



Growth Mindset Scale: Aspects of reliability and validity of a new 8-item scale assessing growth mindset

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ABSTRACT

In this article, the psychometric properties of a new scale aimed at quantifying Growth Mindset are explored. Growth Mindset Scale is a quantitative measure which is context independent and simple to administer.

Growth Mindset Scale was tested on 723 participants between 16 and 85 years of age (mean age = 28.56, SD = 12.14), which allowed for the exploration of feasibility, internal consistency, and construct validity.

The results indicate that the growth mindset scale is applicable for the age studied (16–85). All individual item scores showed a positive correlation with the total score and ranged between 0.45 and 0.63. The Cronbach's alpha value was 0.83 for the standardized items. Pearson's correlation coefficient between the total score of the Growth Mindset Scale and the total score of Theories of intelligence scale was $r = 0.168$ ($p < 0.001$).

These encouraging results assure additional improvement of the growth mindset scale, involving normalization based on a larger, representative sample.

1. Introduction

Growth mindset has been identified as a crucial factor associated with motivational processes, achievement, and well-being (Dweck, 2017; Sarrasin et al., 2018; Sigmundsson et al., 2020a). Additionally, it plays a vital role in the development of expertise and excellence (Sigmundsson et al., 2020a, 2020b). An intricate interplay among various factors including deliberate practice (Ericsson et al., 2007), passion for achievement (Sigmundsson et al., 2020b), grit (Duckworth et al., 2007), growth mindset (Dweck & Leggett, 1988) and follow up/significant others (teacher, trainer, mentor) (Ericsson & Pool, 2016) appears to be essential prerequisites for individuals to be maintain focused, engage in sufficient practice and training, and ultimately become experts (Sigmundsson et al., 2020a, 2020b).

Carol Dweck has been a significant researcher in mindset research for decades. In 1973, she published a paper focusing on learned helplessness and reinforcement responsibility in children (Dweck & Reppucci, 1973). Over a span of 50 years, Dweck has evolved her ideas regarding the importance of cultivating a growth mindset i.e., the ability to see opportunities rather than obstacles and to believe in the malleability and development of personal attributes (Dweck & Yeager, 2019).

In the 1980s, Dweck introduced the basic ideas of growth and fixed,

which she named adaptive motivational patterns ('growth') and maladaptive motivational patterns ('fixed'). Adaptive motivational patterns (mastery orientated) promote: "... the establishment, maintenance, and attainment of personally challenging and personally valued achievement goals." (Dweck, 1986, p. 1040). Conversely, maladaptive patterns (helpless) are associated with "... a failure to establish reasonable, valued goals, to maintain effective striving towards those goals ..." (Dweck, 1986, p. 1040). Two years later, Dweck and Leggett (1988) introduced the terms entity and incremental conceptions of intelligence, later changed to the more user-friendly terms growth (incremental) and fixed (entity) mindsets (Dweck & Yeager, 2019).

Mindset can be defined as a set of beliefs in our own abilities, attributes, and traits such as intelligence and personality (Dweck, 2012). According to Dweck's model of *Implicit Theories of Intelligence*, people may hold different "theories" about the nature of intelligence (Blackwell et al., 2007), which can be divided in two frameworks: fixed and growth mindsets. Individuals with a fixed mindset tend to believe that human attributes and traits are fixed and permanent qualities, while those with a growth mindset assume that qualities are malleable, prone to change and development, rather than fixed, and see them as something that can be enhanced and shaped (Dweck & Leggett, 1988; Dweck & Yeager, 2019; Yeager et al., 2019). When experiencing setbacks or

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stressors across learning or achievement contexts (such as in sports, work, and educational domains) people with a growth mindset seem to exhibit more successful patterns of response, including more effective learning- and self-regulatory strategies, relative to those with a fixed mindset (Dweck, 2017). For example, when having a growth mindset, you think that you become more knowledgeable and skilled through effort, focus more on learning goals, and display mastery-oriented strategies (Blackwell et al., 2007).

2. Measurement of mindset

Psychological constructs may be challenging to measure, and mindset appears to be no exception. For instance, the type of mindset assessment is found to influence the link between incremental beliefs and achievement. Specifically, the use of specific versus general scales measuring mindset, and original versus adapted versions of the scale, strongly moderated the association between mindset and achievement (Costa & Faria, 2018). The Theories of intelligence scale (TIS) has been widely used to assess individuals' growth and fixed mindset (Dweck, 1999). Typically, the questions in TIS are formulated to reveal whether the belief about intelligence is fixed or can be changed (growth). For example, an entity theory item might be "You have a certain amount of intelligence and you really can't do much to change it", whereas an incremental theory item could be "You can always substantially change how intelligent you are". It is also important to note that the use of the term "intelligence" in these questions may be interpreted differently across cultures and samples (Furnham, 2000; Rammstedt & Rammesayer, 2000; Costa & Faria, 2018). Based on the theoretical framework of implicit theories (Blackwell et al., 2007), one could argue that aspects of mindset focusing on how individuals employ (or do not employ) successful patterns of response, such as different self-regulatory processes and learning strategies, should also be explicitly measured. This could involve formulations related to focus and learning goals.

2.1. The current study

In this article, we report on the development of a new scale aimed at the objectively quantifying of the construct Growth Mindset. The primary aim is to examine the applicability of the 8-item scale, its internal consistency and construct validity in a sample of young adults and adults. The overall goal is to contribute to the understanding of the complex construct of Growth Mindset.

3. Method

723 subjects participated in the study, with an average age of 29.84 years ($SD = 13.06$), ranging from 16 to 85 years. The average age of the female group was 28.56 ($SD = 12.14$, $N = 425$) and the male group was 31.67 ($SD = 14.01$; $N = 298$). All the participants answered both the Growth Mindset scale questions, the Theories of intelligence scale questions, the passion for achievement scale questions and the Grit-S questions (for the construct validity part of the study). Recruitment was conducted among young adults and adults in Norway in the spring 2023.

3.1. Measurements

3.1.1. Demographics

The participants in the study indicated their age, gender, and educational level.

3.1.2. Procedure

This study adhered to the ethical standards established by the National Committee for Research Ethics in Social Sciences and the Humanities (NESH) and the Norwegian Agency for Shared Services in Education and Research (Sikt). Since no personal data was collected, it

was considered that obtaining passive consent from the participants was sufficient. The information recorded about the participants was anonymized. Data were collected using the digital questionnaire tool nettskjema.no.

The Growth Mindset Scale was developed by our research group at NTNU. Initially, it was formulated appropriate questions for the scale based on the theories previously mentioned by Dweck. Subsequently, the first version of the scale underwent a pilot study to calculate internal consistency reliability, resulting in a reduction from 10 to 8 items.

3.2. Measures

3.2.1. Growth mindset scale

The Growth Mindset scale was used to measure the participants level of Growth Mindset. The participants scored eight items, using the rating of 1 = not like me at all to 5 = very much like me. The 5-point Likert scale is one of the most common scales (Likert, 1932) and was used for possible comparison to other central factors related to motivational such as passion and grit (Sigmundsson et al., 2020a). For an overview of the 8-items, see Table 1. The maximum score on this scale is 5 (high Growth Mindset) and the lowest is 1 (low Growth Mindset). In this study Cronbach's alpha proved a good internal consistency ($\alpha = 0.825$).

3.2.2. Mindset

Dweck's (1999) Theories of intelligence scale (TIS) was used to assess students' entity (fixed) and incremental (growth) conceptions of intelligence. The self-form for adults of this measure was used to ensure that the participants focused on their ideas about their own intelligence. This scale consists of several subscales with items rated on a 6-point Likert-type scale, from 1 (Strongly Agree) to 6 (Strongly Disagree). The items differ between those associated with an incremental theory (i.e., growth mindset) and those associated with an entity theory (i.e., fixed mindset). The reliability data for the scale comes from Dweck et al. (1995) and is based on the 8-item scale. The scale shows good internal consistency ($\alpha = 0.85$) and test-retest reliability at 2-weeks ($r = 0.80$). The scale also shows a good construct validity with scores predicting meaningful relationship with important variables (Dweck et al., 1995). The Norwegian version of TIS has also shown to be reliable, with Cronbach's α of 0.86 for entity items and 0.88 for the incremental items (Bråten & Strømso, 2004).

3.2.3. Passion

For analyzing the participants' passion levels the Passion scale was used (Sigmundsson et al., 2020a). Participants provided ratings for eight items on a scale ranging from 1 (not like me at all) to 5 (very much like me). The scale's maximum score is 5, indicating extreme passion, while the minimum is 1, denoting no passion at all. The Passion scale demonstrated robust internal consistency, with a Cronbach's alpha value of 0.86, and exhibited strong test-retest reliability, as evidenced by an Intraclass Correlation Coefficient (ICC) of 0.92 between test and retest total scores ($N = 21$, mean age 23.67, $SD = 2.41$). Additionally, the scale demonstrated construct validity, as indicated by a Pearson correlation coefficient of 0.39 between the total scores of Passion and

Table 1
The growth mindset questions.

1.	I know that with effort I can improve my skills and knowledge
2.	I can influence and change my development in general
3.	I can change my skills and knowledge through practice
4.	I like to take challenges and try new things
5.	I see learning as my goal
6.	Effort makes me stronger
7.	I want to spend more time and work more on an area/theme/skill to develop my skills and knowledge
8.	I have faith in my own skills and my possibilities

the Grit S Scale for adults with a mean age of 21.23 (SD = 3.45) (N = 107) (Sigmundsson et al., 2020a).

3.2.4. Grit

To measure participants' grit levels the Grit S, short grit scale was used (Duckworth & Quinn, 2009). Participants rated eight items on a 5-point Likert scale, indicating the extent to which each statement was "true" for them (1 = not like me at all, 5 = very much like me). The scale comprised two subscales, each consisting of four items: Consistency of Interest (COI) and Perseverance of Effort (POE). An example item for COI, reverse-scored, is 'I often set a goal but later choose to pursue a different one,' while for POE, it is 'I finish whatever I begin.' Scores on this scale range from 1 (no grit at all) to 5 (demonstrating extreme grit). Grit-S demonstrated commendable internal consistency, with reported alpha values of 0.82 and 0.84 on separate occasions (Duckworth & Quinn, 2009, p. 170).

3.2.5. Data reduction and analysis

The data were analyzed in SPSS (version 27). Internal consistency of the included items was estimated using Cronbach's alpha values. In addition, an analysis of the correlations (Pearson's *r*) between all items and the total score were calculated. When an individual item score was correlated with the total score, the individual question score was excluded from the total score to avoid statistical dependence. To obtain an estimate of the construct validity, we correlated the total test score of the Growth Mindset Scale with Theories of intelligence scale (TIS) total score. In addition, we analyzed the correlation between Growth mindset scale with both Grit S scale (Duckworth & Quinn, 2009) and Passion for achievement scale (Sigmundsson et al., 2020a). The same procedure was done for Theories of intelligence scale. Sigmundsson et al. (2021, p. 2) argue that passion, grit, and mindset are intertwined constructs. Passion can be seen as the factor that gives direction to the area of interest while grit regulates the effort a person invests in that specific interest. Mindset can be seen as an important underlying factor for both grit and passion as it concerns the persons beliefs in own abilities and considerations on how effort is related to learning and mastery (see Fig. 1).

It would, therefore, be interesting to study the correlation between these factors using the new Growth mindset scale and the Theories of intelligence scale. Construct validity can be established by comparing a new measure with a prior measure known to be valid, which is referred to as a "gold standard" (Fjørtoft et al., 2011). However, for Growth Mindset, no such gold standard is available.



Fig. 1. Passion, grit and mindset are intertwined constructs that are needed for high achievement. Passion is the direction of the arrow to an area/theme/skill, grit is the size and strength of the arrow and mindset is an important underlying factor for both grit and passion (Sigmundsson et al., 2021).

4. Results

4.1. Demographic differences

Firstly, we examined the demographic differences among age and gender. Age did not show a significant correlation with the mean score of the Growth Mindset Scale, $r = -0.043$ ($p = ns.$) using Pearson's correlation. The Independent Sample's T-test indicated a significant difference between the two gender groups: females had a total Growth Mindset score of 4.27 (SD = 0.42), while males had a score of 4.36 (SD = 0.46), $t(721) = 2.7263, p = 0.0066$.

4.2. Feasibility

The means and standard deviations for the eight questions in the Growth Mindset Scale for the sample are shown in Table 2.

4.3. Internal consistency

All individual items correlated positively with the total score, with correlations ranging from 0.45 to 0.63. Correlations between scores of the individual items ranged between low and high (0.24–0.67). The results are presented in Table 4. Additionally, the Growth Mindset Scale showed good internal consistency with Cronbach's alpha value of 0.83.

4.4. Construct validity

The Pearson's correlation coefficient between the total score of Growth Mindset Scale and the total score Theories of intelligence scale (TIS) was $r = 0.17$ ($p < 0.001, N = 723$).

The correlation between growth mindset and passion for achievement was $r = 0.501$ ($p < 0.001$) and with grit it was $r = 0.164$ ($p < 0.001$). The correlation between Theories of intelligence scale and passion for achievement was $r = 0.102$ ($p = 0.006$) and with grit was $r = .082$ ($p = 0.027$).

5. Discussion

The aim of the study was to examine the psychometric properties of a recently developed measure attempting to quantify Growth Mindset independent from activity specification. The scale was administered to a sample of 723 participants, encompassing both females and males in the age range of 16–85, allowing for the investigation of the feasibility, internal consistency, and construct validity of the scale.

5.1. Feasibility

The results show that the Growth mindset scale is applicable across the studied age-span (16–85). It can be argued that it is important for the scale to be suitable for different age groups to monitor the life-span development of growth mindset. Simultaneously, having a new scale

Table 2
Mean and standard deviations for the growth mindset scale (N = 723).

			Female		Male		p*
	Mean	SD	Mean	SD	Mean	SD	
Question 1	4.66	0.49	4.65	0.48	4.67	0.49	ns
Question 2	4.56	0.54	4.51	0.53	4.59	0.56	0.024
Question 3	4.64	0.50	4.61	0.50	4.68	0.50	0.029
Question 4	4.06	0.79	4.00	0.78	4.14	0.79	0.011
Question 5	3.89	0.85	3.87	0.81	3.92	0.91	ns
Question 6	4.37	0.61	4.34	0.57	4.42	0.65	ns
Question 7	4.12	0.72	4.10	0.70	4.17	0.73	ns
Question 8	4.12	0.78	4.04	0.79	4.26	0.78	<0.001
Total Score	4.30	0.44	4.27	.042	4.36	0.46	0.003

p* t-test (one tailed).

Table 3
Pearson Correlation Coefficients for individual Test items and 95% Confidence Intervals for Individual Questions Score and Total Test Score.

Correlation with total score*	95% CI
Question 1	0.52 ^a 0.47, 0.57
Question 2	0.56 ^a 0.50, 0.60
Question 3	0.56 ^a 0.51, 0.61
Question 4	0.54 ^a 0.49, 0.59
Question 5	0.52 ^a 0.47, 0.57
Question 6	0.63 ^a 0.59, 0.68
Question 7	0.52 ^a 0.47, 0.57
Question 8	0.45 ^a 0.39, 0.51

Note. CI= Confidence interval. *On the basis of the other 7 item scores.

^a Correlation is significant at the 0.01 level (2-tailed).

Table 4
Pearson Correlation Coefficients for individual Test items.

	1	2	3	4	5	6	7	8
Question 1	1	0.59 ^a	0.64 ^a	0.24 ^a	0.24 ^a	0.42 ^a	0.26 ^a	0.29 ^a
Question 2		1	0.67 ^a	0.30 ^a	0.24 ^a	0.44	0.32	0.27
Question 3			1	0.27 ^a	0.25 ^a	0.47 ^a	0.32 ^a	0.27 ^a
Question 4				1	0.49 ^a	0.39 ^a	0.39 ^a	0.36 ^a
Question 5					1	0.46 ^a	0.39 ^a	0.31 ^a
Question 6						1	0.42 ^a	0.36 ^a
Question 7							1	0.32 ^a
Question 8								1

^a Correlation is significant at the 0.01 level (2-tailed).

with focusing on key issues within the growth mindset construct, such as ‘I can get smarter’, ‘Learning is my goal’, ‘Effort makes me stronger’, ‘I would spend more time and work harder’ (Blackwell et al., 2007, pp. 249–250) is beneficial for exploring aspects of motivation.

It is also noteworthy that males have a significant higher growth mindset score than females ($M = 4.36$ versus $M = 4.27$). Earlier studies have shown that males tend to score higher than females in relation to passion for achievement (Sigmundsson et al., 2020b). This difference could be related to more dopamine activity associated to selfish reward in males (Soutschek et al., 2017).

5.2. Internal consistency of the scale

The scale was designed with eight items that could be combined into a total score to provide an overall estimate of growth mindset across the life span. These items are crafted to measure growth mindset, which has been defined as “the belief that your basic qualities are things you can cultivate through your efforts” (Dweck, 2017, p. 7). The individual sub-items to total score correlation coefficient ranged from 0.45 to 0.63. Additionally, the sub-item correlation coefficient ranged from 0.24 to 0.67. Based on these results, acceptable test homogeneity suggests that all items seem to measure aspects of the same construct (see Tables 3 and 4). This displays a relatively good homogeneity of the test scores. Test homogeneity was further evaluated by calculating Chronbach’s alpha. An alpha score of 0.83 may suggest that the scale exhibits good internal consistency (Bland & Altman, 1986).

5.3. Construct validity

In the study, we compared the Growth mindset scale to the Theories of intelligence scale to assess construct validity. However, when investigating construct validity, the appropriateness of a test or scale serving as a “gold standard” should always be questioned. The Mindset scale (TIS scale) includes important dimensions of the mindset construct, but compared to Growth mindset scale, there is more focus on intelligence. For instance, questions like “Your intelligence is something about you that you can’t change very much” (question 2), “No matter how much intelligence you have, you can learn new things, but you can’t really

change your basic intelligence” (question 6), and “You can always change it quite a bit” (question 7) are featured in the Theories of Intelligence scale.

The Growth mindset scale places large focus on the individuals effort, learning goals and master-oriented strategies in the construct of growth mindset, such as “I know that with effort I can improve my skills and knowledge” (question 1), “I can influence and change my development in general” (question 2), “Efforts make me stronger” (question 6). In the current study, we found a correlation coefficient between the two total scores of $r = 0.17$ ($p < 0.001$), indicating that, on average, the scales are low related. It is interesting and important to note that the Growth Mindset scale total score had larger correlation with passion for achievement and grit than the TIS scale. Therefore, we may assume that Growth mindset scale could be a more suitable predictor for passion and grit than TIS (see Fig. 1).

5.4. Limitations and future research

It would have been good to have equal number of females and males in the sample. To explore the development of growth mindset across the life span further, studies should include a more characteristic sample regarding different age groups. The scale should also be investigated across different cultures in future studies. More studies are needed to develop the concepts of Growth Mindset and increase our understanding of the relationship to passion, grit, self-efficacy, and flow.

6. Conclusion

Growth mindset have been shown to be important for both achievement and well-being (Dweck & Yeager, 2019). The presented scale, with 8 items, was applied to a wide age-range (16–85 years). It shows a good feasibility and a good internal consistency with Cronbach’s alpha value of 0.83. The results are encouraging and warrant further development of the Growth Mindset Scale.

CRedit authorship contribution statement

Hermundur Sigmundsson: Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Monika Haga: Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Data availability

Data will be made available on request.

References

- Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Development, 78*(1), 246–263.
- Bland, J. M., & Altman, D. G. (1986). Statistical methods for assessing agreement between two methods of clinical measurement. *The Lancet, 1*, 307–310.
- Bråten, I., & Strømso, H. I. (2004). Epistemological beliefs and implicit theories of intelligence as predictors of achievement goals. *Contemporary Educational Psychology, 29*(4), 371–388.
- Costa, A., & Faria, L. (2018). Implicit theories of intelligence and academic achievement: A meta-analytic review. *Frontiers in Psychology, 9*, 829.
- 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.
- 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.
- Dweck, C. S. (1986). Motivational processes affecting learning. *American Psychologist, 41*(10), 1040.
- Dweck, C. S. (1999). *Self-theories. Their role in motivation*. Philadelphia: personality and development Psychology Press, 1999.
- Dweck, C. S. (2012). Mindsets and human nature: Promoting change in the Middle East, the schoolyard, the racial divide, and willpower. *American Psychologist, 67*(8), 614.
- Dweck, C. M. (2017). *Changing the way you think to fulfil your potential*. UK: Robinson.

- Dweck, C. S., Chiu, C. Y., & Hong, Y. Y. (1995). Implicit theories and their role in judgments and reactions: A word from two perspectives. *Psychological Inquiry*, 6(4), 267–285.
- Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review*, 95(2), 256.
- Dweck, C. S., & Reppucci, N. D. (1973). Learned helplessness and reinforcement responsibility in children. *Journal of Personality and Social Psychology*, 25(1), 109.
- Dweck, C. S., & Yeager, D. S. (2019). Mindsets: A view from two eras. *Perspectives on Psychological Science*, 14(3), 481–496. <https://doi.org/10.1177/1745691618804166>
- Ericsson, A., & Pool, R. (2016). *Peak: Secrets from the new science of expertise*. Random House.
- Ericsson, K. A., Prietula, M. J., & Cokely, E. T. (2007). The making of an expert. *Harvard Business Review*, 85(7/8), 114.
- Fjørtoft, I., Pedersen, A. V., Sigmundsson, H., & Vereijken, B. (2011). Measuring physical fitness in children who are 5 to 12 years old with a test battery that is functional and easy to administer. *Physical Therapy*, 91(7), 1087–1095.
- Likert, R. (1932). *A technique for the measurement of attitudes*. Archives of psychology.
- Rammstedt, B., & Rammsayer, T. H. (2000). Sex differences in self-estimates of different aspects of intelligence. *Personality and Individual Differences*, 29(5), 869–880.
- Sarrasin, J. B., Nenciovici, L., Foisy, L. M. B., Allaire-Duquette, G., Riopel, M., & Masson, S. (2018). Effects of teaching the concept of neuroplasticity to induce a growth mindset on motivation, achievement, and brain activity: A meta-analysis. *Trends in neuroscience and education*, 12, 22–31.
- Sigmundsson, H., Guðnason, S., & Jóhannsdóttir, S. (2021). Passion, grit and mindset: Exploring gender differences. *New Ideas in Psychology*, 63, Article 100878.
- Sigmundsson, H., Haga, M., & Hermundsdóttir, F. (2020a). The passion scale: Aspects of reliability and validity of a new 8-item scale assessing passion. *New Ideas in Psychology*, 56, Article 100745.
- Sigmundsson, H., Haga, M., & Hermundsdóttir, F. (2020b). Passion, grit and mindset in young adults: Exploring the relationship and gender differences. *New Ideas in Psychology*, 59, Article 100795.
- Soutschek, A., Burke, C. J., Raja Beharelle, A., Schreiber, R., Weber, S. C., Karipidis, I. I., Ten Velden, J., Weber, B., Haker, H., Kalenscher, T., & Tobler, P. N. (2017). The dopaminergic reward system underpins gender differences in social preferences. *Nature Human Behaviour*, 1(11), 819–827. <https://doi.org/10.1038/s41562-017-0226-y>. Epub 2017 Oct 9. PMID: 31024122.
- Yeager, D. S., Hanselman, P., Walton, G. M., Murray, J. S., Crosnoe, R., Muller, C., ... Dweck, C. S. (2019). A national experiment reveals where a growth mindset improves achievement. *Nature*, 573(7774), 364–369.