Denovan, A, Dagnall, N and Drinkwater, K

Examining what Mental Toughness, Ego Resiliency, Self-efficacy, and Grit measure: An exploratory structural equation modelling bifactor approach

Current Psychology (2023) 42:22148–22163
https://doi.org/10.1007/s12144-022-03314-5

Examining what Mental Toughness, Ego Resiliency, Self-efficacy, and Grit measure: An exploratory structural equation modelling bifactor approach

Andrew Denovan[1] · **Neil Dagnall**[2] · **Kenneth Drinkwater**[2]

Accepted: 5 June 2022 / Published online: 15 June 2022

Abstract
Despite conceptual similarities among the established non-cognitive constructs of Mental Toughness, Ego Resiliency, Self-efficacy, and Grit, preceding research typically considered these as adversary rather than complementary and potentially additive. Subsequently, comparatively few studies have examined these together. This paper, via two independent studies, examined commonality within Mental Toughness, Ego Resiliency, Self-efficacy, and Grit. This identified key elements that contribute to a broad, non-cognitive, resource-based construct. Study 1 ($N = 2137$) assessed shared variance among the non-cognitive constructs relative to a general factor. Study 2 ($N = 1148$) evaluated the replicability of the results from Study 1 and examined measurement invariance. Respondents completed established self-report measures indexing the study variables. Exploratory structural equation modelling bifactor analyses consistently revealed that Mental Toughness, the Ego-Resiliency Optimal Regulation subscale, and Self-efficacy loaded highly on a general factor, which the authors labelled as Non-Cognitive Adaptive Resourcefulness (NCAR). Invariance analyses supported the stability of this model across study context. This paper advanced conceptual understanding of the core shared features of independent non-cognitive constructs. The authors discuss the potential of NCAR and advocate the need for further research.

Keywords Non-cognitive skills · Mental Toughness · Ego Resiliency · Self-efficacy · Exploratory structural equation modelling

Introduction

In contrast to cognitive abilities, which are assessed by aptitude tests (i.e., intelligence scales), non-cognitive skills (e.g., attitudes, behaviours, and strategies such as perseverance, motivation, and self-control) are not directly related to intellectual capabilities (see Ren, Yu, & Yang, 2019). This distinction is useful, but misleading to the extent that non-cognitive skills inherently draw upon perceptive processes (Borghans et al., 2008). Scholars view non-cognitive skills as important because they positively influence performance in intrapersonal and interpersonal domains and can facilitate accomplishment across a range of real-world contexts (i.e., education, work, and sport) (Clough et al., 2016; Gutman & Schoon, 2013). Consequently, academic work into non-cognitive skills has burgeoned. This has identified several non-cognitive constructs (e.g., hardiness, resilience, mental toughness, and grit) and established that they are associated with psychological benefits such as stress resistance and reduced depression (Mojtahedi et al., 2021; Papageorgiou, Denovan, & Dagnall, 2019).

Despite this wealth of research, investigators have tended to focus on specific constructs and/or seen other non-cognitive skills as adversary rather than complementary and possibly additive (Fagioli, Baker, & Orona, 2020). Hence, relatively few studies have considered resilience and mental toughness in tandem. One notable example was Cowden, Meyer-Weitz, and Oppong Asante (2016), who examined whether conceptual overlap between the constructs (i.e., capacity to bounce back from or overcome stress and adversity) was conjunctively related to lower levels of stress in competitive South African tennis players. They found that

✉ Andrew Denovan
a.m.denovan@hud.ac.uk

[1] Department of Psychology, University of Huddersfield, Huddersfield HD1 3DH, UK

[2] Department of Psychology, Manchester Metropolitan University, Manchester, UK

while resilience and mental toughness were strongly positively correlated, they played discrete roles in stress management. Although investigations like this are potentially limited by context, the study findings indicate that consideration of non-cognitive skills in combination is merited and required for conceptual clarity and development.

Noting this, the present paper examined relationships between four frequently used constructs: mental toughness, grit, ego resiliency, and self-efficacy. Selection was informed by the observation that these non-cognitive skills are conceptually distinct but share core characteristics. Accordingly, the authors anticipated that construct scores would interact in complex, nuanced ways (Nicholls et al., 2015) and that consideration of similarities and dissimilarities would facilitate development of a broader, robust, adaptive non-cognitive construct. That is, one that enables coping with stress, pressure and adversity, assists functioning maintenance, and promotes performance across settings.

In this context, it is important to consider working operationalisations of mental toughness, grit, ego resiliency, and self-efficacy, and how these constructs are related, and the ways in which they proport to promote positive psychological outcomes. Although, definitions of mental toughness vary (see Gucciardi, 2017), the term generally signifies possession of a "psychological resource that is purposeful, flexible, and efficient in nature for the enactment and maintenance of goal-directed pursuits" (Gucciardi, 2017, p.18). Grit refers to perseverance and passion for long-term goals (Duckworth et al., 2007). Commensurate with this delineation, grit describes the capacity to actively sustain effort and interest over time despite encountering failures and barriers (Liang, 2021).

Ego resiliency describes an affect processing system. Precisely, the capacity to flexibly modify responses in accordance with changing situational demands, principally during emotionally challenging conditions (Block, 2002; Wang, Eisenberg, & Spinrad, 2019). This combines ego-control (inhibition or expression of impulses) and ego-resiliency (modification of impulses according to situation) (Block & Kremen, 1996; Smith, Barratt, & Hirvo, 2021). Commensurate with these delineations, ego-control is a meta-dimension of impulse regulation, and ego-resiliency is the facility to adjust level of control in accordance with situational demands (Letzring et al., 2005). Self-efficacy denotes belief in competency to achieve desired goals and is an important stress management resource (Bandura, 1997; Livinţi, Gunnesch-Luca, & Iliescu, 2021).

Despite sharing important properties, these constructs differ in important ways. For instance, mental toughness and grit are dispositionally dissimilar (Cormier et al., 2021). Grit is viewed as a stable personality construct (Postigo et al., 2021), whereas the stability of mental toughness is contentious (Bédard Thom, Guay, & Trottier, 2021). Debate on the nature of mental toughness stems from differing conceptualisations and measurement instruments, and from the questionable structural constancy of the widely used 4/6C model (Clough et al., 2002). Although the theoretical model is well established and supported by empirical work (e.g., Perry et al., 2021), several studies have reported poor model fit (Gucciardi et al., 2013) and/or observed contextual variations (i.e., as a function of sample; notably athlete and workplace).

Consequently, some theorists emphasize the state-like nature of mental toughness (Gucciardi et al., 2015), whereas others such as Strycharczyk and Clough (2014) view the construct as a 'plastic' (malleable) personality trait (Dagnall et al., 2021). The latter view reconciles evidence that components of mental toughness are genetic (Horsburgh et al., 2009; McAuley et al., 2022), with the observation that dimensions with the lowest heritability (i.e., Commitment and Control) respond to training. Noting that grit and mental toughness are related but distinct, studies in the area of sport report only low or moderate strength positive correlations between the constructs (e.g., Johnson, 2020; Scharneck, 2017). Illustratively, Joseph (2009) reported that mental toughness accounted for only 18% of the total variance in grit scores.

Studies have also investigated relationships between resilience and grit. Noting that the literature had produced contradictory evidence, Caza, Caza, and Baloochi (2020) undertook a meta-analysis examining associations between grit and trait resilience (i.e., hardiness), and individual-level outcomes indicative of resilient responses (e.g., growth and learning orientation). This was necessary because researchers often assume that grit and resilience are overlapping or similar constructs (Crawford-Garrett, 2018; Stoffel & Cain, 2016), or that grit is an antecedent of resilience (Shaw et al., 2016; Sanderson & Brewer, 2017). The observed pattern of correlations indicated that grit was neither a measure of trait resilience, nor consistently related to resilient outcomes. Based on these findings, Caza et al. (2020) concluded that the two were independent constructs.

Research investigating relationships between mental toughness and resilience supports the notion that the constructs are related but distinct. For example, Gucciardi, Gordon, and Dimmock (2009) found that components of mental toughness (i.e., thrive through challenge, sport awareness, tough attitude, and desire for success) were positively correlated (small to moderately) with dimensions of resilience (Control, Commitment, and Challenge). Gucciardi et al. (2009) contend that definitions of mental toughness that draw upon adverse experiences such as stress and adversity (e.g., Clough et al., 2002, Loehr, 1995) fail to recognise the true nature of the construct and accordingly, possess only limited power to discriminate from such constructs as resilience. This notion is

consistent with qualitative work by Gordon and Dimmock (2008). Investigating understanding of mental toughness in the context of Australian Football, Gucciardi, Gordon, and Dimmock (2008) observed that mental toughness was important to managing both negative (e.g., injury) and positive circumstances (e.g., good form).

Thus, delineations of mental toughness that focus on adversity and coping define the construct too narrowly and focus on elements encapsulated within resilience and hardiness (cf. Maddi, 2002; Nowack & Niemirowski, 2021). The key commonality being the ability to deal with and overcome situations with negative effects. The additional features of mental toughness being the facility to thrive in situations where there are positive effects and perceived "positive pressure". These qualities align more closely with grit, which emphasizes the psychological advantages of increased optimism and effective coping (Nicholls et al., 2008). Mental toughness as operationalised by Clough is also like trait resilience because both constructs draw on hardiness (Kobasa, 1979). Explicitly, Clough et al. (2002) added Confidence to the core facets of hardiness (Control, Commitment and Challenge), which are also used as a measure of trait resilience (Caza et al., 2020).

Noting relationships between independent non-cognitive skills, Nicholls et al. (2015) found that resilience and self-efficacy (alongside factors such as emotional intelligence and motivation) enabled mentally tough individuals to excel under stressful circumstances. Analysis revealed that mental toughness mediated the relationship between resilience and emotional intelligence and was a positive predictor of self-efficacy. Consistent with these outcomes, Nicholls et al. (2015) concluded that mental toughness helps to sustain or enhance self-belief in stressful or unfulfilling activities. Thus, they postulate that mental toughness facilitates self-efficacy. Self-efficacy appears to be an important stress management resource. According to Bandura (1997) self-efficacy denotes belief in competency to achieve desired goals (Szczuka et al., 2021). The positive relationship between mental toughness and self-efficacy provides support for the notion that mental toughness is associated with strong belief in ability (Clough, Earle, & Sewell, 2002; Gucciardi et al., 2008).

This supports the supposition that the presence of other constructs such as resilience and/or self-efficacy empower mentally tough individuals to excel under stressful circumstances. This postulation is consistent with the observation that possession of self-efficacy is associated with lower experience of stress (Meyer et al., 2022; Schwarzer & Hallum, 2008). Correspondingly, the inclusion of mental toughness within interventions could prove beneficial. At a general level, this suggests that the combining of non-cognitive skills could prove beneficial to both psychological outcomes and performance. Although, since the findings of Nicholls et al. (2015) derived from athletes, caution is required when extrapolating to other contexts.

The present study

Acknowledging that few previous studies have evaluated the complementary effects of non-cognitive skills, the present paper examined construct commonality and distinctiveness in two independent studies to identify key elements that contribute to a broad, non-cognitive skills, resource-based construct. Study 1 assessed shared variance among the non-cognitive constructs relative to a general underlying non-cognitive factor. Study 2 replicated the results of Study 1, and additionally tested for measurement invariance. This was important to examine if sample differences occurred for the items utilised to infer the underlying non-cognitive construct, in an unrelated way to participants' actual scores on the construct. If invariance exists, then both samples associate the same items with the same underlying construct irrespective of factors including context and time (Tadesse, Gillies, & Campbell, 2018).

This research was necessary because current general perceptions of non-cognitive skills are incorrect to the extent that some researchers and practitioners wrongly view different non-cognitive skills as synonymous, or alternatively regard one construct as exclusively more beneficial than the others. These perceptions indicate that outside of informed research commonality between different non-cognitive skills is often misunderstood and unappreciated.

Study 1

Materials and Methods

Sample

Study 1 comprised 2137 UK respondents, *M*age = 39.66 years, *SD* = 14.65, range 18–89. In terms of gender, there were 1548 females, *M*age = 38.06 years, *SD* = 13.73, range 18–89, and 574 males, *M*age = 44.25 years, *SD* = 16.01, range 18–88. Fifteen identified as non-binary, *M* = 28.26 years, *SD* = 11.02, range 18–52. The racial composition was majority white (80% White; 11% Black; 6% Asian; 3% Other). Initially, 2300 respondents were invited to participate (response rate of 92%). Recruitment occurred through Qualtrics, an online data collection platform. Qualtrics gathers data from recruitment panels that are made up of a pre-arranged pool of individuals consenting to respond to research-based surveys. Respondents received a small compensation fee for taking part. To obtain a representative sample, the only exclusion criteria was participants under

18 years of age. Gathering data via participant recruitment panels typically results in a more diverse sample than traditional student samples. This advantage does not impede quality and resultant samples are often comparable with traditional samples in terms of demographics and responses to established measures (Kees et al., 2017).

Measures

Mental toughness The Mental Toughness Questionnaire (MTQ-48) was developed by Clough et al. (2002). It contains 48-items and comprises four main factors Challenge, Commitment, Control, and Confidence, which collectively assesses the ability to effectively manage stress and rebound following setbacks. The current study used the abridged ten-item version the MTQ10. This was designed for use in large test batteries where mental toughness is one of several constructs under consideration, testing time is constrained, and overall study length may place a cognitive burden on respondents. The MTQ10 was used in preference to the original shortened MTQ18 measure because it is a superior unidimensional measure of mental toughness.

The MTQ10 comprises the highest line-adding items from Challenge, Commitment, Control, and Confidence. Within the MTQ measures, items are presented as statements (e.g., "I generally cope well with any problems that occur") and respondents indicate their level of agreement on a five-point Likert ranging from 1 = "strongly disagree" and 5 = "strongly agree". Summation of items produces an overall score, with high scores indicating greater levels of mental toughness. The MTQ10 has demonstrated good psychometric integrity (i.e., reliability and validity) (see Papageorgiou et al., 2018; Dagnall et al., 2019).

Grit The Short Grit Scale (Grit-S; Duckworth & Quinn, 2009) is an 8-item instrument that assesses perseverance and passion for long-term goals. The Grit-S comprises two dimensions, Consistency of Interest (CI) and Perseverance of Effort (PE). CI denotes inclination to adopt a similar level of interest over a sustained period. PE represents the degree to which durable effort is exerted when facing challenges. Example items respectively are "I often set a goal but later choose to pursue a different one" and "I finish whatever I begin". Respondents specify their level of endorsement on a 5-point Likert scale ranging from 1 ("not like me at all") to 5 ("very much like me"). Average item scores locate respondents on a dimension between 1 ("lacking grit") to 5 ("extremely gritty"). Psychometric assessment of the Grit-S has established that the overall measure has validity (construct, predictive and criterion) and reliability (internal consistency and test-retest) (see Duckworth & Quinn, 2009). Consequently, each factor possesses high internal consistency (Duckworth et al., 2007; Duckworth & Quinn, 2009). Moreover, studies evidence positive relationships between grit and conscientiousness and attainment.

Ego Resiliency The Ego Resiliency Scale (ER89) was developed by Block and Kremen (1996). The measure conceptualises ego resiliency as a central personality construct for understanding motivation, emotion, and behaviour. Explicitly, as a general disposition, rather than as a direct response to stressors. Thus, ego resiliency represents the ability to self-regulate dynamically and appropriately and adapt quickly to changing circumstances (Block & Kremen, 1996). The focus of the ER89 is mainly on flexibility, curiosity, generosity and social skills. The present study used the ER89-R, which is a 10-item adaption of the original measure. This comprises a higher-order model in which a second-order factor, representing ego-resiliency, affects two first-order components Optimal Regulation (OR) and Openness to Life Experience (OL) (Alessandri et al., 2012). Broadly OR resembles Confidence, Optimism, Insight, and Warmth, and OL Productive Activity and Skilled Expressiveness (Vecchio et al., 2019). Responses were made on a four-point response scale (1 = "does not apply at all" to 4 = "applies very strongly"). The ER89-R in its various forms has demonstrated good psychometric properties.

Self-efficacy The General Self-Efficacy Scale (GSES) (Schwarzer & Jerusalem, 1995) is an established measure of positive self-belief about the ability to cope with life demands. Specifically, perceived personal competence to manage stressful situations. The GSES comprises 10-items, which appear as statements. Respondents indicate agreement on a 4-point Likert-scale ranging from 1 ("not at all true") to 4 ("exactly true"). The GSES has demonstrated validity and reliability.

Procedure and Ethics

Participants accessed the Participant Information Sheet (PIS) through a web-link. This detailed the background of the study before seeking informed consent. Consenting participants then proceeded to the instructions, which encouraged truthful and open responses. The study materials included sections on demographics (i.e., age, preferred gender) and the non-cognitive questionnaires. Participants were debriefed after taking part.

To limit potential data contaminating factors, procedural remedies were implemented. Specifically, rotation of scales and items occurred to avoid order effects, and to limit social desirability participants were informed that no right or wrong answers existed. The study gained ethical approval

from the Manchester Metropolitan University Faculty of Health, Psychology and Social Care Ethics Committee.

Analysis

Bifactor modelling (Rodriguez et al., 2016a/2016b) examined the degree to which multidimensionality existed within items, and concurrently indicated the composition and nature of items loading strongly on a general non-cognitive factor. The advantage of bifactor modelling is that it specifies systematic item variance in relation to an overall factor and sources of additional variance (i.e., specific bifactors). Additionally, analyses employed exploratory structural equation modelling (ESEM) to verify the effect of items across factors by permitting cross-loading and not constraining non-target loadings to zero (Marsh et al., 2010). The authors applied target rotation by assigning zero loadings to bifactor items that did not belong to the scale in relation to the bifactor structure, while allowing other items to be free (Schonfeld, Verkuilen, & Bianchi, 2019).

Model fit was assessed by chi-square, Comparative Fit Index (CFI), Standardized Root-Mean-Square Residual (SRMR), and Root-Mean-Square Error of Approximation (RMSEA). Good fit thresholds for these indices are CFI ≥ .95, SRMR ≤ .08 and RMSEA ≤ .08 (Hu & Bentler, 1995). Interpretation also used the bifactor specific indices of Rodriguez et al. (2016a, 2016b) at the factor, model, and item levels. Coefficient omega determined scale reliability, and hierarchical omega (ω_h) indicated quantity of total scores attributable to a general factor.

Higher construct replicability (i.e., H > 0.80) and factor determinacy (i.e., FD > 0.90) for the general factor, alongside greater relative omega compared with the specific bifactors, inferred that a construct should be considered at the total score level rather than a sub-scale or specific bifactor level. However, since the focus of this study was exploratory, the authors do not advocate formation of sum scores for competing scale items.

Explained Common Variance (ECV), with values >0.60 alongside $\omega_h > 0.70$ was suggestive of unidmensionality (Reise, Bonifay & Haviland, 2013). Analyses considered Item Explained Common Variance (IECV), which indicates how representative an item is of a component (Stucky & Edelen, 2015). Values >0.5 suggest that an item is more indicative of the general factor than a specific bifactor (Winebrake et al., 2021). Inter-factor correlations >.10, >.30, and > .50 specified small, medium, and large effect sizes (Cohen, 1992).

Study 1 Results

Descriptive statistics

Skewness and kurtosis values were in the recommended range − 2 to +2 (Byrne, 2010) (Table 1). Correlation analyses revealed Mental Toughness exhibited moderate to large correlations with all observed variables. Similar results occurred for Ego-Resiliency dimensions (Openness to Life Experiences and Optimal Regulation), Self-Efficacy, and the Perseverance of Effort subscale of Grit. However, the other Grit subscale, Consistency of Interest was only weakly correlated with Openness to Life Experiences, Optimal Regulation, and Self-efficacy (yet moderately correlated with Mental Toughness).

Bifactor ESEM analyses

The bifactor model (computed via Mplus 8.1; Muthén & Muthén, 2018) demonstrated good fit overall, χ^2 (456) = 1439.512, $p < 0.001$, CFI = 0.971, RMSEA = 0.032 (0.030, 0.034), SRMR = 0.017. See Table 2 for target-rotated standardized loadings and IECVs (alongside mean IECVs for convenience). Hierarchical omega (ω_h) for the general non-cognitive factor was 0.834 alongside an ECV of 0.559. The latter implied multidimensionality, even though high total reliability exists. However, ECV specified that the majority of total variance was attributable to the general factor (i.e., > 0.5; Deutscher et al., 2021). High relative omega (0.887), FD (0.954) and H (0.933) scores were also observed (i.e., below 0.9 for the specific bifactors).

Table 1 Descriptive statistics and correlations among Study 1 variables

Variable	*M*	*SD*	Skew.	Kurt.	1	2	3	4	5	6
1. Mental Toughness	31.209	6.744	−0.218	0.286						
2. Openness to Life Experiences	10.854	2.858	−0.192	−0.530	0.293**					
3. Optimal Regulation	16.407	3.339	−0.014	−0.263	0.513**	0.519**				
4. Self-efficacy	29.034	5.486	−0.518	0.826	0.642**	0.454**	0.586**			
5. Consistency of Interest	12.413	3.415	−0.194	−0.159	0.368**	−0.117**	0.015	0.104**		
6. Perseverance of Effort	14.320	3.019	−0.187	−0.048	0.481**	0.306**	0.465**	0.524**	0.191**	

**$p < 0.001$

Table 2 Bifactor ESEM factor loadings and Item Explained Common Variance (IECV) for Study 1

Scale	Sub-scale	Item	General factor	Bifactor						Mean IECV
				MTQ10	OL	OR	GSES	CI	PE	IECV	
MTQ10		Even when under considerable pressure I usually remain calm	0.667	0.261						0.867	0.925
		I tend to worry about things well before they actually happen	0.431	0.133						0.913	
		I usually find it hard to summon enthusiasm for the tasks I have to do	0.456	−0.083						0.968	
		I generally cope well with any problems that occur	0.719	0.136						0.965	
		I generally feel that I am a worthwhile person	0.668	−0.230						0.894	
		"I just don't know where to begin" is a feeling I usually have when presented with several things to do at once	0.488	0.116						0.947	
		When I make mistakes, I usually let it worry me for days after	0.413	0.146						0.889	
		In discussions, I tend to back-down even when I feel strongly about something	0.687	−0.247						0.886	
		I generally feel in control	0.587	0.073						0.985	
		I often wish my life was more predictable	0.695	−0.178						0.938	
ER89-R	OL	I like to do new and different things.	0.134		0.659					0.040	0.257
		I am more curious than most people.	0.543		0.485					0.556	
		I like to take different paths to familiar places.	0.223		0.584					0.127	
		I enjoy trying new foods I have never tasted before.	0.365		0.553					0.303	
	OR	I get over my anger at someone reasonably quickly.	0.205			0.502				0.143	0.576
		My daily life is full of things that keep me interested.	0.411			0.237				0.750	
		I usually think carefully about something before acting.	0.237			0.249				0.475	
		Most of the people I meet are likable.	0.373			0.383				0.487	
		I quickly get over and recover from being startled.	0.545			0.275				0.797	
		I am generous with my friends.	0.437			0.215				0.805	
GSES		I can always manage to solve difficult problems if I try hard enough.	0.477				0.472			0.505	0.592
		If someone opposes me, I can find the means and ways to get what I want.	0.317				0.357			0.441	
		It is easy for me to stick to my aims and accomplish my goals.	0.541				0.326			0.734	
		I am confident that I could deal efficiently with unexpected events.	0.654				0.398			0.730	
		Thanks to my resourcefulness, I know how to handle unforeseen situations.	0.602				0.450			0.642	
		I can solve most problems if I invest the necessary effort.	0.490				0.540			0.452	
		I can remain calm when facing difficulties because I can rely on my coping abilities.	0.651				0.396			0.730	
		When I am confronted with a problem, I can usually find several solutions.	0.565				0.467			0.594	
		If I am in trouble, I can usually think of a solution.	0.540				0.580			0.464	
		I can usually handle whatever comes my way.	0.617				0.478			0.625	

Table 2 (continued)

Scale	Sub-scale	Item	General factor	Bifactor						IECV	Mean IECV
				MTQ10	OL	OR	GSES	CI	PE		
Grit-S	CI	I often set a goal but later choose to pursue a different one	0.208					0.644		0.094	0.162
		I have been obsessed with a certain idea or project for a short time but later lost interest	0.292					0.644		0.171	
		I have difficulty maintaining my focus on projects that take more than a few months to complete	0.232					0.631		0.119	
		New ideas and projects sometimes distract me from previous ones	0.383					0.639		0.264	
	PE	I finish whatever I begin	0.482						0.395	0.598	0.451
		Setbacks don't discourage me	0.547						0.223	0.857	
		I am diligent	0.304						0.679	0.167	
		I am a hard worker	0.338						0.720	0.181	

MTQ10 = Mental Toughness, ER89-R = Ego Resiliency, OL = Openness to Life Experiences, OR = Optimal Regulation, GSES = Self-efficacy, CI = Consistency of Interest, PE = Perseverance of Effort

Moreover, although coefficient omega was acceptable for each bifactor (Mental Toughness $\omega = 0.845$, Openness to Life Experiences $\omega = 0.757$, Optimal Regulation $\omega = 0.651$, Self-efficacy $\omega = 0.910$, Consistency of Interest $\omega = 0.793$, Perseverance of Effort $\omega = 0.768$), relative omega ranged from low to fairly low for Mental Toughness (0.001), Optimal Regulation (0.415) and Self-efficacy (0.401). This suggested that bifactors possessed a minimal amount of variance independent of the general factor.

Furthermore, Mental Toughness items loaded more highly on the general non-cognitive factor than the specific bifactor (mean loading of 0.581 vs. 0.013). Similarly, a higher average loading on the general non-cognitive factor existed for Optimal Regulation (0.368 vs. 0.310) and Self-efficacy (0.545 vs. 0.446). IECV and mean IECV for these constructs indicated that the scale items were essentially unidimensional indicators of a general non-cognitive factor. Specifically, 77% of items possessed IECV values above 0.5 (Hammer and Toland, 2017). Contrastingly, the Openness to Life Experiences and Grit items demonstrated lower IECV values (25% of items reflected IECV above 0.5). Additionally, a higher average factor loading existed for each of these bifactors compared with the general factor (Openness to Life Experiences 0.570 vs. 0.316, Consistency of Interest 0.640 vs. 0.279, Perseverance of Effort 0.504 vs. 0.418).

Rerunning the analysis without Openness to Life Experiences and Grit bifactors (Table 3) clarified the solution. Notably, produced an improved ECV of 0.719 and a greater mean IECV for Mental Toughness (0.730), Optimal Regulation (0.679), and Self-efficacy (0.678). Good model fit existed, χ^2 (225) = 1049.359, $p < 0.001$, CFI = 0.964, RMSEA = 0.041 (0.039, 0.044), SRMR = 0.022. Items loaded more highly on the general factor and to a similar degree as in the first analysis (general factor average loading = 0.533; Mental Toughness average loading = 0.188; Optimal Regulation average loading = 0.260; Self-efficacy average loading = 0.393). A similar ω_h of 0.841 existed in addition to high relative omega (0.900), H (0.930) and FD (0.950) for the general factor. Though, relative omega remained low for Mental Toughness (0.104), Optimal Regulation (0.277), and Self-efficacy (0.315) signifying that these items loaded substantially on the general non-cognitive factor. This model was the most suitable representation of shared variance among the non-cognitive constructs (due to less redundancy among the bifactors) and was taken forward to Study 2 for replication.

Inter-factor correlations in the context of the bifactor model were low albeit significant. Explicitly, Mental Toughness and Optimal Regulation $r = 0.175$; Mental Toughness and Self-efficacy $r = 0.201$; Optimal Regulation and Self-efficacy $r = 0.119$.

Table 3 Bifactor ESEM factor loadings and Item Explained Common Variance (IECV) for analysis without Openness to Life Experiences and Grit scales for Study 1

Scale	Sub-scale	Item	General factor	Bifactor				Mean IECV
				MTQ10	OR	GSES	IECV	
MTQ10		Even when under considerable pressure I usually remain calm.	0.711	−0.086			0.986	0.730
		I tend to worry about things well before they actually happen.	0.350	0.581			0.266	
		I usually find it hard to summon enthusiasm for the tasks I have to do.	0.357	0.391			0.455	
		I generally cope well with any problems that occur.	0.761	−0.072			0.991	
		I generally feel that I am a worthwhile person.	0.661	0.004			1.000	
		"I just don't know where to begin" is a feeling I usually have when presented with several things to do at once.	0.387	0.475			0.399	
		When I make mistakes, I usually let it worry me for days after.	0.331	0.547			0.268	
		In discussions, I tend to back-down even when I feel strongly about something.	0.669	0.089			0.983	
		I generally feel in control.	0.633	−0.118			0.966	
		I often wish my life was more predictable.	0.683	0.073			0.989	
ER89-R	OR	I get over my anger at someone reasonably quickly.	0.196		0.224		0.434	0.679
		My daily life is full of things that keep me interested.	0.578		0.448		0.625	
		I usually think carefully about something before acting.	0.447		0.181		0.859	
		Most of the people I meet are likable.	0.278		0.347		0.391	
		I quickly get over and recover from being startled.	0.547		0.143		0.936	
		I am generous with my friends.	0.472		0.215		0.828	
GSES		I can always manage to solve difficult problems if I try hard enough.	0.531			0.409	0.628	0.678
		If someone opposes me, I can find the means and ways to get what I want.	0.366			0.316	0.573	
		It is easy for me to stick to my aims and accomplish my goals.	0.534			0.324	0.731	
		I am confident that I could deal efficiently with unexpected events.	0.680			0.358	0.783	
		Thanks to my resourcefulness, I know how to handle unforeseen situations.	0.645			0.404	0.718	
		I can solve most problems if I invest the necessary effort.	0.539			0.486	0.552	
		I can remain calm when facing difficulties because I can rely on my coping abilities.	0.683			0.321	0.819	
		When I am confronted with a problem, I can usually find several solutions.	0.597			0.428	0.661	
		If I am in trouble, I can usually think of a solution.	0.582			0.493	0.582	
		I can usually handle whatever comes my way.	0.649			0.395	0.730	

MTQ10 = Mental Toughness, ER89-R = Ego Resiliency, OR = Optimal Regulation, GSES = Self-efficacy

Conclusion

Mental Toughness, Self-efficacy and the Optimal Regulation subscale of Ego Resiliency formed a general non-cognitive construct. Grit and Openness to Life Experiences failed to load strongly on the emergent non-cognitive factor.

Study 2

Materials and Methods

Sample

Study 2 included 1148 UK participants, *M*age = 38.14 years, *SD* = 10.34, range 18–84. Gender composition included 717

females, *M*age = 36.91 years, *SD* = 9.69, range 18–66, and 431 males, *M*age = 40.17 years, *SD* = 11.06, range 18–84. Ethnicity was majority white (84% White; 8% Black; 5% Asian; 3% Other). 1300 participants were invited (response rate of 88%). Recruitment occurred via Qualtrics, as with Study 1.

Measures and Procedure

To replicate the ESEM bifactor analysis from Study 1, the same measures of Mental Toughness (MTQ10), Ego Resiliency (ER89-R), and Self-efficacy (GSES) were administered to participants. The procedure for Study 2 was identical to Study 1 and received ethical approval from the same institutional board (the Manchester Metropolitan University Faculty of Health and Social Care Ethics Committee).

Analysis

The same initial analytic steps occurred as with Study 1, examining correlations before conducting bifactor ESEM. In addition, tests of configural, metric and scalar invariance (comparing Study 1 vs. 2) occurred. CFI changes ≤ .01 alongside RMSEA differences ≤ .015 are acceptable (Chen, 2007). With large samples, chi-square is not recommended as an index for invariance (Brown, 2006). Comparison of latent factor means occurred between Sample 1 and 2.

Study 2 Results

Descriptive statistics

Acceptable skewness and kurtosis values existed (Table 4). Large correlations occurred between Mental Toughness, Optimal Regulation, and Self-Efficacy.

Bifactor ESEM analyses

Replication and analysis of the ESEM bifactor model comprising Mental Toughness, Self-efficacy, and Optimal Regulation reported good fit, $\chi 2\ (225) = 972.758$, $p < 0.001$, CFI = 0.932, RMSEA = 0.054 (0.050, 0.057), SRMR = 0.030. Hierarchical omega (ω_h) for the general non-cognitive factor was 0.800 with ECV of 0.717. High relative omega (0.874), FD (0.944) and H (0.919) scores occurred. As with Study 1, coefficient omega was acceptable for each bifactor (Mental Toughness $\omega = 0.735$, Optimal Regulation $\omega = 0.672$, Self-efficacy $\omega = 0.907$), yet relative omega was low across Mental Toughness (0.341), Optimal Regulation (0.005), and Self-efficacy (0.317). Moreover, relatively higher loadings existed for the general factor vs. the specific bifactors (Fig. 1), and mean IECV indicated support for a general non-cognitive factor (i.e., Mental Toughness = 0.615, Optimal Regulation = 0.984, Self-efficacy = 0.686). Low (but significant) inter-factor correlations existed, Mental Toughness and Optimal Regulation $r = 0.177$; Mental Toughness and Self-efficacy $r = 0.284$; Optimal Regulation and Self-efficacy $r = 0.100$.

Invariance analysis

Invariance tests comparing Study 1 and 2 samples revealed good fit at the configural level (Table 5). Progression from the test of form (configural) to factor structure (metric) reported satisfactory CFI difference (0.008) and no RMSEA change. Comparing metric and scalar models reported a satisfactory CFI and RSMEA difference (0.010 and 0.003). This suggested the bifactor ESEM solution was acceptably invariant across study sample.

Latent mean comparison (with Study 1 as the reference group fixed to zero) indicated that freely estimated means for Study 2 were significantly higher for Mental Toughness ($M = 0.286$, $p < .001$, Cohen's $d = 0.330$), Optimal Regulation ($M = 0.987$, $p < .001$, $d = 1.514$), and Self-efficacy ($M = 0.812$, $p < .001$, $d = 0.334$). For the general factor, a non-significant difference emerged ($M = 0.028$, $p = .419$, $d = 0.030$).

Conclusion

The bifactor ESEM model supported a general non-cognitive factor underlying Mental Toughness, Optimal Regulation, and Self-efficacy (as with Study 1), and findings indicated satisfactory invariance of this model across Study 1 and 2 samples.

Overall Discussion

Aside from the Grit subscale Consistency of Interest in Study 1, analysis found moderate to large correlations among non-cognitive measures across both independent studies. These relationships represent stronger effect sizes when Gignac and Szodorai's (2016) guidelines for individual differences

Table 4 Descriptive statistics and correlations among Study 2 variables

Variable	*M*	*SD*	Skew.	Kurt.	1	2	3
1. Mental Toughness	32.233	5.314	−0.212	0.717			
2. Optimal Regulation	17.061	3.315	−0.526	0.622	0.511**		
3. Self-efficacy	29.985	5.587	−0.585	0.957	0.601**	0.642**	

**$p < 0.001$

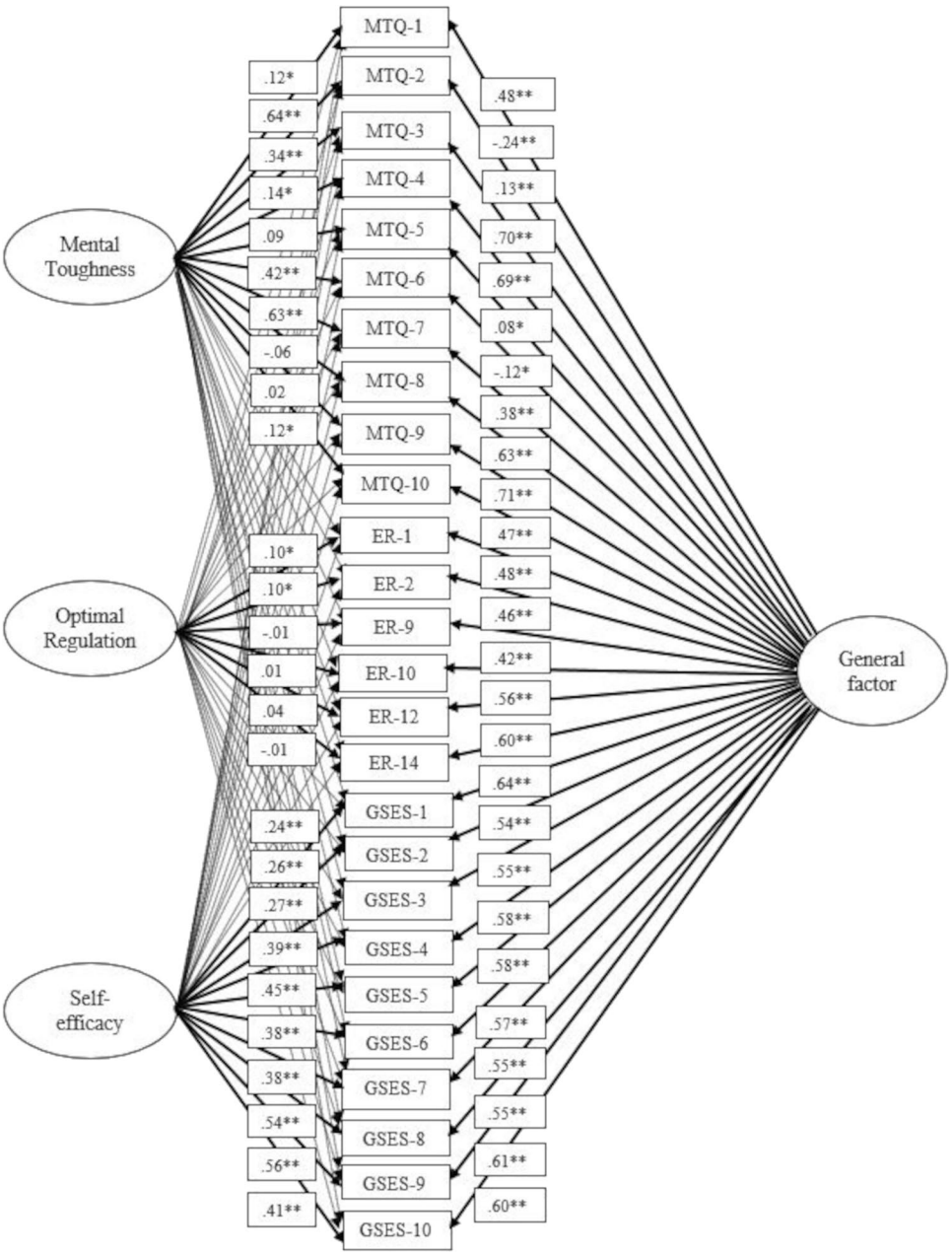

Fig. 1 Bifactor ESEM solution. *Note*. Latent variables are represented by ellipses; measured variables are represented by rectangles; error is not shown, but was specified for all variables. Bold arrows depict target loadings; faded arrows depict cross-loadings. Only standardized factor loadings for target items are shown. * $p < .05$; ** $p < .001$

Table 5 Fit indices for invariance models

Model	χ^2	*df*	CFI	CFI difference	SRMR	RMSEA (90% CI)	RMSEA difference
Configural	2022.117**	450	0.954		0.025	0.046 (0.044-0.048)	
Metric	2377.982**	538	0.946	.008	0.035	0.046 (0.044-0.048)	None
Scalar	2723.739**	560	0.936	.010	0.038	0.049 (0.047-0.050)	0.003

χ^2 = chi-square; *df* = degrees of freedom; CFI = Comparative Fit Index; SRMR = Standardized Root-Mean-Square Residual; RMSEA = Root-Mean-Square Error of Approximation; **χ^2 significant at $p < .001$

researchers are applied (small ≥ .10, moderate, ≥ .20, and large ≥0.30). Generally, results aligned with prior research. Explicitly, the observed moderate relationships between Mental Toughness and Grit subscales were like those reported by Johnson (2020). Although, Scharneck (2017) reported a low correlation this is likely an artefact arising

from the use of total Grit scores. Regarding Consistency of Interest (i.e., inclination to adopt a similar level of interest over a sustained period), subsequent studies should assess why this factor is less strongly related to Ego-Resiliency and Self-efficacy than Perseverance of Effort (i.e., exertion of durable effort when facing challenges).

Moreover, moderate correlations between Perseverance of Effort and Ego Resiliency subscales concurs with Meyer et al. (2020), who also found weaker correlations between resilience and Consistency of Interest, as with Study 1. This latter outcome requires cautious interpretation because Meyer et al. (2020) used a different resilience measure (the Connor-Davidson Resilience Scale; CD-RISC; Connor & Davidson, 2003). The CD-RISC defines resilience as a measure of stress coping ability, whereas the ER89 delimits ego resiliency as adaptability, explicitly the tendency to resist anxiety and to engage positively with the world. Although, ER89 measures are often used to assess resiliency some critics contend that ego resiliency is only one of the dispositional, protective factors involved in resilient outcomes (Windle, Bennett, & Noyes, 2011). This methodological issue is not particular to this paper, it is a common difficulty that arises from different conceptualisations of resilience as evidenced by the existence of myriad measurement instruments and the fact that there is no current 'gold standard' index of the construct (Windle, Bennett, & Noyes, 2011).

Consistent with Gucciardi et al. (2009), small to large correlations existed between Mental Toughness and Ego Resiliency. Openness to Life Experiences exhibited a small relationship, whereas Optimal Regulation was strongly related. This pattern of associations probably arises because the Optimal Regulation subscale most closely aligns with the stress management aspect of Ego Resiliency, and the MTQ10 focuses on coping with adverse experiences (i.e., the ability to effectively manage stress and rebound following setbacks) (Gucciardi et al., 2009).

The moderate to large relationships between Self-efficacy, Mental Toughness and Resilience concurs with Nicholls et al. (2015). Similarly, De La Cruz et al. (2021) reported a moderate positive correlation between Grit and Self-efficacy. However, this investigation assessed Grit at the total level and used the Exercise Self-efficacy Questionnaire (Marcus et al., 1992). Hence, it is difficult to extrapolate the finding to Grit subscales and general self-efficacy. From a conceptual perspective, both Perseverance of Effort and Self-efficacy embody the pursuit of goals in the face of obstacles and therefore as observed in this paper should share at least moderate variance.

In contrast, as discussed earlier, Consistency of Interest indexes proclivity to maintain interests for a lengthy period of time. This focus on individual goals can produce inconsistent outcomes when respondents prioritise objectives that are congruent with others rather than their own dispositions and preferences (Datu, Valdez, & King, 2016). Datu et al. (2016) found this was the case in the Philippines, which is a collectivist culture. In such societies, adherence to personal predilections is non-adaptive because there is a greater need for flexibility and individual consistency is therefore less important. A further manifestation of differences in collective (vs. Western) cultures is greater tolerance of contradictory beliefs and attitudes. This dialectical cognitive style contrasts with the Western preference for consistent self-belief and perceptions (Choi & Choi, 2002).

The results of ESEM bifactor analysis indicated that items from the MTQ10, Optimal Regulation subscale, and Self-Efficacy loaded on a general factor. Consideration of the highest loading items revealed that they referenced stress coping, resourcefulness, and general performance. For instance, MTQ10 item 1 ("Even when under considerable pressure I usually remain calm"), MTQ10 item 4 ("I generally cope well with any problems that occur"), Optimal Regulation item 2 ("I quickly get over and recover from being startled"), and Self-efficacy item 7 ("I can remain calm when facing difficulties because I can rely on my coping abilities").

The coalescence of Mental Toughness and Optimal Regulation reflects the fact that both constructs tap the capacity to deal with and overcome adverse situations. Additionally, Mental Toughness, like Self-efficacy, is associated with strong belief in ability (Clough et al., 2002; Gucciardi et al., 2008) and comprises aspects of confidence. Optimal Regulation too encompasses related elements of self-belief and optimism in its definition (Klohnen, 1996), and Self-efficacy is consistently linked with stress coping (Schwarzer & Hallum, 2008), suggesting that a shared relationship with Mental Toughness and Ego Resiliency that originate from stress coping conceptualisations is likely. However, the current paper advanced understanding of where these shared features exist (specifically in the aspects/items more indicative of stress coping, resourcefulness, and performance across contexts).

In addition, satisfactory invariance existed when comparing Study 1 and 2 samples. This, to a degree, supports the stability of the model across study context and suggests both samples associated the same items with the same underlying construct, and the differences in latent means can be attributed to actual mean variation as opposed to artefacts of measurement (Tadesse et al., 2018).

This overlap potentially infers the existence of an underlying construct, which the authors label as Non-Cognitive Adaptive Resourcefulness (NCAR). The term 'resourcefulness' represents the capacity to manage demands and draw on personal resources to overcome obstacles (Zauszniewski, 2016), whereas 'adaptive' captures the notion of flexibility and ability to recover. Admittedly this is the first paper to

identify and label shared variance among the non-cognitive constructs. Therefore, it would be useful in subsequent research to develop a standardised measure and examine if NCAR is a viable construct.

Overlap among constructs highlights common features and indicates unique construct components. In combination this process deepens understanding and appreciation of discrete non-cognitive skills and explicates why apparently similar constructs are only low to moderately correlated. Explicitly, variable-centred analyses (*i.e.*, Pearson correlation) includes items that relate less strongly to the shared relationships, which weaken the overall relations. Example items include "Most of the people I meet are likeable" (Optimal Regulation item 3), which exhibited a relatively low loading on the general factor across studies.

Openness to Life Experiences and Grit failed to load strongly on the general factor in Study 1. Regarding Openness to Life Experiences, this is because the dimension references exclusive properties (i.e., productive activity and skilled expressiveness) (see Klohnen, 1996). In the case of Grit, this is possibly attributable to the fact that Consistency of Interest comprises mainly negatively keyed items. Within the psychometric literature there is considerable debate about the usefulness of reversed statements. Although they are frequently included to counter response bias, critics contend that they are problematic. Specific concerns focus on the fact that negative items are difficult to comprehend and that responses are often difficult to interpret (Sonderen et al., 2013). For instance, lacking confidence in a specific situation does not necessarily generalise to other or all contexts.

For these reasons, participants respond differently to negative (vs. positive) items. This is evidenced by the fact that positive item totals typically produce higher scores than negative following inversion. Furthermore, reversed items often demonstrate lower reliability and weaker item-to-total correlations than positive-worded counterparts (Benson & Hocevar, 1985; Cronbach, 1942). Thus, although both item sets reference the same construct endorsement differs (Salazar, 2015; Weems et al., 2003). Moreover, when several co-occurring negative items exist (as with Consistency of Interest) they tend to intercorrelate because respondents perceive them as similar during survey completion (Weijters, Geuens, & Schillewaert, 2009). Consistent with this notion, reversed items have often proved difficult to accommodate within factorial models; negatively phrased items regularly load on a separate factor (see Benson & Hocevar, 1985; Herche & Engelland, 1996). This was evident in this study by the relatively high loadings of Consistency of Interest items on the specific bifactor (from 0.631 to 0.644) compared with the general factor (0.208 to 0.383). In addition, negatively keyed Mental Toughness items (2, 3, 6, 8) loaded consistently lower on the general factor across studies.

For Perseverance of Effort in Study 1, this was close to an acceptable average IECV of 0.5. However, the items "I am diligent" and "I am a hard worker" resulted in a low IECV, and reflected a deviation in focus (*i.e.*, conscientiousness) in comparison with the general factor.

Overall, the existence of a general factor underlying Mental Toughness, Optimal Regulation, and Self-efficacy is at odds with the prevailing view within some of the research literature that these represent distinct constructs. Instead, this study identified shared features indicative of adaptability and resourcefulness. However, the degree to which NCAR represents a viable construct is uncertain until additional corroborating evidence is attained.

Limitations

The ESEM approach has methodological strengths. Precisely, it enables the identification of methodological artefacts of questionnaire design that, in addition to the general non-cognitive construct, produce item covariance. For instance, the negatively keyed Consistency of Interest items loaded together due to local dependence. Moreover, target rotation provides a principled means of assessing dimensionality, and ECV and IECV afford useful measures for this focus.

Despite the strengths of advanced factor analytic techniques, the present study has limitations. Firstly, the study only used single measures of each non-cognitive construct. The inclusion of further measures is desirable as it permits examination of variable convergence. For example, Meyer et al. (2020) used the CD-RISC (Connor & Davidson, 2003) alongside resilience and grit. An allied concern relates to the type of measures used. To limit respondent burden and assess the breadth of non-cognitive skills this investigation used abridged instruments such as the MTQ10. The use of longer measures would potentially have added additional variance to the emergent construct. Concomitantly, this paper used only precise instruments. Hence, subsequent analysis alongside longer measures would be useful. Moreover, generalizing the findings to non-Western populations is difficult given the measures were constructed with Western samples and this research utilised such a sample.

Another limitation was the cross-sectional design. Since data was collected at one point in time it is not possible to infer causation. Accordingly, ensuing work should employ longitudinal approaches as these will facilitate consideration of construct stability. Moreover, it would be useful to examine whether the construct of Hardiness additionally aligns with NCAR. This is important given this conceptually shares qualities with Mental Toughness, Optimal Regulation, and Self-efficacy, including stress resistance and adaptability (Caza et al., 2020).

Lastly, the paper benefitted from access to two large, fairly representative samples. Satisfactory replication of the results provides some indication that the emergent construct is not an artefact of the Study 1 context. This is significant because lack of invariance has proved an issue with non-cognitive skills measures (e.g., Gucciardi, Hanton, & Mallett, 2012; Perry et al., 2021).

Conclusion

Attempts to compare and synthesize research on non-cognitive skills has typically encountered conceptual difficulties (see Fagioli et al., 2020). These arise from the fact that researchers have identified a range of skills, which have often been delineated in varying ways (e.g., mental toughness). This has produced a fragmented approach to non-cognitive skills, which themselves are often described in differing ways (see Duckworth & Yeager, 2015). Moreover, theorists have tended to focus on a specific non-cognitive skill to the detriment of others. This construct-focused approach has generated much research of worth, however, it ignores the fact that non-cognitive skills are often related and/or share important common features. In this context, the ability to identify complementary and additive features of Mental Toughness, Ego Resiliency, Self-efficacy, and Grit is theoretically important because it identifies core aspects. This should in time produce greater conceptual agreement and clarity.

Author contributions AD and ND designed the study and prepared the article. AD additionally prepared the data and completed the analysis. KD edited, reviewed, and commented on drafts.

Funding This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability The datasets generated during and/or analysed during the current research are accessible via figshare:
https://figshare.com/s/a516ac2b96638088c50c
https://figshare.com/s/91753f1334ce800a2179

Declarations

Competing interests The authors have no competing interests to declare that are relevant to the content of this article.

Ethics approval Approval was obtained from the ethics committee of Manchester Metropolitan University. The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

Consent Informed consent was obtained from all individual participants included in the research.

References

Alessandri, G., Vecchione, M., Caprara, G. V., & Letzring, T. D. (2012). The Ego Resiliency Scale revised: A cross-cultural study in Italy, Spain, and the United States. *European Journal of Psychological Assessment, 28*(2), 139–146. https://doi.org/10.1027/1015-5759/a000102

Bandura, A. (1997). *Self-efficacy: The exercise of control*. Freedom and Company.

Bédard Thom, C., Guay, F., & Trottier, C. (2021). Mental toughness in sport: The goal-expectancy-self-control (GES) Model. *Journal of Applied Sport Psychology, 33*(6), 627–643. https://doi.org/10.1080/10413200.2020.1808736

Benson, J., & Hocevar, D. (1985). The impact of item phrasing on the validity of attitude scales for elementary school children. *Journal of Educational Measurement, 22*(3), 231–240. https://doi.org/10.1111/j.1745-3984.1985.tb01061.x

Block, J. (2002). *Personality as an affect-processing system: Toward an integrative theory*. Lewis Erlbaum.

Block, J., & Kremen, A. M. (1996). IQ and ego-resiliency: conceptual and empirical connections and separateness. *Journal of Personality and Social Psychology, 70*(2), 349–361. https://doi.org/10.1037/0022-3514.70.2.349

Borghans, L., Duckworth, A. L., Heckman, J. J., & Ter Weel, B. (2008). The economics and psychology of cognitive and non-cognitive traits. *Journal of Human Resources, 43*(4), 972–1059. https://doi.org/10.1353/jhr.2008.0017

Byrne, B. M. (2010). *Structural Equation Modeling with Amos: Basic Concepts, Applications, and Programming* (2nd ed.). Taylor and Francis.

Caza, A., Caza, B. B., & Baloochi, M. E. (2020). Resilient personality: is grit a source of resilience? In E. Powley, B. B. Caza, & A. Caza (Eds.), *Research Handbook on Organizational Resilience* (pp. 25–38). Edward Elgar Publishing.

Choi, I., & Choi, Y. (2002). Culture and self-concept flexibility. *Personality and Social Psychology Bulletin, 28*(11), 1508–1517. https://doi.org/10.1177/014616702237578

Clough, P., Earle, K., & Sewell, D. (2002). Mental toughness: The concept and its measurement. In I. Cockerill (Ed.), *Solutions in sport psychology* (pp. 32–44). Thomson.

Clough, P., Oakes, S., Dagnall, N., St Clair-Thompson, H., & McGeown, S. (2016). The study of non-cognitive attributes in education: Proposing the mental toughness framework. In M. S. Khine, S. Areepattamannil, & S. (Eds.), *Non-cognitive skills and factors in educational attainment* (pp. 315–329). SensePublishers.

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112*(1), 155–159. https://doi.org/10.1037/0033-2909.112.1.155

Connor, K. M., & Davidson, J. R. (2003). Development of a new resilience scale: The Connor-Davidson resilience scale (CD-RISC).

Depression and Anxiety, 18(2), 76–82. https://doi.org/10.1002/da.10113

Cormier, D. L., Ferguson, L. J., Gyurcsik, N. C., Briere, J. L., Dunn, J. G., & Kowalski, K. C. (2021). Grit in sport: A scoping review. *International Review of Sport and Exercise Psychology, 1-38*. https://doi.org/10.1080/1750984X.2021.1934887

Cowden, R. G., Meyer-Weitz, A., & Oppong Asante, K. (2016). Mental toughness in competitive tennis: relationships with resilience and stress. *Frontiers in Psychology, 7*, 320. https://doi.org/10.3389/fpsyg.2016.00320

Crawford-Garrett, K. (2018). Lacking resilience or mounting resistance? Interpreting the actions of indigenous and immigrant youth within teach first New Zealand. *American Educational Research Journal, 55*(5), 1051–1075. https://doi.org/10.3102/0002831218769563

Cronbach, L. J. (1942). Studies of acquiescence as a factor in the true-false test. *Journal of Educational Psychology, 33*(6), 401–415. https://doi.org/10.1037/h0054677

Dagnall, N., Denovan, A., Papageorgiou, K. A., Clough, P. J., Parker, A., & Drinkwater, K. G. (2019). Psychometric assessment of shortened Mental Toughness Questionnaires (MTQ): factor structure of the MTQ-18 and the MTQ-10. *Frontiers in Psychology, 10*, 1933. https://doi.org/10.3389/fpsyg.2019.01933

Dagnall, N., Drinkwater, K. G., Denovan, A., & Walsh, S. (2021). The potential benefits of non-skills training (mental toughness) for elite athletes: Coping with the negative psychological effects of the COVID-19 pandemic. *Frontiers in Sports and Active Living, 3*, 581431. https://doi.org/10.3389/fspor.2021.581431

Datu, J. A. D., Valdez, J. P. M., & King, R. B. (2016). Perseverance counts but consistency does not! Validating the short grit scale in a collectivist setting. *Current Psychology, 35*(1), 121–130. https://doi.org/10.1007/s12144-015-9374-2

De La Cruz, M., Zarate, A., Zamarripa, J., Castillo, I., Borbon, A., Duarte, H., & Valenzuela, K. (2021). Grit, Self-Efficacy, Motivation and the Readiness to Change Index Toward Exercise in the Adult Population. *Frontiers in Psychology, 12*, 732325. https://doi.org/10.3389/fpsyg.2021.732325

Deutscher, D., Hayes, D., Cook, K. F., Werneke, M. W., Tucker, C. A., Mioduski, J. E., Levenhagen, K., Tidhar, D., Pfarr, M., & Kallen, M. A. (2021). Upper Quadrant Edema Patient-Reported Outcome Measure Was Reliable, Valid, and Efficient for Patients with Lymphatic and Venous Disorders. *Physical Therapy, 101*(12), pzab219. https://doi.org/10.1093/ptj/pzab219

Duckworth, A. L., Peterson, C., Matthews, M. D., & Kelly, D. R. (2007). Grit: perseverance and passion for long-term goals. *Journal of Personality and Social Psychology, 92*(6), 1087–1101. https://doi.org/10.1037/0022-3514.92.6.1087

Duckworth, A. L., & Quinn, P. D. (2009). Development and validation of the Short Grit Scale (GRIT–S). *Journal of Personality Assessment, 91*(2), 166–174. https://doi.org/10.1080/00223890802634290

Fagioli, L. P., Baker, R., & Orona, G. A. (2020). The role of non-cognitive variables in identifying community college students in need of targeted supports. *Research in Higher Education, 61*(6), 725–763. https://doi.org/10.1007/s11162-020-09588-7

Gignac, G. E., & Szodorai, E. T. (2016). Effect size guidelines for individual differences researchers. *Personality and Individual Differences, 102*, 74–78. https://doi.org/10.1016/j.paid.2016.06.069

Gucciardi, D. F. (2017). Mental toughness: progress and prospects. *Current Opinion in Psychology, 16*, 17–23. https://doi.org/10.1016/j.copsyc.2017.03.010

Gucciardi, D. F., Gordon, S., & Dimmock, J. A. (2008). Towards an understanding of mental toughness in Australian football. *Journal of Applied Sport Psychology, 20*(3), 261–281. https://doi.org/10.1080/10413200801998556

Gucciardi, D. F., Gordon, S., & Dimmock, J. A. (2009). Evaluation of a mental toughness training program for youth-aged Australian footballers: a quantitative analysis. *Journal of Applied Sport Psychology, 21*(3), 307–323. https://doi.org/10.1080/10413200903026066

Gucciardi, D. F., Hanton, S., Gordon, S., Mallett, C. J., & Temby, P. (2015). The concept of mental toughness: Tests of dimensionality, nomological network, and traitness. *Journal of Personality, 83*(1), 26–44. https://doi.org/10.1111/jopy.12079

Gucciardi, D., Hanton, S., & Mallett, C. (2013). Progressing Measurement in Mental Toughness: A Response to Clough, Earle, Perry and Crust. *Sport, Exercise and Performance Psychology, 2*(3), 157–172. https://doi.org/10.1037/spy0000002

Gutman, L. M., & Schoon. I. (2013). The Impact of non-Cognitive Skills on Outcomes for Young People: Literature Review. Education Endowment Foundation, London, Available at http://hdl.voced.edu.au/10707/287500. Accessed 10 December 2021.

Hammer, J. H., & Toland, M. D. (2017). Internal structure and reliability of the Internalized Stigma of Mental Illness Scale (ISMI-29) and Brief Versions (ISMI-10, ISMI-9) among Americans with depression. *Stigma and Health, 2*(3), 159–174. https://doi.org/10.1037/sah0000049

Herche, J., & Engelland, B. (1996). Reversed-polarity items and scale unidimensionality. *Journal of the Academy of Marketing Science, 24*(4), 366–374. https://doi.org/10.1177/0092070396244007

Horsburgh, V. A., Schermer, J. A., Veselka, L., & Vernon, P. A. (2009). A behavioural genetic study of mental toughness and personality. *Personality and Individual Differences, 46*(2), 100–105. https://doi.org/10.1016/j.paid.2008.09.009

Hu, L., & Bentler, P. (1995). *Measuring model fit. Structural equation modeling: Concepts, issues and applications.* Sage.

Johnson, K. L. (2020). Exploring the relationship between mental toughness and self-compassion in the context of sport injury: A mixed methods approach [Master's thesis]. University of Saskatchewan. Harvest.

Joseph, A. I. (2009). *The role of grit in predicting performance in collegiate athletes* (Publication No. 3379578) [Doctoral dissertation]. Capella University. ProQuest Dissertations and Theses Global.

Kees, J., Berry, C., Burton, S., & Sheehan, K. (2017). An analysis of data quality: Professional panels, student subject pools, and Amazon's Mechanical Turk. *Journal of Advertising, 46*(1), 141–155. https://doi.org/10.1080/00913367.2016.1269304

Klohnen, E. C. (1996). Conceptual analysis and measurement of the construct of ego resiliency. *Journal of Personality and Social Psychology, 70*(5), 1067–1079. https://doi.org/10.1037/0022-3514.70.5.1067

Letzring, T. D., Block, J., & Funder, D. C. (2005). Ego-control and ego-resiliency: Generalization of self-report scales based on personality descriptions from acquaintances, clinicians, and the self. *Journal of Research in Personality, 39*(4), 395–422. https://doi.org/10.1016/j.jrp.2004.06.003

Liang, Q. (2021). Lift the grit's veil: The literature review and prospects of grit. *Psychology, 12*(04), 580–594. https://doi.org/10.4236/psych.2021.124036

Livinți, R., Gunnesch-Luca, G., & Iliescu, D. (2021). Research self-efficacy: A meta-analysis. *Educational Psychologist, 56*(3), 215–242. https://doi.org/10.1080/00461520.2021.1886103

Loehr, J. E. (1995). *The new mental toughness training for sports.* Plume.

Marcus, B. H., Selby, V. C., Niaura, R. S., & Rossi, J. S. (1992). Self-Efficacy and the stages of exercise behavior change. *Research Quarterly for Exercise and Sport, 63*(1), 60–66. https://doi.org/10.1080/02701367.1992.10607557

Marsh, H. W., Lüdtke, O., Muthén, B., Asparouhov, T., Morin, A. J., Trautwein, U., & Nagengast, B. (2010). A new look at the big five factor structure through exploratory structural equation modeling.

Psychological Assessment, 22(3), 471–491. https://doi.org/10.1037/a0019227

McAuley, A. B., Hughes, D. C., Tsaprouni, L. G., Varley, I., Suraci, B., Baker, J., Herbert, A. J., & Kelly, A. L. (2022). Genetic associations with personality and mental toughness profiles of English academy football players: An exploratory study. *Psychology of Sport and Exercise, 102209*. https://doi.org/10.1016/j.psychsport.2022.102209

Meyer, N., Niemand, T., Davila, A., & Kraus, S. (2022). Biting the bullet: When self-efficacy mediates the stressful effects of COVID-19 beliefs. *PLoS One, 17*(1), e0263022. https://doi.org/10.1371/journal.pone.0263022

Meyer, G., Shatto, B., Kuljeerung, O., Nuccio, L., Bergen, A., & Wilson, C. R. (2020). Exploring the relationship between resilience and grit among nursing students: A correlational research study. *Nurse Education Today, 84*, 104246. https://doi.org/10.1016/j.nedt.2019.104246

Mojtahedi, D., Dagnall, N., Denovan, A., Clough, P., Hull, S., Canning, D., Lilley, C., & Papageorgiou, K. A. (2021). The Relationship Between Mental Toughness, Job Loss, and Mental Health Issues During the COVID-19 Pandemic. *Frontiers in Psychiatry, 11*, 1668. https://doi.org/10.3389/fpsyt.2020.607246

Muthén, L. K., & Muthén, B. O. (2018). *Mplus user's guide* (8th ed.). Muthén & Muthén.

Nicholls, A. R., Polman, R. C., Levy, A. R., & Backhouse, S. H. (2008). Mental toughness, optimism, pessimism, and coping among athletes. *Personality and Individual Differences, 44*(5), 1182–1192. https://doi.org/10.1016/j.paid.2007.11.011

Nicholls, A. R., Perry, J., Jones, L., Sanctuary, C., Carson, F., & Clough, P. J. (2015). The mediating role of mental toughness in sport. *The Journal of Sports Medicine and Physical Fitness, 55*(7-8), 824–834.

Nowack, K., & Niemirowski, A. (2021). Cognitive hardiness in coaching: Personality trait, skill, or outcome. *Coaching Psychologist, 17*(1), 14–31.

Papageorgiou, K. A., Denovan, A., & Dagnall, N. (2019). The positive effect of narcissism on depressive symptoms through mental toughness: Narcissism may be a dark trait but it does help with seeing the world less grey. *European Psychiatry, 55*, 74–79. https://doi.org/10.1016/j.lindif.2021.102053

Papageorgiou, K. A., Malanchini, M., Denovan, A., Clough, P. J., Shakeshaft, N., Schofield, K., & Kovas, Y. (2018). Longitudinal associations between narcissism, mental toughness and school achievement. *Personality and Individual Differences, 131*, 105–110. https://doi.org/10.1016/j.paid.2018.04.024

Perry, J. L., Strycharczyk, D., Dagnall, N., Denovan, A., Papageorgiou, K. A., & Clough, P. J. (2021). Dimensionality of the mental toughness questionnaire (MTQ48). *Frontiers in Psychology, 10*, 3389. https://doi.org/10.3389/fpsyg.2021.654836

Postigo, Á., Cuesta, M., García-Cueto, E., Menéndez-Aller, Á., González-Nuevo, C., & Muñiz, J. (2021). Grit assessment: Is one dimension enough? *Journal of Personality Assessment, 103*(6), 786–796. https://doi.org/10.1080/00223891.2020.1848853

Reise, S. P., Bonifay, W. E., & Haviland, M. G. (2013). Scoring and modeling psychological measures in the presence of multidimensionality. *Journal of Personality Assessment, 95*(2), 129–140. https://doi.org/10.1080/00223891.2012.725437

Ren, T., Yu, X., & Yang, W. (2019). Do cognitive and non-cognitive abilities mediate the relationship between air pollution exposure and mental health? *PLoS One, 14*(10), e0223353. https://doi.org/10.1371/journal.pone.0223353

Rodriguez, A., Reise, S. P., & Haviland, M. G. (2016a). Applying bifactor statistical indices in the evaluation of psychological measures. *Journal of Personality Assessment, 98*(3), 223–237. https://doi.org/10.1080/00223891.2015.1089249

Rodriguez, A., Reise, S. P., & Haviland, M. G. (2016b). Evaluating bifactor models: Calculating and interpreting statistical indices. *Psychological Methods, 21*(2), 137–150. https://doi.org/10.1037/met0000045

Salazar, M. S. (2015). The dilemma of combining positive and negative items in scales. *Psicothema, 27*(2), 192–199. https://doi.org/10.7334/psicothema2014.266

Sanderson, B., & Brewer, M. (2017). What do we know about student resilience in health professional education? A scoping review of the literature. *Nurse Education Today, 58*, 65–71. https://doi.org/10.1016/j.nedt.2017.07.018

Scharneck, L. (2017). *The mediating effect of self-determined motivation in student-athlete perceptions of coaching behaviors and its effect on grit and mental toughness* (Publication No. 10263782) [Doctoral dissertation]. Illinois State University. ProQuest Dissertations and Theses Global.

Schonfeld, I. S., Verkuilen, J., & Bianchi, R. (2019). An exploratory structural equation modeling bi-factor analytic approach to uncovering what burnout, depression, and anxiety scales measure. *Psychological Assessment, 31*(8), 1073–1079. https://doi.org/10.1037/pas0000721

Schwarzer, R., & Hallum, S. (2008). Perceived teacher self-efficacy as a predictor of job stress and burnout: Mediation analyses. *Applied Psychology, 57*(s1), 152–171. https://doi.org/10.1111/j.1464-0597.2008.00359.x

Schwarzer, R., & Jerusalem, M. (1995). Generalized self-efficacy scale. Measures in health psychology: A user's portfolio. *Causal and Control Beliefs, 1*(1), 35–37. https://doi.org/10.1037/t00393-000

Shaw, J., McLean, K. C., Taylor, B., Swartout, K., & Querna, K. (2016). Beyond resilience: Why we need to look at systems too. *Psychology of Violence, 6*(1), 34–41. https://doi.org/10.1037/vio0000020

Smith, C. E., Barratt, C. L., & Hirvo, A. (2021). Burned out or engaged at work? The role of self-regulatory personality profiles. *Stress and Health, 37*(3), 572–587. https://doi.org/10.1002/smi.3015

Stoffel, J. M., & Cain, J. (2016). Review of grit and resilience literature within health professions education. *American Journal of Pharmaceutical Education, 82*(2), 6150. https://doi.org/10.5688/ajpe6150

Strycharczyk, D., & Clough, P. (2014). *Developing Mental Toughness in Young People: Approaches to Achievement, Well-Being, Employability, and Positive Behaviour*. Karnac Books.

Stucky, B. D., & Edelen, M. O. (2015). Using hierarchical IRT models to create unidimensional measures from multidimensional data. In S. P. Reise & D. A. Revicki (Eds.), *Handbook of item response theory modeling: Applications to typical performance assessment* (pp. 183–206). Routledge.

Szczuka, Z., Banik, A., Abraham, C., Kulis, E., & Luszczynska, A. (2021). Associations between self-efficacy and sedentary behaviour: a meta-analysis. *Psychology & Health, 36*(3), 271–289. https://doi.org/10.1080/08870446.2020.1784419

Tadesse, T., Gillies, R. M., & Campbell, C. (2018). Testing models and measurement invariance of the learning gains scale. *Education Sciences, 8*(4), 192. https://doi.org/10.3390/educsci8040192

van Sonderen, E., Sanderman, R., & Coyne, J. C. (2013). Correction: Ineffectiveness of reverse wording of questionnaire items: Let's learn from cows in the rain. *PLoS One, 8*(9), 10.1371. https://doi.org/10.1371/annotation/af78b324-7b44-4f89-b932-e851fe04a8e5

Vecchio, G. M., Barcaccia, B., Raciti, P., Vera, P. V., & Milioni, M. (2019). Validation of the Revised Ego-Resiliency Scale in a High-Vulnerable Colombian Population. *Universitas*

Psychologica, 18(3), 1–13. https://doi.org/10.11144/Javeriana.upsy18-3.vrer

Wang, F. L., Eisenberg, N., & Spinrad, T. L. (2019). Bifactor model of effortful control and impulsivity and their prospective prediction of ego resiliency. *Journal of Personality, 87*(5), 919–933. https://doi.org/10.1111/jopy.12444

Weems, G. H., Onwuegbuzie, A. J., Schreiber, J. B., & Eggers, S. J. (2003). Characteristics of respondents who respond differently to positively and negatively worded items on rating scales. *Assessment and Evaluation in Higher Education, 28*(6), 587–606. https://doi.org/10.1080/0260293032000130234

Weijters, B., Geuens, M., & Schillewaert, N. (2009). The proximity effect: The role of inter-item distance on reverse-item bias. *International Journal of Research in Marketing, 26*(1), 2–12. https://doi.org/10.1016/j.ijresmar.2008.09.003

Windle, G., Bennett, K. M., & Noyes, J. (2011). A methodological review of resilience measurement scales. *Health and Quality of Life Outcomes, 9*(1), 1–18. https://doi.org/10.1186/1477-7525-9-8

Winebrake, D., Gueron-Sela, N., Propper, C., Mills-Koonce, R., & Wagner, N. J. (2021). An examination of the relations between effortful control in early childhood and risk for later externalizing psychopathology: A bi-factor structural equation modeling approach. *PsyArXiv,* https://doi.org/10.31234/osf.io/5d4sw.

Zauszniewski, J. A. (2016). Resourcefulness. *Western Journal of Nursing Research, 38*(12), 1551–1553. https://doi.org/10.1177/0193945916665079