource that is perceived as salient for goal-directed pursuits; this interpretation is aligned with a goal-directed perspective on the distinction between resources and non-resources (Halbesleben, Neveu, Paustian-Underdahl, & Westman, 2014; Hobfoll, 1989). As a psychological resource of people (entity), mental toughness represents a human capacity or potential for action towards some personally valued objective that is distinct from the deployment of resources via action and their outcomes (essential property).
In terms of the *conceptual theme*, a broad review of previous research and conceptual work suggests there are three essential characteristics: mental toughness is characterised by (i) direction and energy towards self-referenced targets (i.e., purposeful), (ii) congruency between actions and self-referenced objectives (i.e., efficiency), and (iii) adaptation of regulatory processes across stressors or situational demands (i.e., flexibility). Couched within the theoretical context of conservation of resources (Hobfoll, 1989) and the nature of goal-directed pursuits (e.g., Neal, Ballard, & Vancouver, 2017; Sun & Frese, 2013), mental toughness as a psychological resource should be characterised by both enduring (e.g., multiple, independent goals require common resources) and transient dimensions (e.g., dynamic nature of goal pursuits) across time, context and people (*stability*). Finally, conceptualised as a resource caravan because of the high correlation among individual attributes (Hobfoll, 2002), the acquirement, refinement and conservation of psychological resources that are salient for potential or actual threats to goal-directed pursuits coalesce over time as a unidimensional concept because they share the commonality of purpose, efficiency, and flexibility (*dimensionality*). Taking into consideration these substantive details, I offered a refined working definition of mental toughness 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).

**From Definition to Operationalisation: What is Involved?**

I proposed a working definition of mental toughness not as a statement that captures every possible substantive nuance, but rather one that synthesises and integrates existing information on the essential and necessary attributes through a scientific lens (Gucciardi, 2017). If this definition is accepted either in its current format or in a revised version, or an alternative definition is proposed, the utility of the conceptualisation will need to be assessed within a construct validity framework. Construct validation is considered a research program
Mental toughness is characterised by three independent yet intimately linked phases (Loevinger, 1957). The primary focus in the *substantive phase* is on the theoretical domain of the concept (i.e., definition) and its operationalisation through measurement (i.e., item indicators). Of particular importance in this phase are precise definitions (Podsakoff et al., 2016) and assessments of the extent to which observable indicators are individually and collectively representative of theoretical constructs (content validity). The *structural phase* is concerned with the empirical fidelity of the operationalisation, that is, the extent to which the indicators of the essential and necessary attributes of the concept are consistent with theoretical expectations (e.g., dimensionality, hierarchical structural). Factor analyses are the primary mechanism by which to test hypotheses regarding the theoretical structure of psychological concepts in empirical data (Zumbo, 2006). In the *external phase*, the focus is on examining the meaning of test scores via associations with other constructs (convergent and divergent validity) and salient outcomes (predictive validity), and assessments of group differentiation (groups thought to differ on the construct). Key here is the articulation of the exact nature of these associations with the focal concept as either an antecedent, consequence, correlate, or moderator within the nomological network. Imprecise definitions of constructs therefore have the potential to undermine the construct validity enterprise in numerous ways across each of these three phases (e.g., deficient or contaminated measures, model misspecification, unwarranted relations with focal concept) (MacKenzie, 2003; Podsakoff et al., 2016). When considering the best approach to measure mental toughness in research or practice, therefore, it is imperative that researchers critically evaluate their guiding definition and its alignment with the operationalisation via the measurement tool or experimental manipulation.

**What Exactly is New Here with Mental Toughness?**

In posing this question, I refer to the distinctiveness and usefulness of mental toughness in relation to established psychological constructs and the measures that have been
Mental toughness developed to operationalise the concept. In other words, there is a need to consider both conceptual and empirical redundancies and practical value when proposing and testing the utility of mental toughness and measures in which researchers have operationalised the concept. This question is salient when considering Podsakoff and colleagues’ (2016) criteria for high-quality definitions, and the phases within the construct validity enterprise (Loevinger, 1957). In terms of theoretical distinctiveness, comparing mental toughness with related constructs can help clarify or refine the attributes that characterise it, minimise the potential for construct proliferation (e.g., “old wine, new bottle”), and identify constructs that could be examined as part of the nomological network in the external phase of construct validity tests (Podsakoff et al., 2016). Of course, it is important to assess quantitatively the degree to which concepts that are distinguished theoretically are in fact empirically distinct (for guidelines, see Shaffer, DeGeest, & Li, 2016). Ultimately, conceptual or empirical redundancy undermines the utility of a concept and its operationalisation for systematic and cumulative research, and therefore its value for science and practice (Le, Schmidt, Harter, & Lauver, 2010).

Despite representing one of the major threats to the development of useful concepts and theories (Le et al., 2010), there has been limited attention devoted to narrative or statistical examinations of the conceptual and empirical distinctiveness of mental toughness in past work. Take the case of the 4Cs model of mental toughness and its operationalisation via the MTQ48 (Clough et al., 2002) because of its popularity among researchers. If one is to accept the proposition that mental toughness, as conceptualised within the context of the 4Cs model, is a dispositional trait that is characterised by cross-situational consistencies in beliefs and attitudes about stressful or challenging situations, then logically the concept is embedded within personality trait theory (for reviews, see Cervone & Pervin, 2016). Relative to the amount of research that has utilised the operationalisation of the 4Cs model of mental
Mental toughness via the MTQ48, limited work has been conducted to examine its theoretical and empirical distinctiveness. First, an exposition of the theoretical distinctiveness between mental toughness as conceptualised within the 4Cs model and other salient personality traits (e.g., Big Five, core self-evaluations; Chang, Ferris, Johnson, Rosen, & Tan, 2012; Soto & John, 2017) is currently absent from the literature. Second, researchers have observed small-to-large associations between the dimensions of the MTQ48 and the Big Five facets among monozygotic and dizygotic twins, where phenotypic correlations ranged from $\pm .05$ to $.64$, genetic correlations ranged from $\pm .01$ to $.91$, and non-shared environmental correlations ranged from $\pm .01$ to $.44$ (Horsburgh et al., 2009). The associations between mental toughness and the dark triad (narcissism, psychopathy and Machiavellianism) have been examined among the general adult population, with correlations involving the four facets ranging from $\pm .03$ to $.26$ in one study (Papageorgiou, Wong, & Clough, 2017; see also, Onley, Veselka, Schermer, & Vernon, 2014) and $.20$ to $.50$ for a global mental toughness score (Sabouri et al., 2016). Although these studies were not framed explicitly as tests of discriminant validity, the findings suggest that the operationalisation of mental toughness via the MTQ48 is empirically distinct from these related personality constructs. However, given the concerns regarding the interpretability of the MTQ48 facets (e.g., content validity evidence, pattern of factor loadings) detailed here and elsewhere (e.g., Gucciardi et al., 2012, 2013), it is difficult to interpret these findings with confidence when the meaning of each subscale is unclear.

Perhaps most important for the value of the 4Cs model of mental toughness and its operationalisation via the MTQ48 (Clough et al., 2002) for science and practice is evidence of incremental validity in relation to dispositional hardiness (Hunsley & Meyer, 2003). In other words, what is the unique contribution of confidence for the prediction of salient outcomes (e.g., performance) beyond that of the three hardiness dimensions of control, challenge, and commitment? There is ample convergent validity evidence for scores obtained
Mental toughness with the MTQ48 in terms of associations with learning, performance and psychological well-being (for a review, see Lin et al., 2017). However, no research to date has tested the incremental validity evidence of test scores obtained with the MTQ48 in relation to hardiness or other established personality traits. As the modal measure of mental toughness among researchers, the absence of incremental validity evidence of test scores obtained with the MTQ48 is concerning; if test scores obtained with the MTQ48 offer little in terms of unique explanation or enhanced accuracy of prediction, relative to other salient constructs, then claims of theoretical or practical utility would be unjustified (Hunsley & Meyer, 2003). It seems prudent that academic users of the MTQ48 formally test the incremental validity of test scores obtained with this tool, as a minimum, against the construct of hardiness.

As requisites for concept development and theory building (Podsakoff et al., 2016), efforts to rationalise and assess discriminant and incremental validity evidence of existing, refined, and new conceptualisations and operationalisations of mental toughness represent an important priority for future research. Elsewhere I have provided initial insight as to how the working definition of mental toughness as a “state-like psychological resource that is purposeful, flexible, and efficient in nature for the enactment and maintenance of goal-directed pursuits” can be distinguished conceptually from related constructs including resilience and grit (Gucciardi, 2017, p. 18). Briefly, mental toughness and resilience differ conceptually in the following two ways: (i) the entity to which it applies in that mental toughness is concerned solely with people, whereas resilience generalises to any type of system (e.g., people, organisations); and (ii) the conceptual theme in that mental toughness applies to psychological resources only, whereas resilience is characterised by a broad range of protective factors (e.g., individual, community, societal) (for a review of resilience, see Kossek & Perrigino, 2016). In contrast, mental toughness and grit – defined as the disposition to pursue long-term goals with “passion and perseverance” (Duckworth, Peterson, Matthews,
Mental toughness – can be distinguished conceptually in terms of: (i) *stability* in that mental toughness is characterised by both enduring and transient dimensions and therefore is state-like in nature, whereas grit is conceptualised as a higher-order personality trait characterised by cross-situational and temporal consistencies in passion and perseverance towards a long-term, overarching goal (for concerns regarding the internal structure and discriminant validity of grit, see Credé, Tynan, & Harms, 2017); and (ii) the *conceptual theme* relating to the scope of the goal, whereby mental toughness is concerned primarily with multiple subordinate goals (i.e., performance and process) that feed into superordinate goals, whereas grit is salient for superordinate goals (e.g., make the Olympic team). Of course, it is important to test whether constructs that can be distinguished conceptually are in fact empirically distinct in terms via test scores from their operationalisations.

**Conclusions**

When taking stock of scholarly work on mental toughness in sport and physical activity contexts, it is clear that the concept has garnered increased attention among researchers over the past two decades. Despite such widespread interest, the empirical study of mental toughness is relatively young and sparse, and no unifying conceptualisation currently exists. Broadly, it appears that most researchers have conceptualised mental toughness from their preferred conceptual model or substantive viewpoint. Scientific progress often benefits from divergent or event conflicting ideas about psychological phenomena, yet scholarly enthusiasm for mental toughness has evolved at a rate much quicker than the scientific evidence. Perhaps most salient for the current state of affairs, mental toughness research has progressed rapidly through the three phases of construct validation (Loevinger, 1957), with insufficient attention devoted to carving out the theoretical domain of the concept (i.e., definition) and its operationalisation through measurement (i.e., item indicators) during
the substantive phase. For example, it is difficult to draw a clear line between mental toughness as conceptualised within the 4Cs model (Clough et al., 2002) and the established construct of hardiness because they are so intertwined that no clear distinctions have been made between the concepts (for a scholarly debate, see Clough, Earle, Perry, & Crust, 2012; Gucciardi et al., 2012, 2013). Poorly defined concepts and inadequate indicators of their theoretical features undermine the value of subsequent inquiry because the results of such work are uninterpretable. Therefore, of critical importance for the next frontier of the scientific study of mental toughness is to enhance the precision of its definition and conceptual boundaries (e.g., discriminant validity evidence). I have offered a working definition of mental toughness as a starting point for this discussion (Gucciardi, 2017), which may be refined through systematic efforts to evaluate, interpret and integrate findings from past qualitative work; a Delphi study of academic experts and practitioners (Diamond et al., 2014); and case studies (Eisenhardt & Graebner, 2007). Suffice to say, the most pressing challenges that confront scholars interested in the science of mental toughness are conceptual in nature. Clarity regarding the substantive features of mental toughness and its definition are required before it can be operationalised with confidence through measurement, manipulation or intervention.
Mental toughness

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<td>2009</td>
<td>Andrew Levy</td>
<td>Mental toughness as determinant of beliefs, pain, and adherence in sport injury rehabilitation</td>
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<td>Cory Middleton</td>
<td>The Psychological Performance Inventory: Is the mental toughness test enough?</td>
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Note: QL = qualitative study; QN = quantitative study; C = conceptual paper/review; Int = intervention study
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<thead>
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<td>Jones et al. (2002, p. 209)</td>
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<td>Clough et al. (2002, p. 38)</td>
<td>Mentally tough individuals tend to be sociable and outgoing; as they are able to remain calm and relaxed, they are competitive in many situations and have lower anxiety levels than others. With a high sense of self-belief and an unshakeable faith that they control their own destiny, these individuals can remain relatively unaffected by competition or adversity.</td>
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<td>Thelwell et al. (2005, pp. 328-329)</td>
<td>Having the natural or developed edge that enables you to: (i) always [emphasis added], cope better than your opponents with the many demands (competition, training, lifestyle) that sport places on a performer; (ii) specifically, be more consistent and better than your opponents in remaining determined, focused, confident, and in control under pressure.</td>
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<td>Gucciardi et al. (2008, p. 278)</td>
<td>A collection of values, attitudes, behaviours, and emotions that enable you to persevere and overcome any obstacle, adversity, or pressure experienced, but also to maintain concentration and motivation when things are going well to consistently achieve your goals.</td>
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<td>Coulter et al. (2010, p. 715)</td>
<td>The presence of some or the entire collection of experientially developed and inherent values, attitudes, emotions, cognitions, and behaviours that influence the way in which an individual approaches, responds to, and appraises both negatively and positively construed pressures, challenges, and adversities to consistently achieve his or her goals.</td>
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<td>Middleton et al. (2011, p. 94)</td>
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<td>Madrigal, Hamill, &amp; Gill (2013, p. 63)</td>
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<td>Hardy et al. (2014, p. 70)</td>
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<td>A collection of reasonably stable, advantageous characteristics that facilitate positive responses to the demands and pressures of sport participation.</td>
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<td>Jaeschke, Sachs, &amp; Dieffenbach (2016, p. 251)</td>
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</table>
Figure 1. Peer-reviewed publications on mental toughness and the sum of their annual citations per year as indexed by Web of Science.
Appendix A – Mental Toughness Literature


# Appendix B – Chronology of Definitions of Mental Toughness

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