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Research article

A measure for assessment of beneficial and harmful fortitude: development and initial validation of the Sisu Scale

Pentti Henttonen [a,1], Ilmari Määttänen [a,*,1], Emilia Makkonen [a], Anita Honka [b], Vilja Seppälä [a], Johanna Närväinen [b], Regina García-Velázquez [a,c], Jaakko Airaksinen [a], Markus Jokela [a], Emilia Elisabet Lahti [d]

[a] University of Helsinki, Helsinki, Finland
[b] VTT Technical Research Centre of Finland, Finland
[c] Finnish Institute for Health and Welfare (THL), Helsinki, Finland
[d] Aalto University, Espoo, Finland

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ABSTRACT

Sisu is a Finnish cultural concept that denotes determination and resoluteness in the face of adversity. We propose that sisu will supplement the English-language based research on mental fortitude traits. Sisu has not been the focus of systematic research until very recently. We created a new questionnaire measuring sisu (the Sisu Scale), sought to validate the sisu construct and its sub-factor structure as postulated in a recent qualitative study. We investigated associations of sisu with other measures of mental fortitude and well-being. More generally we aimed to enrichen the cross-cultural understanding of human experience of overcoming adversity across life's challenges.

We describe and validate a questionnaire that effectively measures both beneficial and harmful sisu, each comprising three sub-factors. Beneficial sisu was associated with other measures of fortitude, but less with personality dimensions. We also confirmed the existence of an independent harmful sisu factor. Beneficial sisu was associated with higher well-being and lower depressive symptoms, and harmful sisu with lower well-being and higher levels of general stress, work stress and depressive symptoms. Together the two factors were superior compared to pre-existing measures when predicting well-being-related variables. Results suggest that the new Sisu Scale we developed may provide a valuable addition to research on mental fortitude, resilience and their consequences for well-being.

1. Introduction

The main purpose of this study was to develop and validate a completely new sisu questionnaire, the *Sisu Scale*. Sisu is a cultural construct that is native to the Finnish language and denotes deep-seated resolve and determination in the face of adversity that an individual deems significant. Although the term dates back hundreds of years and is a significant part of the Finnish cultural identity, as well as of everyday language, only few studies have examined the construct in detail, primarily as a cultural marker (see Aho, 1994; Lucas and Buzzanell, 2004; Palo Stoller, 1996; Taramaa, 2009). Until recently there has been very little systematic empirical research on the psychological core of the construct (e.g. Amato-Henderson, Slade & Kemppainen, 2014). To our knowledge, Emilia Elisabet Lahti was the first to investigate sisu as a psychological quality (Lahti, 2019). According to her thematic analysis based on self-reports tracking its cultural representations among Finnish respondent individuals, sisu is a combination of beneficial ("What is sisu?") and harmful ("Can there be too much sisu or can it be the wrong kind?") qualities. Three constituent aspects of sisu were identified: extraordinary perseverance in terms of overcoming one's preconceived mental and physical barriers; an action mindset that denotes the ability to take action in the face of almost non-existent odds; and latent power that derives from stored-up reserves of energy. Harmful sisu, in turn, manifests itself as harm to reason, to the self, and to others that may have a long-lasting detrimental impact. An individual who is locked into stubbornness (harmful sisu) does not know when to stop, is not open to receiving guidance and may become merciless towards others. In such cases, sisu may end up being the very thing that inhibits an individual

* Corresponding author.
E-mail address: Ilmari.maattanen@helsinki.fi (I. Määttänen).
[1] These authors contributed equally.

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from succeeding, and instead causes failure and outright damage. Although the detrimental effects of excessive perseverance on performance have been observed (Alaoui and Fons-Rosen, 2021; Khan, Neveu & Murtaza, 2021; Lucas et al., 2015), and mental toughness has been associated with ignoring medical advice and disregarding rehabilitation among athletes (Sabouri et al., 2016), to our knowledge, no corresponding scale, explicitly measuring this disposition has been proposed.

Psychological lexicon explaining human behaviour that is almost exclusively in the English language may be problematic. One of the possible issues is that English-based scales may not fully capture the ways of thinking present in other languages. It is important to increase the variability of social contexts (Becker and Marecek, 2008). The concept of sisu was cited as one of the inspirations for the study of positive cross-cultural lexicography of "untranslatable" words pertaining to well-being that do not have a direct English translation (Lomas, 2016). Internationally popularised during wartime, the significance and meaning of sisu have undergone transformations. Although there have been fluctuations in how it has been regarded in its native country (reflecting Finland's socio-economic changes, history and sports success), it has more or less remained part of the country's ongoing popular discourse.

The development of a scale measuring sisu may have several benefits. It is possible that creating and using a non-English-language-based scale reveals something new and interesting as a measurement tool regarding the determinants of overcoming adversity. The pre-existing mental fortitude scales also fail to capture the possible adverse effects of too much or wrong type of mental fortitude, which this scale takes into consideration. Additionally, the existing psychological traits that are strongly associated with well-being are typically emotional stability (neuroticism) and their correlates (e.g. rumination) and they, in turn, have strong links with depression and anxiety (Ervasti et al., 2019). There are fewer mental traits that have strong associations with well-being, which are not simultaneously strongly associated with emotional stability, sisu being one, and studying them could provide valuable new information on different traits that influence well-being.

Despite the fact that the development of the Sisu Scale did not have any direct influence from the other, existing scales, a brief look at the existing questionnaire literature is warranted. Several existing psychological concepts resemble sisu, hereby referred to as indices of mental fortitude. Examples include grit (Duckworth et al., 2007), mental toughness (Clough, Earle & Sewell, 2002), hardiness (Kobasa, 1979), hope (as measured on a scale; Snyder et al., 1991), resilience (Wagnild, 2009) and self-efficacy (Schwarzer and Jerusalem, 1995). Separating these concepts has proven to be difficult: the terms describe overlapping constructs, correlate strongly with each other (e.g., Martin et al., 2015) and are frequently used synonymously or interchangeably (Stoffel and Cain 2018).

Questionnaires covering traits of mental fortitude have proved useful in research on well-being as well as on physical and mental health. Hardiness (Skomorovsky and Sudom, 2011), resilience (Harms et al., 2018), grit (Datu, Valdez & King, 2016; Salles, Cohen & Mueller, 2014; Vainio and Daukantaitė, 2016), hope (O'Sullivan, 2011; Satici 2016) and mental toughness (Stamp et al., 2015) are positively connected to well-being.

Multiple studies report an association between traits of mental fortitude and lower levels of harmful stress. Low mental toughness has been associated with more stress and burn-out symptoms (Gerber et al., 2015), for example. Grit has predicted well-being and a smaller likelihood of burnout later on in life (Salles, Cohen & Mueller, 2014), and higher levels of grit have also been found to protect against thoughts related to suicide after stressful life events (Blalock et al., 2015). Self-efficacy has been identified as a protective factor against symptoms of stress among university students (Han, 2005). Resilience, in turn, appears to associate positively with variables that denote good mental health, and negatively with variables that denote poor mental health (Hu, Zhang, & Wang, 2015).

In sum, traits of mental fortitude are positively associated with well-being and other favourable outcomes in life. Such outcomes include more positive affect (Rodriguez-Rey, Alonso-Tapia & Garrido-Hernansaiz, 2016), a better quality of life (Chou and Hunter, 2009), less harmful stress, less burnout and better mental health. On the basis of the literature reviewed above, we predict that sisu will correlate with and have similar associative patterns to criteria variables than existing traits of mental fortitude. However, due to its additional harmful aspect, it might provide further predictive power beyond other pre-existing unidimensional constructs. The criteria variables we measured included perceived stress (Elo, Leppänen & Jahkola, 2003), well-being (Topp et al., 2015) and depressive symptoms (Radloff 1977), which could be understood as straight-forward reflections of positive or negative well-being. In addition, to address the harmful manifestation of sisu as misdirected effort, we included a measure to assess the optimal allocation of resources to goals. Siegrist's work stress model (1996) measures the effort-reward imbalance, indicating that stress may increase if work effort (e.g. a high level of responsibility, constant time pressure) increases or if the rewards (e.g. support from colleagues, job security) diminish.

The goal of the current study was to devise and validate a novel scale based on pre-existing thematic conceptualisations of sisu, and to examine its psychometric properties. The study objectives were:

1. To define a set of optimal items for measuring the beneficial and harmful aspects of sisu, and to provide a quantitative replication of the six-factor structure as suggested by Lahti (2019).
2. To test the resultant scale's internal reliability and convergent validity in relation to existing measures of mental fortitude and personality.
3. To assess the scale's external validity as a predictor of well-being, positive and negative mental health, stress and work stress.
4. To test the invariance of the scale due to age and sex, and to compare the differences in latent means attributable to these factors.

To this end, three studies were conducted, each with independent data. First, the initially proposed items measuring aspects of sisu were subjected to exploratory factor analysis. Second, the item set was pruned and confirmatory analysis was carried out to assess the scale's internal and external psychometric validity. Finally, the further predictive capacity of the scale was tested on a non-student sample.

2. Study 1: scale development

The three of the authors (PH, IM and EL) developed 50 novel items for measuring *beneficial and harmful sisu*. The items were formulated as propositional sentences (in Finnish), which were evaluated and discussed to arrive at subsets of between eight and 10 items, each focusing on one dimension of Lahti's (2019) suggested six categories of sisu (*extraordinary perseverance, action mindset, latent power, harm to reason, harm to self, harm to others*). They were then cross-referenced with a set of pre-existing related questionnaires on mental fortitude, detailed below, and close matches were excluded. For the purpose of reporting and further use, PH and IM translated the items into English: a bilingual professional checked the translations for equivalence.

2.1. Participants

The formulated *beneficial and harmful sisu* items were administered and rated on a Likert scale ranging from one ("strongly disagree") to seven ("strongly agree") as part of a larger set of related measures detailed below. Responses were obtained from a convenience sample of informants contacted via University of Helsinki mailing lists and an online form. The compensation for those who completed the questionnaire was a chance to participate in a raffle for movie tickets. In total, 463 recipients returned the questionnaire. Data from 27 respondents were discarded in accordance with exclusion criteria determined as the

occurrence of over seven identical consecutive answers to the *beneficial and harmful sisu* items (n = 25), over 30 identical consecutive answers to the other scale items (n = 1), and missing responses due to technical problems (n = 1). The final number of respondents was 436 (362 or 83.03% female). The mean age was 25.88 (range = 19–54, SD = 5.86) years. All participants gave their informed consent in all of the studies. The studies were approved by the ethical advisory boards of University of Helsinki and/or the VTT Technical Research Centre of Finland (decision number UH: 18/2018 and decision date VTT: 27.5.2019).

2.2. Measures

Mental fortitude and personality scales with prospective relevance to the measures of *beneficial and harmful sisu* were selected for comparison. These scales are detailed below, along with their observed reliability indices. When no pre-existing Finnish translation was available, PH and IM translated the questionnaire items. Internal reliability was assessed by Cronbach's α statistic. R 4.1.0 and lavaan 0.6–9 (Rosseel 2012) were used for the analyses in this and the following studies.

MTQ-18 (Clough, Earle & Sewell, 2002), a scale that is often used in sport psychology, was applied to measure mental toughness. The shortened version (MTQ-10; Dagnall et al., 2019) was used in the analysis, and exhibited good reliability (α = 0.82).

Grit was measured with a shortened version of the grit scale (**GRIT-S**; Duckworth and Quinn, 2009). The reliabilities of the subscales, namely *consistency of interest* (α = 0.76) and *perseverance of effort* (α = 0.76), were acceptable. Reliability of the total Grit-S was good (α = 0.82).

Resilience was measured with the **RS-14** -scale (Wagnild 2009), based on a Finnish translation detailed in Losoi et al. (2013). The reliability of RS-14 was excellent (α = 0.90).

Hardiness (Kobasa 1979), with origins in military psychology, was measured on the **HARDY-S** scale (Bartone et al., 1989). The 30-item version of the scale comprises three subscales: *commitment* (α = 0.74), *control* (α = 0.48 or α = 0.60 after dropping a poorly performing item) and *challenge* (α = 0.70). The total reliability of the Hardiness scale was acceptable (α = 0.79).

Dispositional hope was measured with the **Adult Hope Scale** (Snyder et al., 1991). It consists of two subscales, *agency* (α = 0.73) and *pathways* (α = 0.76), the reliabilities of which were acceptable. The total reliability of the AHS scale was good (α = 0.82).

The **General Self-efficacy Scale** (GSE; Schwarzer and Jerusalem, 1995) was used to measure self-efficacy: the reliability was good (α = 0.89).

Personality dimensions were measured with the **Brief HEXACO Inventory** (BHI; De Vries, 2013), which resembles the 'big five' personality questionnaires, with *honesty-humility* (HH) as an additional personality trait. The reliabilities were poor with the exception of *extraversion* (α = 0.71); *emotionality* α = 0.39, *agreeableness* α = 0.47, *honesty-humility* α = 0.42, *conscientiousness* α = 0.50 and *openness* α = 0.55.

Reinforcement sensitivity was measured with the revised **RST scale,** "Jackson-5" (Jackson 2009), which is based on a revised version of Gray's biopsychological theory of personality (Gray and McNaughton, 2000). The scale comprises subscales that measure individual differences in the tendency to approach (*behavioural activation system, rBAS*), withdraw or react otherwise (*fight, flight or freeze*) in response to different stimuli, as well as to resolve conflicting information (*behavioural inhibition system, rBIS*). The reliability of the *rBAS* subscale was good (α = 0.80), but for the rest of the subscales it was satisfactory (*fight* α = 0.78, *freeze* α = 0.74) to mediocre (*rBIS* α = 0.67, *flight* α = 0.66).

2.3. Results

Exploratory factor analysis with weighted least squares extraction was conducted on the items concerning *beneficial and harmful sisu*. Because the data deviated from multiple normality according to Mardia's test (Mardia 1970), polychoric correlations were used, as recommended for the analysis of Likert-scale items (Li 2016). Items with low (<0.6) Kaiser-Meyer-Olkin (KMO) values of sampling adequacy and/or excessive skewness and kurtosis (>|1|), or in which over 50 per cent of the responses were in the two extreme scale values (1/2 or 6/7), were omitted. After preliminary examination, three items detailing sports or explicit physical activity were observed to have low loading properties, and were consequently removed. Overall, the KMO measure of sampling adequacy of the resulting 40 items was 0.88.

Various criteria were considered to determine the appropriate number of factors to be extracted (Zwick and Velicer, 1986). PROMAX rotation was used as the factors were expected to correlate. In a two-factor solution, suggested by VSS (Very simple structure) criterion (Revelle and Rocklin, 1979) and accounting for 32 per cent of the total variance, roughly half (20) of the items loaded substantially (λ > 0.4) on the first factor and almost half (15) on the second, with only one item cross-loading (λ > 0.3) on both factors observed. In a five-factor solution, suggested by both the Velicer MAP (Minimum average partial test) criterion and parallel analysis, and explaining 42 per cent of the total variance, the two factors decomposed into a further two and three factors, respectively. Finally, in a nine-factor solution, following the Empirical BIC (Bayesian information criterion) and explaining 50 per cent of the total variance, the decomposition of factors 1 and 4 into two and three novel factors was observed. Factor interpretation was facilitated by retaining only the items with substantial loading (λ > 0.5) on a single factor and no major cross-loadings (λ > 0.4) under the nine-factor solution. When multiple items fulfilled this condition per factor, the three highest-loading items were selected. Table 1 presents the retained items and their loadings under the three extractions. Complete descriptions of the translated items and their loading profiles are provided in Supplemental Table 1.

As expected, the three positive and three negative categories posited by Lahti (2019) emerged from the solutions. *Beneficial sisu* comprises *latent power* (LP; example item: "In the face of challenges or adversities, I often find that I exceed myself"), *action mindset* (AM; example item: "I always face my fears rather than avoid them") and *extraordinary perseverance* (EP; example item: "Once I am resolved to do something, there is nothing that can stop me from doing it"). In a two-factor solution, these are supplemented with additional items from a related construct, dubbed *control over fate* (CF; example item: "I am in control of my fate"). The other factor under the two-factor solution could be interpreted as a collection of items with negative connotations, hence dubbed *harmful sisu.* These items include *harm to reason* (HR; example item: "I often lose sight of what I am doing and fail to see the big picture"), *harm to self* (HS; example item: "I tend to accept tasks that exceed my capabilities"), *Harm to Others* (HO; example item: "My determination often leads to conflict with other people") and *hubris* (HU; example reverse-coded item: "I am good at receiving help from others"). Constituting an independent factor under the five- and nine-factor solutions, the final *harmful sisu* factor is *outcomes*, which contains the items "I often feel that my self-worth is defined by my success in important areas of life" and "I have disregarded my health – for example, forgoing eating or sleeping – when pursuing an important goal".

Table 2 presents the intercorrelations of the interpreted factors. The *beneficial sisu* factors had substantial positive intercorrelations ($r > 0.4$), with the exception of a slightly lower coefficient between LP and CF ($r = 0.32$). Similarly, the *harmful sisu* factors had modest but positive correlations ($r < 0.3$), except for the diminished coefficients of HR-HU ($r = 0.20$) and HU-OC ($r = 0.20$). The average inter-item correlations of HO and OC were lower than some of their correlations with other factors, indicating less than optimal independence in the constructs.

The discriminant validity of the *beneficial and harmful sisu* factors compared to existing scales was assessed from their correlations with a set of existing scales of mental fortitude (see Table 3). In general, the *beneficial* factors had moderate to large positive associations with most of these instruments, the highest conformity being with RS-14 and the weakest patterns relating to certain sub-factors of GRIT-S (*consistency of*

Table 1. Standardised loadings and interpreted factor membership of retained sisu items under two-, five- and nine-factor extraction solutions.

Item	2 factors		5 factors					9 factors								
	1.	2.	1.	2.	3.	4.	5.	1.	2.	3.	4.	5.	6.	7.	8.	9.
LP1	**0.57**	0.04	**0.71**	-0.06	-0.03	0.08	0.02	**0.99**	-0.12	0.02	-0.04	0.05	-0.06	0.00	0.15	-0.06
LP2	**0.62**	-0.05	**0.75**	0.04	-0.12	-0.04	0.02	**0.76**	0.11	0.00	-0.12	-0.11	-0.07	0.05	0.05	0.09
LP3	**0.74**	-0.05	**0.75**	0.01	0.13	-0.05	0.04	**0.50**	*0.31*	-0.07	0.17	0.00	0.02	-0.12	0.03	0.15
AM1	**0.56**	-0.03	**0.51**	0.27	-0.23	0.09	-0.26	-0.02	**0.69**	0.22	-0.25	-0.04	0.03	0.12	0.02	-0.07
AM2	**0.53**	0.07	**0.55**	0.07	-0.07	0.15	-0.12	-0.01	**0.67**	-0.05	-0.08	0.05	0.05	0.16	-0.10	0.14
AM3*	**0.56**	-0.06	**0.44**	0.29	-0.11	-0.02	-0.16	-0.06	**0.58**	0.14	-0.05	-0.19	0.17	-0.08	0.06	0.04
EP1	**0.57**	0.24	0.18	**0.53**	0.15	0.09	0.07	0.03	-0.10	**0.83**	0.05	-0.04	0.13	0.02	-0.08	-0.16
EP2	**0.59**	0.04	0.22	**0.53**	0.16	-0.16	0.13	-0.10	0.13	**0.66**	0.08	0.00	0.00	-0.15	-0.10	0.01
EP3	**0.57**	0.08	**0.40**	**0.51**	-0.12	-0.10	0.14	0.14	0.16	**0.63**	-0.20	-0.03	-0.02	-0.10	0.03	0.03
CF1	**0.42**	0.09	-0.04	0.04	**0.69**	0.19	-0.21	0.01	0.02	-0.11	**0.80**	0.00	0.07	0.05	0.08	-0.12
CF2*	**0.49**	-0.08	0.08	0.15	**0.57**	-0.13	-0.01	-0.07	0.08	-0.04	**0.64**	-0.13	0.02	-0.03	-0.16	0.12
CF3	*0.33*	0.17	-0.01	0.07	**0.50**	0.17	-0.04	0.09	-0.20	0.10	**0.53**	0.00	0.10	0.11	-0.09	-0.10
HR1	-0.25	**0.57**	-0.02	*-0.32*	0.05	**0.55**	0.19	0.01	-0.06	-0.09	-0.05	**0.73**	0.02	0.14	0.01	0.04
HR2	-0.27	**0.51**	-0.03	*-0.33*	0.02	**0.55**	0.11	0.00	-0.05	-0.13	-0.03	**0.53**	0.18	0.03	0.12	-0.02
HS1	0.21	**0.51**	*0.39*	-0.14	-0.02	**0.49**	0.15	-0.04	0.12	0.08	0.03	0.12	**0.81**	-0.14	-0.17	0.04
HS2	0.14	**0.60**	0.29	-0.11	-0.01	**0.58**	0.16	-0.06	0.14	-0.08	0.08	0.02	**0.74**	0.00	-0.07	0.17
HO1	0.07	**0.56**	-0.02	0.07	0.05	**0.60**	-0.07	0.04	0.03	-0.05	0.01	0.00	-0.06	**0.80**	-0.09	0.11
HO2	-0.04	***0.38***	-0.07	-0.06	0.05	**0.51**	-0.17	0.00	0.04	-0.08	-0.01	0.10	-0.09	**0.66**	-0.09	-0.06
HO3	0.04	**0.62**	0.03	0.04	0.00	**0.63**	0.01	0.00	0.15	-0.19	0.05	-0.03	0.15	**0.51**	0.09	0.25
HU1	-0.18	**0.52**	-0.26	0.19	-0.04	**0.41**	0.14	0.09	-0.04	0.06	0.01	0.23	-0.10	-0.19	**0.88**	0.10
HU2*	-0.23	*0.32*	-0.24	0.14	-0.23	*0.35*	-0.09	0.03	0.17	-0.15	-0.16	-0.06	-0.11	0.07	**0.76**	0.06
OC1	0.17	**0.46**	*0.31*	0.20	-0.22	0.24	*0.38*	0.13	0.20	-0.07	-0.18	-0.12	0.14	0.07	0.12	**0.60**
OC2	-0.08	**0.48**	-0.16	0.17	0.15	0.17	**0.49**	-0.03	-0.18	-0.10	0.21	0.01	0.00	-0.01	0.13	**0.58**

PROMAX rotation. Loadings $\lambda > 0.4$ emboldened, $\lambda > 0.3$ in italics, * = reverse coded item, LP = Latent power, AM = Action mindset, EP = Extraordinary perseverance, CF = Control over fate, HR = Harm to reason, HS = Harm to self, HO = Harm to others, HU = Hubris, OC = Outcomes.

Table 2. Intercorrelations between the sisu factors and inter-item correlations within a single factor.

	1.LP	2. AM	3. EP	4. CF	5. HR	6. HS	7. HO	8. HU	9. OC
1. Latent power	**(0.64)**	**0.66**	**0.40**	*0.32*	-0.05	0.11	-0.08	*-0.34*	0.05
2. Action mindset		**(0.44)**	**0.43**	**0.41**	-0.23	-0.08	-0.14	*-0.35*	-0.06
3. Extraordinary perseverance			**(0.52)**	**0.55**	0.03	0.12	0.25	0.05	*0.38*
4. Control over fate				**(0.53)**	-0.04	-0.04	0.08	-0.05	0.13
5. Harm to reason					**(0.57)**	*0.38*	*0.37*	0.20	*0.36*
6. Harm to self						**(0.64)**	**0.56**	**0.47**	*0.32*
7. Harm to others							*(0.37)*	**0.51**	*0.31*
8. Hubris								**(0.51)**	0.20
9. Outcomes									(0.26)

Pearson correlations. Average inter-item correlation within each factor on diagonal, coefficients $|r|>0.4$ emboldened, $|r|>0.3$ in italics.

interest) and Hardiness (*challenge)*. Using only the three positive factors from Lahti (2019) (LP, AM, EP) yielded slightly larger correlations (r = 0.27–0.72) approaching the level of 0.6 with most measures, which can be taken to be indicative of construct redundancy (Le et al., 2010). The linear combination of all the included mental fortitude scales along with age and sex predicted over half of the variance in the *beneficial sisu* score (adjusted $R^2 = 0.57$).

The *harm to reason* factor had consistent moderate negative correlations with the other fortitude scales. *Hubris* exhibited a similar profile, albeit with lower correlations. On the other hand, *harm to self, harm to others* and *outcomes* had only low negative associations. Consequently, using only the three negative factors from Lahti (2019) (HR, HS, HO) resulted in significant but low general associations with existing fortitude measures. This relative independence was also observed in the low amount of variance ($R^2 = 0.14$) in the *harmful sisu* score explained by a linear combination of existing scales of mental fortitude.

Table 4 shows how the *beneficial and harmful* factors of *sisu* relate to the personality measures. As expected, compared to the fortitude measures, the associations were lower to a degree. The *beneficial sisu* items had high positive correlations with BHI *extraversion* (r = 0.45) and rBAS (r = 0.51), but substantial negative correlations with BHI *emotionality* (r = -0.38) and *Freeze* (r = -0.41). *Control over fate* had weaker associations compared to the other three positive factors. BHI personality dimensions, age and sex in combination predicted one third of the variance (R^2 = 0.32) in the *beneficial sisu* score. A similar magnitude was observed with r-RST scales ($R^2 = 0.34$) as a predictors.

As with the mental fortitude scales, *harmful sisu* (3 sub-factors) again had weaker connections with personality dimensions than *beneficial sisu,* exhibiting a moderate negative correlation only with BHI *honesty-humility* (r = -0.32). *Hubris* had a moderate negative correlation with BHI *extraversion* (r = -0.37), whereas *outcomes* had a moderate negative correlation with rBIS (r = 0.38). The BHI personality dimensions ($R^2 = 0.14$), as well

Table 3. Intercorrelations between sisu factor sum scores and associated mental fortitude scales.

	MTQ-10	RS-14	GRIT-S		Hardiness			HOPE		GSE
			CI	PE	CM	CO	CH	PW	AG	
1. Latent power	**0.48**	**0.61**	0.14	*0.38*	**0.42**	*0.38*	*0.34*	**0.45**	**0.48**	**0.52**
2. Action mindset	**0.53**	**0.57**	0.24	**0.42**	*0.36*	*0.37*	**0.44**	**0.47**	**0.45**	**0.56**
3. Extraord. perseverance	**0.43**	**0.55**	0.29	**0.45**	**0.43**	*0.37*	0.18	**0.50**	**0.50**	**0.55**
4. Control over Fate	*0.37*	**0.42**	0.23	*0.31*	**0.44**	**0.45**	0.08	*0.36*	**0.44**	**0.40**
5. Harm to reason	**-0.47**	*-0.36*	**-0.44**	*-0.32*	*-0.37*	*-0.36*	-0.13	-0.23	***-0.34***	***-0.37***
6. Harm to self	-0.06	0.04	-0.15	0.01	-0.05	-0.02	0.07	0.10	0.06	0.04
7. Harm to others	-0.14	-0.06	-0.09	-0.11	-0.17	-0.12	-0.07	-0.04	-0.06	-0.07
8. Hubris	*-0.32*	*-0.31*	-0.15	-0.25	*-0.36*	*-0.38*	-0.16	-0.19	-0.27	-0.23
9. Outcomes	-0.20	-0.05	-0.14	0.01	-0.08	-0.05	-0.07	-0.02	0.04	-0.02
Beneficial sisu (1.-3.)	**0.59**	**0.72**	0.27	**0.51**	**0.50**	**0.46**	**0.40**	**0.59**	**0.59**	**0.67**
Harmful sisu (5.-7.)	*-0.30*	-0.16	*-0.30*	-0.19	-0.26	-0.22	-0.07	-0.08	-0.15	-0.18

Pearson correlations. Coefficients |r|>0.09 are significant ($p < 0.05$), |r|>0.4 emboldened, |r|>0.3 in italics. Highest association for each factor underlined. CI = *Consistency of Interest*. PE = *Perseverance of effort*. CM = *Command*, CO = *Control*, CH = *Challenge*, PW = *Pathways*, AG = *Agency*.

Table 4. Intercorrelations between sisu factor sum scores and Brief HEXACO Inventory and Revised Reinforcement Sensitivity Theory scales.

	Brief HEXACO Inventory (BHI)						r-RST (Jackson-5)				
	EMO	EX	AG	HH	CO	OP	rBAS	rBIS	FI	FL	FR
1. Latent power	-0.24	**0.41**	0.14	0.01	0.11	0.19	**0.44**	0.09	0.03	-0.06	-0.25
2. Action mindset	**-0.42**	*0.38*	-0.09	-0.08	0.08	0.25	**0.50**	0.02	0.15	-0.19	**-0.48**
3. Extr. perseverance	-0.25	*0.31*	0.04	0.02	0.16	0.05	*0.30*	0.15	0.09	0.09	-0.26
4. Control over fate	-0.24	0.23	0.14	-0.02	0.18	-0.03	0.19	0.14	-0.01	-0.02	-0.18
5. Harm to reason	0.22	-0.23	-0.02	-0.21	-0.24	0.02	-0.12	0.11	0.10	0.16	0.29
6. Harm to self	-0.07	0.06	-0.01	-0.18	-0.09	0.18	0.18	0.17	0.10	0.09	-0.03
7. Harm to others	0.00	-0.18	-0.28	*-0.31*	-0.06	0.01	0.02	0.23	0.29	0.09	-0.03
8. Hubris	0.06	*-0.37*	0.05	-0.19	-0.09	-0.01	-0.16	0.08	0.10	0.02	0.18
9. Outcomes	0.08	-0.13	-0.03	-0.18	-0.04	0.09	0.01	*0.38*	0.10	0.11	0.08
Beneficial sisu (1.-3.)	*-0.38*	**0.45**	0.04	-0.02	0.15	0.20	**0.51**	0.10	0.11	-0.07	**-0.41**
Harmful sisu (5.-7.)	0.07	-0.16	-0.15	*-0.32*	-0.17	0.09	0.03	0.23	0.23	0.15	0.09

Pearson correlations. Coefficients |r|>0.09 are significant ($p < 0.05$). Coefficients |r|>0.4 emboldened, |r|>0.3 in italics. Highest association for each factor underlined. EMO = *Emotionality*, EX = *Extraversion*, AG = *Agreeableness*, HH = *Honesty-humility*, CO = *Conscientiousness*, OP = *Openness*, rBAS = *Behavioral approach system*, rBIS = *Behavioral inhibition system* FI = *Fight*, FL = *Flight*, FR = *Freeze*.

as r-RST scales ($R^2 = 0.12$), explained a low amount of variance in *harmful sisu*.

Based on these results, the six factors corresponding to the sub-components suggested by Lahti (2019) were taken to show adequate degree of internal and external structure and used in the further analysis.

3. Study 2: scale validation

For confirmatory analysis of the factor structure suggested in Study 1, a second independent sample was collected using a separate questionnaire containing only the revised set of *beneficial and harmful sisu* items. The authors (PH and IM) appended the *harm to reason* and *harm to self* subscales by creating and adding a third item to each one, resulting in an final 18-item version of the Sisu Scale with three items per subscale. The items were randomised and rated on a scale ranging from one ("strongly disagree") to five ("strongly agree"). Outcomes pertaining to well-being were assessed by two single items, namely "How satisfied are you with your life as a whole?" and "How is your health in general?" ($r = 0.43$).

We examined the fit indices of various different models to determine the optimal structure of the relationships between the *beneficial and harmful sisu* items. Diagonally weighted least squares (DWLS) estimator was used, as recommended for ordered categorical data (Li 2016). Model comparison was based on chi-square value tests, supplemented by comparison of the scaled CFI (Comparative fit index), TLI (Tucker-Lewis index), RMSEA (Root mean square error of approximation) and SRMR (Standardised root mean squared residual) fit indices. CFI and TLI values of over 0.95 and a RMSEA value of below 0.06 were considered to indicate a relatively well-fitting model, whereas CFI and TLI of over 0.90 were interpreted as satisfactory (Hu and Bentler, 1999). Additionally, we applied a bifactor model to the items to address the (uni)dimensionality of the respective general factors of *beneficial and harmful sisu* and to calculate the independence and internal reliability measures of their sub-factors (Rodriguez, Reise & Haviland, 2016). We tested the measurement models for invariance attributable to sex and age by comparing models with constrained loadings and intercepts. In cases of established invariance, the latent means of the sub-factors were compared between groups. Finally, the best fitting model was expanded into a structural model predicting well-being, and the ratio of explained variance was examined.

3.1. Participants

The same means of recruitment, compensation and administration were used as in Study 1. Of the 488 respondents, 57 had participated in Study 1, or provided matching contact information, and were excluded along with participants with missing responses (n = 2) and respondents who gave more than seven identical consecutive answers (n = 6). Thus, the validation sample that comprised 423 respondents (343 or 81.09%

female). The mean age was 28.63 years (range = 19–65, SD = 7.82). Hence, the sample demographics were similar to those in Study 1 but there were no overlapping subjects.

3.2. Results

A model with two separate and correlated nine-item *beneficial* and *harmful sisu* factors did not fit the data (CFI = 0.653, TLI = 0.603, RMSEA = 0.153, SRMR = 0.146). However, a measurement model with six independent and correlated factors, illustrated in Figure 1A, demonstrated an acceptable fit (CFI = 0.940, TLI = 0.923, RMSEA = 0.067, SRMR = 0.062): *beneficial sisu* sub-factors exhibited a high degree of covariance, whereas *harmful sisu* sub-factors were moderately associated. A model with a correlated single *beneficial sisu* factor and three separate *harmful sisu* sub-factors had a slightly worse, although still acceptable fit (CFI = 0.930, TLI = 0.917, RMSEA = 0.070, SRMR = 0.068). The large negative covariances between *harm to reason* and all three sub-factors of *beneficial sisu* indicate that the two latent *beneficial* and *harmful sisu* structures are not entirely positively correlated, as initially expected. Accordingly, the best overall fit was achieved with a high-level model in which *harm to reason* was allowed to be cross-predicted by both *beneficial* and *harmful* latent structures (CFI = 0.942, TLI = 0.930, RMSEA = 0.064, SRMR = 0.066). This model fitted significantly better than the measurement model. Expanding it to predict well-being via the latent *beneficial* and *harmful* structures resulted in an additional improvement in the fit (CFI = 0.946, TLI = 0.936, RMSEA = 0.058, SRMR = 0.063). A large portion of the variance of the two-item well-being measure was predicted by the latent factors ($R^2 = 0.58$). The structural model is illustrated in Figure 1B. Tables detailing the complete model parameters and fit indices are included in the Supplemental Table 2.

A bifactor model with categorical variables and DWLS estimator did not converge, so robust maximum likelihood (MLR) with continuous data was used in the calculation of the bifactor indices. *Beneficial sisu* emerged as a solid unidimensional construct in terms of an explained common variance (ECV) value of 0.82 and an omega hierarchical (ωH) value of 0.80. Low amount of general variance was accounted for by the *beneficial sisu* sub-factors (ECV = 0.13–0.31), as evidenced in the low omega hierarchical values (ωH = 0.06–0.19), indicating that most of the variance was attributable to the common *beneficial sisu* factor. The internal reliability of the nine-item *beneficial sisu* scale was good (Omega coefficient of reliability; ω = 0.86). The *latent power* (ω = 0.72) and *action mindset* (ω = 0.71) subscales had satisfactory reliability, whereas that of the *Extraordinary perseverance* subscale was slightly less than satisfactory (ω = 0.65). The *harmful sisu* general factor could not be established as essentially unidimensional (ECV = 0.46, ωH = 0.60), given the relatively large degree of independence in the *harm to reason* (ωH = 0.57) and *harm to others* (ωH = 0.45) subscales. The internal reliabilities of the nine-item *harmful sisu* scale (ω = 0.83) and the *harm to self* subscale (ω = 0.82) were good. The reliability of the *harm to reason* subscale (ω = 0.71) was satisfactory, whereas that of *harm to others* was mediocre (ω = 0.67). The complete bifactor loadings and dimensionality indices are included in the Supplemental Table 3.

Invariance attributable to sex (male vs. female) and age (below or above the sample median) was tested on the measurement model containing the six subscales (see Figure 1A), using DWLS estimation. Configural models with no constraints produced a satisfactory fit with both age (CFI = 0.915, RMSEA = 0.051) and sex (CFI = 0.917, RMSEA = 0.049). Constraining the item loadings to their respective factors to be equal between the groups did not deteriorate the model fit significantly, thus indicating metric invariance (equal item loadings among the groups). In a similar fashion, constraining both the item loadings and the intercepts did not significantly weaken the model fit either in terms of sex, thus indicating scalar (strong) invariance (equal item intercepts among the sexes). For age, establishing strong invariance required relaxing the constraint on equal intercepts for single item (AM1), according to methods described in Putnick and Bornstein (2016), The

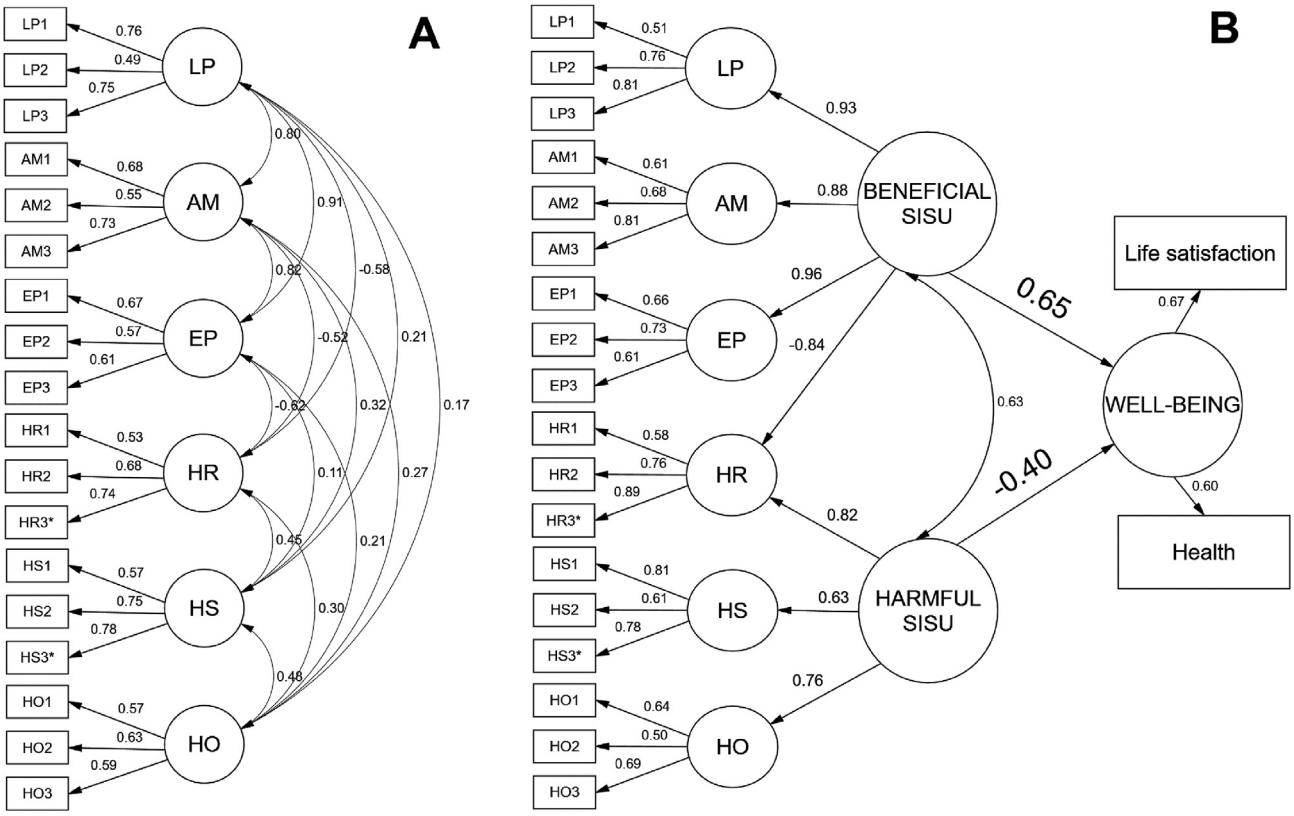


Figure 1. Loadings and covariances of the six Sisu Scale factors in measurement model (A) and in high level structural model with cross-loaded HR sub-factor and predicting well-being (B).

six-factor measurement model was thus shown to be adequately invariant with regard to sex and age, allowing comparison of the means of the latent sub-factor scores for *beneficial and harmful sisu*. The model parameters with different constraints are provided in the Supplemental Table 4. Younger participants (below 26 years of age; n = 185) achieved significantly higher scores in the *extraordinary perseverance* sub-factor (z = 2.34, $p < 0.05$) compared to the older participants (26 years of age or older, n = 237), and they exhibited a trend of lower *harm to reason* scores (z = -1.73, $p = 0.08$). Males (n = 79) had higher scores than females (n = 343) on the *harm to reason* subscale (z = 2.69, $p < 0.01$), and tended to have lower scores in the *extraordinary perseverance* sub-factor (z = -1.84, $p = 0.07$). Total sample and group means are provided in Supplemental Table 5.

4. Study 3: predictive associations with well-being

We collected a third dataset to compare the predictive associations of the Sisu Scale with further measures of positive and negative well-being, stress and work stress. We selected such variables for this study that would measure both negative and positive well-being, as well as a work stress measure, which measures the individual's relationship with the immediate environment, which may be supportive or harmful. To simplify the analysis, we did not use the sub-factors of sisu. Instead, *beneficial* and *harmful sisu* were utilised in the analyses of Study 3. We assessed predictive capacity by means of stepwise regression analysis, observing the degrees of accounted variance in the dependent variable, indicated by an adjusted R^2 statistic and its change between models. We started by comparing a model containing age and sex (model 1), then we included another mental fortitude score as a control variable (model 2) and finally included the scores for *beneficial and harmful sisu* (model 3). Independent analyses were conducted for each of the three dependent variables (WHO-5, CES-D, ERI) and with two separate control variables (MTQ-10 and GRIT-S). The control variables were included to facilitate investigation of the convergent validity of the Sisu Scale. MTQ-10 was included on the basis of the exploratory analysis conducted on the Study 1 sample, in which the scale emerged with highest predictive capacity over the two previously utilised well-being items from the set of all included fortitude scales (β = 0.26). GRIT-S was chosen partly because of its relative distance in correlational patterns from the Sisu Scale used in Study 1, and partly given its prevalent usage in contemporary studies as a direct equivalent to the concept of sisu (see Tang et al., 2019).

4.1. Participants

These data were collected from knowledge workers employed in four Finnish companies as part of a longitudinal study for which physiological (e.g. heart rate, skin conductance) and behavioural (accelerometer) measurements were taken continuously via wearable devices over a three-week period. In addition, ESM/EMA self-reports were administered three times a day. We collected the data utilised for assessing the associations between the Sisu Scale scores and well-being measures at the onset of the longitudinal study via an online form, which was sent by e-mail to the participants. All the participants were given movie tickets as compensation for taking part in the longitudinal study. The dataset contained material from 82 respondents (52 or 63.41% female) with a mean age of 41.03 (range = 24–58, SD = 8.51) years. Thus, the sample was older and more balanced in terms of sex ratio than the samples in Studies 1 and 2.

4.2. Measures

We used the 18-item version of the Sisu Scale, equal to the one introduced in Study 2. Scores on the respective subscales were used as predictors, each one containing nine items: *beneficial sisu* exhibited good reliability (α = 0.82) whereas *harmful sisu* was slightly beyond the borderline of satisfactory (α = 0.69).

We also used the **MTQ-10** (α = 0.74) and **GRITS-S** (α = 0.84) scales as alternative measures of mental fortitude. Positive well-being was measured on the five-item **WHO-5** scale (Topp et al., 2015), which has proved to be useful in studying general well-being and had satisfactory reliability (α = 0.78). Negative well-being was assessed on the 20-item **CES-D**, which measures depression (Radloff, 1977). The reliability of the CES-D was good (α = 0.88). Work stress was assessed on the 16-item **ERI scale**, which measures effort-reward balance: more effort and less reward lead to higher levels of work stress (Siegrist, 1996). The scores were calculated as a ratio of the subscales, which exhibited satisfactory reliability (*rewards* α = 0.79; *effort* α = 0.73). A single-item measure was used to assess general stress (Elo, Leppänen & Jahkola, 2003).

4.3. Results

The beneficial sisu scale correlated significantly with the WHO-5 mental-well-being measure (r = 0.41, p < 0.001) and had a negative correlation with CES-D depressive symptoms ($r = -0.27$, $p < 0.05$). The *harmful sisu* scale exhibited an inverse pattern, correlating negatively with WHO-5 ($r = -0.33$, $p < 0.01$) and positively with CES-D ($r = 0.52$, $p < 0.001$), ERI work stress ($r = 0.46$, $p < 0.001$) and perceived general stress ($r = 0.39$, $p < 0.001$).

Stepwise regression analysis results are presented in Table 5. Three separate analyses were done with the following dependent variables: well-being (WHO-5), depressive symptoms (CES-D) and work stress (effort-reward imbalance, ERI). Independent variables were added into each of the analysis in a stepwise manner. For instance, well-being (WHO-5) was first predicted by GRIT-S only (step 2A), then beneficial sisu and harmful sisu were added into the same analysis in the next step (step 3A). The analysis with mental toughness (MTQ-10) was executed in a similar fashion, denoted by steps 2B and 3B.

When predicting positive well-being (WHO-5), the *beneficial* and *harmful sisu* measures accounted for additional variance over GRIT-S ($\Delta R^2 = 0.18$, $p < 0.001$). The full model (step 3A) predicted 35 per cent of the variance, *beneficial sisu* being the most prominent predictor (β = 0.42. $p < 0.001$). GRIT-S had a trending positive contribution (β = 0.21, $p < 0.10$) whereas *harmful sisu* had a trending negative effect (β = -0.20, $p < 0.10$). When we included MTQ-10 as a control variable in the other full model (step 3B) only *beneficial sisu* had a trending (positive) effect (β = 0.20, $p < 0.10$). This model was the most prominent predictor (β = 0.46, p < 0.001), and explained 43 per cent of the variance in WHO-5.

With regard to negative well-being (CES-D), the models with Sisu Scale proved superior to both models with GRIT-S ($\Delta R^2 = 0.23$, $p < 0.001$) and with MTQ-10 ($\Delta R^2 = 0.14$, $p < 0.001$). In the GRIT-S full model (step 3A), both *beneficial* (β = -0.34, p < 0.001) and *harmful* (β = 0.45, $p < 0.001$) *sisu* emerged as the only significant predictors. This model accounted for 42 per cent of the variance in CES-D. *Harmful sisu* (β = 0.42, $p < 0.001$) had the largest predictive capacity in the full model with MTQ-10 (step 3B), followed by MTQ-10 (β = -0.29, $p < 0.05$) and surpassing *beneficial sisu* (β = -0.21, $p < 0.10$), which had a trending effect. The second control model accounted for 45 per cent of the variance in CES-D.

As for work stress (ERI), only the models containing Sisu Scale had additional predictive power over sex and age. Compared to the model with GRIT-S (step 2A), the full model increased R^2 by 0.22, with a total of 28 per cent of the variance explained. In this full model (step 3A), both *harmful sisu* (β = 0.52, $p < 0.001$) and GRIT-S (β = 0.26, $p < 0.05$) were significant positive predictors of work stress. The positive effect of *harmful sisu* (β = 0.39, $p < 0.001$) and the total variance explained (23%) were comparable to the full model containing MTQ-10 (model 3B), which was not associated with the ERI scores.

5. Discussion

We have presented and validated a scale for measuring the psychological construct of sisu. We also examined sisu's associations with other

Table 5. Regression coefficients and stepwise changes (1–3) in determination of three dependent variables between parallel models including either GRIT-S (A) or MTQ-10 (B) as predictor along with beneficial and harmful sisu in office worker data (n = 82).

Dependent variable	Step	Added predictors	Beta	t		R^2	Adj. R^2	ΔR^2	
WHO-5	1	Sex, age				0.05	0.03	0.05	
Well-being	2A	GRIT-S	0.41	4.02	***	0.21	0.18	0.16	***
	3A[1]	GRIT-S	0.21	1.92	†	0.39	0.35	0.18	***
		Beneficial sisu	0.42	4.52	***				
		Harmful sisu	-0.20	-1.89	†				
	2B	MTQ-10	0.64	7.23	***	0.43	0.41	0.38	***
	3B	MTQ-10	0.46	3.78	***	0.46	0.43	0.03	
		Beneficial sisu	0.20	1.82	†				
		Harmful sisu	-0.14	-1.52					
CES-D	1	Sex, age				0.04	0.02	0.04	
Depression	2A	GRIT-S	-0.44	-4.33	***	0.23	0.20	0.19	***
	3A[2]	GRIT-S	-0.13	-1.28		0.46	0.42	0.23	***
		Beneficial sisu	-0.34	-3.87	***				
		Harmful sisu	0.45	4.59	***				
	2B	MTQ-10	-0.57	-5.95	***	0.34	0.31	0.30	***
	3B	MTQ-10	-0.29	-2.41	*	0.48	0.45	0.14	***
		Beneficial sisu	-0.21	-1.88	†				
		Harmful sisu	0.42	4.54	***				
Effort-reward imbalance (ERI)	1[2]	Sex, age				0.11	0.09	0.11	*
	2A[2]	GRIT-S	0.02	0.19		0.11	0.07	0.00	
Work stress	3B[2]	GRIT-S	0.26	2.28	*	0.33	0.28	0.22	***
		Beneficial sisu	0.07	0.67					
		Harmful sisu	0.52	4.78	***				
	2B[2]	MTQ-10	-0.08	-0.71		0.11	0.08	0.01	
	3B[2]	MTQ-10	-0.03	-0.24		0.28	0.23	0.17	***
		Beneficial sisu	0.15	1.15					
		Harmful sisu	0.39	3.57	***				

*** = p < .001, * = p < 0.05. † = p < 0.10

[1] Sex(male) significant ($p < 0.05$) positive predictor in the model

[2] Sex(male) significant ($p < 0.05$) negative predictor in the model, Adj. R^2 = Adjusted $R^{2,}$ $\Delta R^{2,}$ = R^2 change from previous model.

scales assessing mental fortitude and personality traits as well as well-being, depressive symptoms, work stress and general stress. The initial exploratory analysis revealed a factor structure that was consistent with the previously suggested model (Lahti 2019) of *beneficial sisu* as comprising *latent power*, *action mindset* and *extraordinary perseverance*. These three sub-factors form an essentially unidimensional structure and could reliably be used as a single scale with high internal consistency. The sub-factor reliabilities were above satisfactory with the exception of *extraordinary perseverance*, which implies the need to exercise caution in using sub-factor scores as a separate measure. A fourth factor, dubbed *control over fate,* emerged as a further dimension of sisu. Although it was not included in the final scale, future studies may benefit from the finding and could explore the linkage further.

According to predictions, and complementing the standard interpretation of sisu, *harmful sisu* emerged as an independent construct. It consisted of three sub-factors, labelled *harm to reason*, *harm to self* and *harm to others*, confirming previous research (Lahti 2019). However, the three-factor solution used in this study was theory-driven as other interpretations of the number of the harmful sisu sub-factors would also be possible. Even though the loading patterns in the exploratory analysis indicated a solid underlying construct of *harmful sisu*, full unidimensionality was not demonstrated in the confirmatory bifactor analysis. This implies that the sub-factors are somewhat more independent from the general construct of *harmful sisu*. The internal reliabilities of the general factor and the sub-factors were satisfactory except for *harm to others,* which was slightly below the threshold. In addition to the three expected dimensions, two unexpected factors emerged under *harmful sisu*: *hubris* and *outcomes*. The harmful context of social behaviour thus warrants further research, specifically on the combination of *harm to others* that has items related to social consequences, and *hubris* that is concerned with attitudes. Harmful sisu, despite having some possible structural issues, seems to be a promising construct due to its many associations with well-being-related variables.

In general, as evidenced by the very good fit indices of our model with intercorrelated sub-factors, the proposed 18-item model captures relevant variance related to *sisu*. However, a further improved fit was obtained by allowing prediction of the *harm to reason* sub-factor by both the *beneficial* and the *harmful* latent constructs. This finding has multiple possible implications. First, it highlights the pivotal role of *harm to reason*, manifested as directed and focused effort in measures of mental fortitude. However, this cognitive side of mental fortitude is never presented as an explicit factor in other scales. Second, when the model allowing this cross-loading was applied, the covariance between the beneficial and the harmful latent constructs was positive. If *harm to reason* is omitted, the *beneficial* and *harmful sisu* scores are independent. The otherwise independent aspects of sisu thus converge on this factor, which warrants future investigation with path models, for example. Alternatively, the *beneficial sisu* subscale could be appended to include the *harm to reason* items and thereby increase its scope. Full description of the scale, as used in Studies 2 and 3 is provided in Supplemental Table 6A (in English) and 6B (in Finnish).

As expected, sisu was strongly associated with well-being, as evidenced in the structural model that had an excellent fit to the data. The constructs of latent *beneficial and harmful sisu*, measured with the six sisu sub-factors, predicted over half of the variance of the dependent variable comprising life satisfaction and health perception, findings that were

replicated in a work context with a non-student sample. This is in line with previous research findings on other scales of mental fortitude traits showing multiple associations with well-being: hardiness (Skomorovsky and Sudom, 2011), resilience (Harms et al., 2018), grit (Datu, Valdez & King, 2016), hope (O'Sullivan, 2011; Satici 2016) and mental toughness (Stamp et al., 2015). However, the direction of causality is as yet uncertain: it may be that sisu affects well-being and that well-being affects sisu.

Given the association between several traits of mental fortitude and beneficial health behaviour and other positive health-related variables, further research on sisu and health behaviour could prove useful in the future. To be more specific, self-efficacy has been associated with beneficial health behaviour (Jackson, 2009). Grit associates with lower levels of drug use and a lower probability of getting into fights (Guerrero et al., 2016). Hardiness, although not directly correlated with health behaviour, has predicted behavioural preferences among individuals concerned about their health (Hannah, 1988).

Both *beneficial and harmful sisu* subscales were shown to be invariant regardless of sex and age, which means that the loadings and item intercepts are equivalent and that the scale can be used in a similar fashion in the total population. There were detectable differences in the latent subscale scores: women and younger people had higher levels of *extraordinary perseverance*, yet lower *harm to reason.* This finding is in line with the results of previous research in which women reported higher levels of sisu (Lahti 2013).

Our findings imply that aspects of sisu could potentially be associated with age. It is known that some traits of mental fortitude may change to some degree over time: grit increases with age, on average, although the order of scores between individuals remains the same (Duckworth et al., 2007). On the other hand, there is evidence that resilience, associated with navigating childhood trauma for instance, is quite a stable trait (Linnemann et al., 2020). Future longitudinal studies are required to investigate the change or stability over time of the sisu trait and its subcomponents.

According to our results, *beneficial sisu* correlates highly or relatively highly with the other mental fortitude scales, with the exception of the Grit-S subscale *consistency of interest.* We observed the strongest associations with resilience (RS-14) and self-efficacy (GSE). The correlational pattern could be interpreted as exhibiting some construct redundancy—*beneficial sisu* appearing to be part of the family of existing mental fortitude traits, with their linear combination accounting for over half of its variance. *Harmful sisu,* on the other hand, did not associate strongly with other mental fortitude traits, and as expected, all of the associations were negative. The predictive capacity of the dual sisu model was superior to that of existing mental fortitude scales in predicting positive and negative mental health and work stress. Significant increases in explained variance were achieved when we supplemented the MTQ-10 and Grit-S scales with measures of *beneficial and harmful sisu*. These results further support the saliency of the *harmful sisu* component and its potential use in future studies.

Personality explained only one third of the variation in *beneficial sisu*, which in itself was strongly positively associated with extraversion and *rBAS*, slightly associated with conscientiousness and openness, and negatively associated with emotionality and freezing. Previous research has indicated that resilience correlates negatively with neuroticism and positively with the other five traits (O'Sullivan, 2011). This is largely compatible with our findings.

Harmful sisu was inversely associated with *honesty-humility*. Mental fortitude may have its dark side: it was suggested in a recent study that narcissistic personality traits increase mental strength, which will in turn improve one's ability to cope with stress (Papageorgiou et al., 2019). Grit has been suggested to be disadvantageous in some situations (Alaoui and Fons-Rosen, 2021; Khan, Neveu & Murtaza, 2021; Lucas et al., 2015). Furthermore, *harmful sisu* was associated only slightly with rBIS*, fight* and *flight,* and slightly inversely associated with extroversion, agreeableness and conscientiousness: these findings could be taken as further evidence of *harmful sisu* as an independent construct that existing measures of personality traits do not explicate. However, results connected with the BHI personality dimensions should be interpreted with caution given that, except for *extraversion*, the internal reliabilities were low.

The study has some potential limitations. The first two samples predominantly comprised females and university students, which may affect the generalisability of the findings. However, equivalent results were obtained from the third sample, which although smaller in size represented a non-student adult population (i.e. white-collar workers). The fact that the results and the majority of the studies discussed concern cross-sectional samples makes it challenging to conclude anything about causal relationships, thereby highlighting the need for future longitudinal studies on the subject.

Based on the discovery of salient harmful component of sisu, we endorse further research on it, or even the creation of novel scales utilising it. However, in future applications, concern should perhaps be exercised in using terms such as "*harmful sisu*", which may be interpreted as too negative or stigmatising. Other ways for labelling the scales could be used: for example, *beneficial sisu* could be referred to as "sisu 1" *and harmful sisu* as "sisu 2".

Our research did achieve its initial goals, resulting in an internally and externally reliable scale, advancing the line of research on sisu, and adding new aspects to the study of traits related to mental fortitude. The notion of *harmful sisu* in particular, with its multiple strong associations with well-being-related variables and only a few associations with other questionnaires, may add something that is almost completely lacking in the existing research literature. Although domiciled in Finland as a cultural construct, sisu may well be a universal capacity unconstrained by cultural or geographic boundaries. It is a novel term in the field of psychology, but in light of research conducted so far, we propose that it has much to offer in terms of deepening collective understanding of the determinants of achievement and of the ability in individuals constructively to endure and navigate tough times.

The research on the practical and clinical applications of the Sisu Scale is ongoing. In the future, the scale and feedback could also be used as a way to increase one's self-awareness. Research is also ongoing regarding the Sisu Scale feedback. Among other possible use-cases the Sisu Scale could also be utilised by psychotherapists and well-being professionals as a non-clinical tool to find possible reasons for poor well-being, which may not visible using other scales.

We don't yet know the possible associations between Sisu Scale and personality disorders or serious mental disorders, such as psychosis and schizophrenia. Future research may reveal further associations. It could be speculated that obsessive-compulsive personality disorder (OCPD) might be associated with harmful sisu, as they contain some similarities, such as rigidity and interpersonal problems related to stubbornness of the individual (American Psychiatric Association [APA], 2013). It must be emphasised, however, that the Sisu Scale is not a clinical diagnostic tool and most people are not in the extreme ends of the continuum.

6. Conclusions

We created the novel Sisu Scale, which measures beneficial and harmful sisu and is based on the Finnish language. The Sisu Scale demonstrates adequate internal and external validity along with invariance due to age and gender. The scale has been translated into English and German and is meant to be used internationally, as a useful new research tool. Sisu has strong associations with well-being related variables. Beneficial sisu was positively associated with well-being and negatively associated with depressive symptoms. Harmful sisu was negatively associated with well-being and positively associated with depressive symptoms, general stress and work stress. The Sisu Scale is independent from previously exiting questionnaires, although beneficial sisu has

associations with pre-existing mental fortitude measures. Sisu is not sufficiently explained by personality traits, i.e. using a separate scale that measures sisu is warranted. Harmful sisu is a completely new measure, which has particularly low associations with personality or other similar measures.

Declarations

Author contribution statement

Pentti Henttonen; Ilmari Määttänen: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Emilia Makkonen; Vilja Seppälä: Performed the experiments; Wrote the paper.

Anita Honka; Johanna Närväinen; Markus Jokela: Contributed reagents, materials, analysis tools or data; Wrote the paper.

Regina Garcia-Velazquez; Jaakko Airaksinen: Analyzed and interpreted the data; Wrote the paper.

Emilia Elisabet Lahti: Conceived and designed the experiments; Wrote the paper.

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Data availability statement

The data that has been used is confidential.

Declaration of interest's statement

The authors declare no conflict of interest.

Additional information

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