

Candidate 10106

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Bachelor's thesis in Psychology
Supervisor: Hermundur Sigmundsson
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Trondheim (Norway), spring 2023

Norwegian University of Science and Technology (NTNU)

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Preface

This spring I have participated in the bachelor's project "how do we become experts? BA09". Researcher, professor, and supervisor Hermundur Sigmundsson has administered this project with the help of two research assistants. The focus of the research project has been on important aspects of learning and skill development such as grit, mindset, passion, and flow. This current study was inspired by reading research on achievement and success especially regarding academic and athletic frameworks. The collection of data was initiated by the supervisors and executed by the students where the goal was to collect 15-20 participants each. The data management of the survey in SPSS was organized and coordinated by the supervisors. The study conducted is written by myself, and even though the ideas that encouraged the study are inspired by previous research, they are largely a construct of my own. It is however important to mention that Hermundur and his assistants have provided guidance and clarification on several drafts of the study, which has helped restructure concepts and research questions. The statistical choices have also been made in dialogue with my supervisor and his assistants, while the statistical analysis themselves has been completed by myself.

I want to use the opportunity to thank Hermundur and the research assistants for their theoretical and statistical guidance during this term. Additionally, I want to give appreciations to my family, fellow students, and friends for their continued support during this period. My girlfriend and sister are especially deserving of acknowledgements, as they have occasionally helped me with issues concerning grammar and structure. To conclude I wish to reiterate that this study is my own.

Word count: approx. 7495

Abstract

Background: grit is the ability to have perseverance to reach the goals you set over a longer period, whereas mindset is how you perceive your potential and ability to reach your goals. These psychological factors have been found important in research on achievement, success and expertise. **Objective:** this study explored the relationship between grit and mindset and tried to find if there existed differences in grit and mindset between different levels of education and across the genders. **Methodology:** the study conducted explored reported scores of grit and mindset from a sample mainly consisting of students at NTNU Trondheim in Norway and their acquaintances ($N = 723$). ANOVA, t-test, and Pearson's correlation was used. **Results:** The study found moderate significant differences in grit between people with the highest reported education and people with the lowest education, $F(2, 720) = 13.67, p < .001$. There was however not found any significant differences in neither grit nor mindset between the genders. There was found to be a weak significant correlation between grit and mindset, $r = .083, p = .025$. **Conclusion:** the most significant finding in this study was that people with higher education report higher levels of grit. Future research should focus on checking how much variance of academic achievement can be explained by grit, mindset and incorporate passion as well.

Key words: grit, mindset, gender, education, academic achievement

Study of the relationship between grit and mindset, with focus on differences in education and gender

There are thought to be several psychological factors needed to become an expert or to achieve expertise in a given field (Ericsson et al, 2007). Research on becoming an expert can be said to be relatively new, and there has been several important discoveries, especially within the last 30 years (Barbouta et al, 2020). Aspects such as learning, skill development and practice have historically been focused on when researchers have tried to find out what separates the experts from other people trying to achieve greatness. More specifically factors such as having a growth mindset have been theorized as important, as people with such mindsets tend to see the potential in themselves even if they do not have the best of prerequisites to reach expertise (Dweck, 2016, p.4). Grit is another factor which has been regarded as one of the most important influences on expertise (Duckworth et al, 2007). Duckworth et al. (2007) has supported the idea that having a focused hardworking mentality over a prolonged period is essential to reaching high levels of performance. Centered around these factors this study will seek out to examine what the relationship between grit and mindset is, and how they potentially can differentiate in people with different education and gender.

Theory

Research on expertise with the focus on learning, skill development and practice can be said to be relatively new. Ericsson is often credited as being one of the first researchers on this field, with his research on pianists and the theory surrounding practice and how to become an expert, where the idea of needing around 10 000 hours of practice or 10 years of practice was first introduced (Ericsson & Charness, 1994). This theory further cemented the

idea that you need deliberate practice to become an expert, training for 10 years is not enough in itself, it must be focused and deliberate (Ericsson & Charness, 1994). Ericsson also went on to break down the popular assumption that talent plays a defining role in making an expert (Ericsson & Charness, 1994; 2007). Through extensive empirical evidence found during the last 30 years or so, there is generally a large consensus in the literature that becoming an expert is more than possessing natural talent (Ericsson et al, 2007).

Now that the relationship between becoming an expert and the general research surrounding learning and practice has been given account for, the study can move to the next stage, where the most important modern research on this topic will be discussed. Research in the last years has found that grit, passion, mindset and flow can be defined as some of the most important variables in order to achieve success and expertise (Sigmundsson et al, 2020a; 2020b; 2021).

Even though this paper mainly will focus on grit and mindset, both passion and flow have been given importance in existing literature on expertise, and will therefore be given a quick description for, before angling the empiric focus towards grit and mindset (Sigmundsson, 2020a; Csikszentmihalyi, 1990, p.74). Sigmundsson et al. (2020a; 2020b; 2021) has showcased through his research, how passion in the form of great interest, is an important factor to success. While Csikszentmihalyi (1990) can be said to be the first researcher who conceptualized and popularized flow in relation to success. Through his books and research, he established how flow and being in a zone of flow is linked to higher rates of performance (Csikszentmihalyi, 1990, p.74).

Grit

One of the leading scientists in the field of grit Angela Duckworth describes grit as a combination of passion and perseverance (Duckworth et al, 2007; 2016, p. 45). Duckworths

research suggests that grit often separates people with high success from those who do not achieve success (Duckworth et al, 2007; 2016, p.5). People with high levels of grit manage to be extremely resilient and hardworking in their fields, and they possess direction and determination to reaching their set goals (Duckworth et al, 2007). Grit can be explained as the ability to keep going almost no matter how hard the challenge might be, and to have the inner drive to withstand the possible hinders that lay ahead. This tremendous willpower to succeed is more than just intensity and working incredibly hard to achieve your goals, it is also more importantly about the stamina this process is dependent on (Duckworth et al, 2007; 2016, p.42).

Mindset

In the case of mindset Carol Dweck both has been and continues to be one of the leading researchers on this specific field. Dweck differentiates between what she calls a fixed mindset and a growth mindset (Dweck & Yeager, 2019). The fixed mindset can be characterized as the belief that your qualities are set and that you have limited influence on these qualities (Dweck, 2017, p.3). The growth mindset is on the other hand a more positive mindset where people tend to see beyond the pure qualities they have, and rather see the potential for development (Dweck, 2017, p.4). Even though the growth mindset has a tendency to value the potential over the individual skills of a person, it does however not insinuate that everyone can become an expert just with the right amount of motivation, training and passion (Dweck, 2017, p.4; Dweck & Yeager, 2019). It rather challenges the common thought of the fixed mindset, where people see their qualities and skills as fixed and almost unchangeable, and puts this to test by suggesting that potential can be changed with considerable passion and training (Dweck, 2017, p.3). People with growth mindset have an ability to canalize a bad situation or grade in this situation, to fuel motivation for trying even

harder (Dweck, 2017, p.3). When comparing people with a fixed mindset who have a more defeated mentality, individuals with a growth mindset are more likely to see their potential, thus being more prone to confronting the challenges that lay ahead (Dweck & Yeager, 2019).

The role of grit in success and achievement

Since the paper will focus on the relationship between grit and mindset in context of education levels, it is essential to examine the existing theories and literature on grit and academic success (and achievement in other fields).

A cross sectional study checking grit, mindset and academic success in physical therapist students across 4 universities in Australia, found that grit was an independent predictor of academic success, accounting for 24% of the variance, $\beta = 0.24$, $p < .01$ (Calo et al, 2022). They also found that students with low grit were more likely to fail a clinical placement in comparison to students with higher levels of grit, $r = -.20$, $p = .001$ (Calo et al, 2022).

These findings can be supported by positive correlations between grit and academic success also found in research on medical, pharmacy and dentistry students (Calo et al, 2022; see also Miller-Mater et al, 2018; Pate et al, 2017; Montas et al, 2021).

Meta data on the available literature on grit suggest that the factor is highly correlated to conscientiousness and moderately correlated to performance, with perseverance being the most important factor in academic performance (Crede et al, 2017). This is further supported by other research indicating that perseverance of interest predict grades (Muenks et al, 2017; Duckworth & Quinn, 2009). The same empirical sources also seem to indicate that interventions meant to improve grit have limited effect on performance and success (Crede et al, 2017; Muenks et al, 2017).

Much research on grit and success indicates that there are other variables and factors interfering with the relationship (Crede et al, 2017; Muenks et al, 2017; Tang et al, 2019; Steinmayr et al, 2018). Especially interesting was Steinmayr et al. (2018) results which showcased that grit subscales only explained 3-6% of academic achievement when controlled for variables such as personality, engagement, values, motivation and previous grades (Tang et al, 2019; Steinmar et al, 2018).

It has been claimed that grit increases with age by several newer research articles, perhaps being related to life experience (Barbouta et al, 2020; Sigmundsson; 2020b). More specifically, an article which checked grit and mindset in regards to academic achievement, found that grit in increased with age, where results indicated a moderate strong positive correlation between age and grit, $r(238)=0.442$, $p <.001$ (Barbouta et al, 2020).

This has also been highlighted by research on passion, grit and mindset in football players, where there has been found indication that older football players had higher grit scores, with a significant difference between the elite football team and the junior team, $p =.0035$, Mann-Whitney U test; $d = 0.443$ (Sigmundsson et al, 2020b).

A recent study involving grit and mindset between athletic students and students studying health related studies found that students studying the health field had higher levels of grit than the athletic students, $p =.014$ (Gray et al, 2022).

The role of mindset in success and achievement

In the research on mindset, the literature displays more unclear discoveries, especially concerning mindset amongst different groups which will be quite relevant to this paper. A study between athletic students and health students found no significant difference in mindset between the two groups, $p =.071$ (Gray, 2022).

This is further supported by Sigmundsson et al. (2020b), which also did not find any significant differences between the mindset in football players and the mindset in university students. They however theorize whether or not this result might explain how both groups need high levels of mindset in both of their respective fields, and how this can explain the lack of difference between the groups (Sigmundsson et al, 2020b).

The research on physical therapist students in Australia did not find any significant correlation between mindset and academic success, nor clinical performance (Calo et al, 2022).

As seen, empirical contributions indicate that there can be expected limited differences between academic students and sports related students. However, research on the relationship between mindset and academic achievement indicate a moderate positive correlation, $r(238)=0.464, p <.001$ (Barbouta et al, 2020; Hacisalihoglu et al, 2020).

A national experiment in the USA found results which indicated that a growth mindset intervention of less than an hour will improve achievement (Yeager et al, 2019). One of the more important results discovered, was the fact that mindset intervention was found to improve average effects on GPAs (grade point average), $B = 0.10, p = <.001$ (Yeager et al, 2019). This can be supported by other research on mindset interventions also providing indication for an increase in achievement (Paunesku et al, 2015).

A meta-analytic review of mindsets found that having a growth mindset significantly predicted goal setting, goal operating, mastery-oriented strategies and goal monitoring, which all in turn predict goal achievement (Burnette et al, 2013).

Gender differences in grit and mindset

An additional variable that is also highly relevant when it comes to research on grit and mindset, is to examine if there are gender differences. Sigmundsson et al. (2020a; 2021)

has completed extensive research on this specific field, where one of the most important findings can be said to be the significant difference in passion found in between men, $M = 4.12$, $SD = 0.60$, and women, 3.85 , $SD = 0.63$, $p < .001$ (Sigmundsson et al, 2020a; 2021). They did however not find significant differences between the genders when checking for grit and mindset (Sigmundsson et al, 2020a;2021). In the article examining the relationship and gender differences in passion, grit and mindset with a sample representative for ages from 14-77, it was found that with grit, females had a mean score of 3.45 ($SD = 0.56$) while males scored 3.43 ($SD = 0.61$) (Sigmundsson et al, 2021). For mindset females had a mean score of 4.23 ($SD = 0.89$) and males 4.15 ($SD = 1.01$) (Sigmundsson et al, 2021). Similarly in the article checking the same variables in younger adults, results indicated that females had a mean score of 3.53 ($SD = 0.51$) in grit, with males having 3.52 ($SD = 0.63$), and in mindset females had a mean score of 4.40 ($SD = 0.83$), with males having a score of 4.28 ($SD = 1.07$) (Sigmundsson et al, 2020a).

The limited other empirical findings on this relatively unexplored field, namely research on the factors on Portugese sports science students also indicate that there are no significant gender differences in grit and mindset (Frontini et al, 2021). The research found that males had a mean score of 3.6 in grit ($SD = 0.5$) and 4.6 in mindset ($SD = 0.9$), while women was found to have a mean score of 3.7 in grit ($SD = 0.5$) and 4.7 ($SD = 0.7$) in mindset (Frontini et al, 2021).

Even though there has not been found any gender differences between the mean scores of grit and mindset in respect to the two genders, there was however found a gender difference in the general correlation between grit and mindset (Sigmundsson et al, 2020a). There was found a significant medium correlation between grit and mindset in the female sample, $r = .356$, which in turn was not found significantly correlated between the male sample, $r = .215$ (Sigmundsson et al, 2020a). However, in the other article it was found a

significant similar low correlation between grit and mindset in both the female sample, $r = .170$, and the male sample, $r = .163$ (Sigmundsson et al, 2021).

Relationship between grit and mindset

As showcased previously, there is scientific reason to consider that both grit and mindset can be linked to success and achievement in both sports and academic relations. In addition, many of these studies explore the relationship between grit and mindset as success factors. Sigmundsson et al. (2020a) found a significant relationship between passion and grit, $r = .435$, passion and mindset, $r = .260$, and grit and mindset, $r = .274$ (Sigmundsson et al, 2020a). In another study from Sigmundsson et al. (2021), with a wide age range group and a sample consisting of 917 participants, they found a significant low correlation between grit and mindset, $r = .167$, $p < .001$. Another study also indicated this, where it was found a moderate positive correlation between grit and mindset scores, $r(238) = .527$, $p < .001$ (Barbouta et al, 2020).

Research questions

As showcased, research on grit and mindset is a relatively new and unexplored field which until now has limited and conflicting results. It is important to mention that research on grit and mindset often include passion as a variable (Sigmundsson et al, 2020a; 2020b; 2021). Considering the scope of the task and the available time, this study was nonetheless limited to the variables of grit and mindset. Much of the research on grit and mindset has previously focused on the factors in relation to academic or athletic students, and especially regarding differences in gender or performance, and the relationship between the factors. This study will focus on grit and mindset in a way that seemingly has not been done before, with the focus

being differences in regard to education level, gender and the general relationship between the factors.

The first **research question (RQ1)** in this study can therefore be formulated as “*is there a difference in grit and mindset in people with different levels of education?*”

The second **research question (RQ2)** “*does there exist gender differences in grit and mindset?*”, is set to explore gender differences in the two variables, with education levels being excluded.

Lastly, the **third research question (RQ3)** “*what is the relationship between grit and mindset?*”, will look past both education levels and gender differences and explore the two variables on a more general level.

Method

Sample

The study contained 723 participants in total. The response rate could not be determined since it was not measured how many people were asked to participate in the study. The age difference varied all the way from the youngest participant being 16 years old to the oldest being 85 years old, with the average participant being 30 years old skewing towards younger participants, $M = 29.82$, $SD = 13.21$. 16 participants were considered missing values as they did not specify their age in the survey. Furthermore, the sample consisted of 296 males (41%) and 425 females (59%), with 2 participants failing to address their gender. When it comes to education level the split was, education level 1, $N = 395$ (55%), education level 2, $N = 218$ (30%), and education level 3, $N = 110$ (15%).

Procedure

The sample was collected through an online survey that was sent out to friends, family and general acquaintances of the students involved in the bachelor project. This can be described as a convenience collection method where you select participants through the easiest possible way. There can also be an argument that the data collection method leans toward a snowball selection. Several students sent the survey to people with the intention and suggestion that they would redistribute it to other people, and in this way the collection can be described as a combination of a convenience and snowball sample.

Furthermore, the procedure approach of the education variables associated with research question 1 will now be described. The focus in research question 1 is if there are differences in grit and mindset between different education levels. To measure grit and mindset the mean score of all the items in each factor and for each participant was used. When it comes to highest education level accomplished, it was operationalized as 1-5 in the survey, from middle school (1), high school/vocational school (2), bachelor's degree (3), master's degree (4) and all the way to doctors degree (5). This could have been a reasonable measurement if enough respondents answered in each of the levels that the sample would be valid and could be generalizable. However, only 8 participants had a doctor's degree as their highest degree obtained, and only 21 participants had middle school as their highest accomplished degree. Whilst 374 participants answered high school/vocational school, 218 bachelor's degree and 102 master's degree. If the desired analysis was to be run on this data, it would lead to several statistical problems especially concerning the statistical strength of the small sample size with completed doctor's degree and middle school. Therefore, it was assessed as necessary to merge the 5 education levels into 3 levels. Here the two first levels (middle and high school) were merged together as level 1, the bachelor level stayed as one

level (level 2), and lastly the participants who had accomplished a master’s degree merged as level 3 with the doctors degree participants.

Table 1.

Demographic characteristics of participants.

Baseline characteristic	<i>n</i>	%
Sex		
Male	296	41%
Female	425	59%
Highest achieved education		
Middle school	21	3%
High school/vocational school	374	52%
Bachelor’s degree	218	30%
Master’s degree	102	14%
Doctors degree	8	1%
Operationalized education level		
Level 1: middle school-high school/vocational school	395	55%
Level 2: bachelors degree	218	30%
Level 3: masters-doctors degree	110	15%

Note. N = 723.

Instrument

The participants answered several items associated to different standardized scales measuring grit, mindset, passion, flow, and perseverance. The relevant scales measured in this paper is however the Grit S scale measuring grit and the TIS scale measuring mindset (Duckworth & Quinn, 2009; Dweck, 1999). The answers from all the items these scales contained was used to determine mean scores which was used during the analysis.

Grit S scale

The participants were measured on grit by using Duckworth and Quinn's (2009) Grit S scale, which is a standardized scale that is found several places in existing research on grit (Duckworth & Quinn, 2009). The scale consists of 8 items which are supposed to measure how much perseverance people must have in order reach their goals (Duckworth & Quinn, 2009). Examples on questions are "I often set a goal but later choose to pursue a different one" or "I am a hard worker" or "I finish whatever I begin" (Duckworth & Quinn, 2009). These items are ranked in a typical 5-point likert-scale, where 5 = *very typical me*, and 1 = *not like me at all*, and where 5 is the highest value which represents a high score of grit and 1 is the lowest value representing a low grit score. To check the reliability of this scale, a Cronbach's alpha test was applied. However, due to reversed items, 2 tests with 4 items each had to be run. A Cronbach's alpha test on grit item 1, 3, 5 and 6 provided evidence for high internal consistency, $\alpha = .79$, whilst a similar test on grit item 2, 4, 7 and 8 indicated less internal consistency, $\alpha = .66$, however still at a relatively acceptable level. Taking a glance at previous Cronbach's alpha tests on the scale it has previously been proven to contain good internal consistency, $\alpha = .83$ and $\alpha = .84$ (Duckworth & Quinn, 2009).

TIS scale (mindset)

Mindset was measured by using a Norwegian version of the TIS scale that was first introduced by Dweck (Dweck et al, 1999; Bråten & Strømsø, 2004; see also Sigmundsson et al; 2021). This scale also included 8 items, and just like the grit scale it follows a 5 point likert-scale, where 5 = *very typical me* and 1 = *not like me at all*. Examples of questions here are "you have a certain amount of intelligence, and you can't really do much to change it" and "no matter who you are, you can drastically change your intelligence" (Dweck et al, 1999). A Cronbach's alpha test was also used to measure this scale, and just like the grit scale the

mindset scale also contains reversed items. It was found very high internal consistency in mindset item 1, 2, 4 and 6, $\alpha = .91$, and a little less but nonetheless still high internal consistency in mindset item 3, 5, 7 and 8, $\alpha = .87$. This indicates that the scale used has a high level of reliability.

Testing and analysis

Data was analyzed using IBM SPSS Statistics version 27. Furthermore, the analysis of data was done with an ANOVA analysis of variance, t-test and Pearson's correlation. The significance level was set to, $p = .01$ at the 1% percentile, which is a common statistical level in psychological research. The basis for choosing an analysis of variance, was bound by the research question, which emphasized the wish of examining differences in means between three groups. The t-test was used since gender consists of two groups (men and women), and two independent t-test were run on gender with grit and mindset separately. The assumption for running an ANOVA and t-test is based on normality and homogeneity of variance. A Shapiro-Wilk test, Q-Q plots and histograms provided indication of distribution of normality in mindset and grit. While homogeneity of variance was checked with a Levene's test which provided indication for the assumption of equal variances in both factors.

Correlation was used to check the relationship between grit and mindset. The same assumptions as with t-test and ANOVA was also used here, however scatterplots showed somewhat limited linearity.

Ethics

When it comes to ethical considerations, there was not used any privacy sensitive data. In addition, all participants were assured of anonymity in the questionnaire, and there were no health-related questions. This study was therefore not required NSD nor REK approval. On a

more general note, this study can be said to follow the ethical guidelines set by the Helsinki declaration.

Results

Research question 1

RQ1 was examined by checking differences in grit and growth mindset between 3 different education levels (education level 1: middle school-high school/vocational school, education level 2: bachelor's degree, education level 3: master's degree-doctors degree). A one-way ANOVA variance analysis was run with the factor being education level and the dependent variables being mean scores of grit and growth mindset. The ANOVA indicated a significant difference in grit between different education levels, $F(2, 720) = 13.67, p < .001$, and a non-significant difference in growth mindset and different education levels, $F(2, 720) = .094, p = .910$. To find where the differences between the groups when it comes to grit exist, a post hoc test was deemed necessary. The Hochberg GT2 post hoc test was chosen based on relatively different sample sizes in the education levels. The post hoc showed that the biggest difference, $\Delta M = .29492, p < .001$, was between education level 3, $N = 110, M = 3.50, SD = .57$, and education level 1, $N = 395, M = 3.21, SD = .63$. The second biggest difference, $\Delta M = .20602, p < .001$, was education level 2, $N = 218, M = 3.42, SD = .63$, and education level 1. There was no significant difference, $\Delta M = .08891, p = .528$, between grit in education level 3 and education level 2.

Table 2. ANOVA (Variance Analysis).

Table of means, standard deviations and One-Way analyses of variance between grit and mindset and 3 different education levels.

Measure	Education level 1		Education level 2		Education level 3		<i>F</i> (2, 720)	η^2
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
	Grit	3.21	0.63	3.42	0.63	3.51		
Mindset	4.12	0.94	4.15	0.96	4.16	0.95	0.09	.00

Note. Education level 1 is middle school-high school/vocational school, education level 2 is bachelor's degree and education level 3 is

masters-doctors degree.

*** $p < .001$.

Research question 2

In line with research question 2, two independent sample t-tests were run with the intention of checking if there existed differences between the genders in relation to grit and mindset. By running the t-test with grit it was found that men had slightly higher mean scores of grit, $M=3.32$, $SD=0.62$, then women, $M=3.31$, $SD=0.64$. This slight difference was found to be non-significant, $t(721)=0.11$, $p = .909$. When running the t-test with growth mindset it was found that women had higher mean scores of growth mindset, $M=4.16$, $SD=0.86$, then men, $M=4.10$, $SD=1.05$. This difference was also found to be non-significant, $t(555)=-.78$, $p= .435$.

Table 3. T-tests.

Results of 2 t-tests comparing grit values between men and women and mindset values between men and women.

Logistic parameter	Men		Women		<i>t</i> (721)	<i>p</i>	Cohen's <i>d</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
Grit	3.32	0.62	3.32	0.64	.114	.909	0.009
Mindset	4.10	1.05	4.16	0.86	-.781	.435	-0.061

*** $p < .001$

Research question 3

In addition, a Pearson's correlation was used to check the proposed general relationship between grit and mindset as factors, which was also a part of RQ2. A significant weak correlation was found, $r = .083$, $p = .025$.

Table 4. Correlation.

Table of correlation with the variables grit and growth mindset (N=723).

Variable	<i>n</i>	<i>M</i>	<i>SD</i>	1	2
1.Grit	723	3.32	0.63	-	.08
2. Growth mindset	723	4.13	0.95	.08	-

* $p < .05$

Discussion

Research question 1 (RQ1): grit and mindset – education differences

To begin with, the results related to the first research question showed that there was a significant difference in grit between the different education levels, $F=13.67$, $p < .001$. The Hochberg GT2 post hoc test provided statistical indication that the largest difference in grit mean scores, $\Delta M = .29492$, $p < .001$, was between the masters- PHD group and the middle school/vocational school/high school group. This result indicated that people who accomplished the highest education level reported on average 0.3 higher grit score than people with the lowest education level accomplished. The second largest difference between groups, was as shown in the results found to be between the bachelor's group and the lowest

education level. The finding also points towards a relative difference of 0.2 in grit score between higher university education and lower education, just as the masters- and PHD group difference. There was not found a significant difference in grit between the two highest education levels, $\Delta M = .08891$, $p = .528$, indicating that people who have accomplished a university degree (either a bachelor, master or PHD) have no significant difference in mean grit score reported. These results indicate that people with higher education have higher reported scores of grit than people with no university degrees. When putting these findings up against existing theory, literature and previous empirical findings there are several aspects to discuss.

The fact that different education levels hold different levels of grit can be said to be in line with Duckworth's theories and research regarding grit (Duckworth et al, 2007).

Duckworth hypothesizes and inherits a perspective that people with high levels of grit have greater chances of achieving success because of their resilience and determination amongst others (Duckworth et al, 2007).

Furthermore, studies have provided indication of a positive correlation between grit and academic success in the form of perseverance of interest which can predict grades (Crede et al, 2017; Muenks et al, 2017; Duckworth & Quinn, 2009). This can provide further clarification on the differentiating grit results found in this study, where it can be theorized that people with a high level of perseverance (and grit) is more likely to have accomplished higher education. It is however important to be aware that correlation does not mean causality, and one does not know in which direction the correlation affects. Other empirical research on grit and academic success does nevertheless support that grit works as a predictor of academic success, with results indicating that grit explained 24% of the variance of success (Calo et al, 2022). This finding can however be disputed somewhat, as other empirical findings on the field indicate that grit explained less of the variance in success when

controlled for other confounding variables effecting the relationship (Crede et al, 2017; Muenks et al, 2017; Tang et al, 2019; Steinmar et al, 2018). Additionally, since grit has been found to increase with age, it could be a supposed confounding variable affecting the results found in this study (Barbouta et al, 2020; Sigmundsson et al, 2020b). As completing different education levels require being of different ages, age could therefore have an effect on the grit scores.

Empirical findings from both Gray and Sigmundsson provide further evidence for the existence of difference in grit between different groups in relation to education and sports respectively (Gray 2022; Sigmundsson 2020b). This can further support that there are existing differences in grit between groups requiring higher expertise and groups requiring lower expertise. If one assumes that accomplishing higher university education can be thought of as a form of expertise, there may be a basis for a comparison, where people with in the two highest education groups were found to have higher reported grit than people in the lowest education group.

As far as the fact that there was found no difference in grit between people with university degrees (people with bachelor's degree vs masters and doctors degree), this can be argued to be a result of both groups requiring high scores of grit. Research has found that perseverance is the most important factor in academic performance, and since a university degree very much requires several years of commitment, focus and goal determination, it can be argued that achieving a degree requires grit (Crede et al, 2017; Muenks et al, 2017). Even though the academic level of a doctor's degree or master's degree is higher than that of a bachelor's degree, it can be argued that both groups require similarly high levels of perseverance.

As shown in the results there was not found a significant difference in mindset between different levels of education accomplished, $F(2, 720) = .094, p = .910$. Further on this meant that there was no statistical reason to check a possible post-hoc test to explore where possible differences exist. This finding was somewhat surprising, given the implications previous theory and empirical findings have assumed mindset has in relation to success and expertise. As shown in the theory, Dweck has put much emphasis on mindset, and especially how people with a growth mindset are prepositioned to see the potential in themselves and in this way gain success even if they do not have the best of prerequisites (Dweck & Yeager, 2019). Based on this one could assume that accomplishing several years of academic degrees and hardship at universities would require a growth mindset, and higher reported values of mindset than people with lower education.

On the other hand, the empirical findings on mindset and success can be said to be weaker than with grit and success (Gray et al, 2022; Sigmundsson et al, 2020b). Gray et al. (2022) found no significant difference in mindset between athletic- and health students, and Sigmundsson et al. (2020b) also found no significant differences between their groups of football players and university student. Even though these groups are somewhat different from the education levels that make up the analysis basis in this study, it is still noteworthy that there was found no significant differences between the mindsets in regard to academic success versus athletic success. However, it can be hypothesized whether or not both the academic students and the football players need mindset to accomplish success, and in the process making it difficult to differentiate between levels of mindset (Sigmundsson et al, 2020b). This is similar to what is found in this study, even though the Norwegian groups of football players displayed higher and more contrasting levels of mindset (4.26 to 4.58) than found in this study (4.12 to 4.16), perhaps suggesting that football players require more belief in themselves and their potential than people with education (Sigmundsson et al, 2020b).

Back to the fact that there was not found any differences between education groups in mindset, it can be reasonable to assume that for example, both people with accomplished bachelor's degrees and people with accomplished master's degrees need a growth mindset to be successful. When it comes to the high mean values of mindset in the lower education group, it gets more complicated. The same logic as with the last example could be applied here as well, however it can also be realistic that there are many people in more practical jobs who also need to see the potential in themselves to be successful in their field. So even though the results from the variance analysis did not spot significant differences, this in itself can be considered as a meaningful result. Possessing a growth mindset might not be exclusive to success higher academic circumstances, but might also be important to success in other field such as sports or more practical work environments.

It is also important to mention that research has found a medium positive correlation between academic success and growth mindset, $r = .464$, and found that growth mindset can be seen as a success trait which favors academic success (Barbouta et al, 2020; Hacısalihoglu et al, 2020). While meta-analytic findings on mindset and achievement seem to indicate that possessing a growth mindset predicts goal achievement (Burnette et al, 2013). These findings can contribute to explain the importance of having a growth mindset way of thinking of your potential to achieve success. This may also strengthen the basis of the previously mentioned theory that all education groups depend on having a growth mindset to succeed in completing their relative education stage.

Another interesting discovery found in research on mindset and success, is how short mindset interventions can improve achievement (Yeager et al, 2019; Paunesku et al, 2015). Given the prospect of mindset being predictive of achievement, such mindset interventions can potentially be important for people lacking belief in themselves and their potential.

Research question 2 (RQ2): Grit and mindset - gender differences

Gender differences in relation to both grit and mindset was another additional variable that was hypothesized and given theoretic framework for in RQ2. Previous empirical findings indicated that there existed no differences between the genders in regards to both grit and mindset (Sigmundsson et al, 2020a;2021; Frontini et al, 2021). This can be said to be in line with the results found in this study. Two independent t-tests on the two genders with grit, $t(721)=0.11, p = .909$, and mindset, $t(555)=-.78, p= .435$, also found no statistical indication to say that there existed any gender differences. Based on results from research on mindset and grit and results found in this study there is reason to assume that both factors are independent of gender.

Even though the statistical tests indicated no significant gender differences between the genders, it is interesting how similar the genders mean scores of grit and mindset are in this study compared to other research (Sigmundsson et al 2020a; 2021).

However, when comparing mean scores of grit and mindset in the genders from this study, to research on sports science students in Portugal, there is a comparative difference (Frontini et al, 2021). This study found that mean grit scores varied from 3.32 for males to 3.31 in females versus the sports students where males had 3.6 and females 3.7 (Frontini et al, 2021). Furthermore, this study found that with mindset, males had a mean score of 4.10 and females 4.16 versus the sports students where males had 4.6 and females 4.7 in average scores (Frontini et al, 2021). This can indicate as previously mentioned, that people involved in sports might have higher levels of grit than university students (Sigmundsson et al, 2020b; Frontini et al, 2021). Other results from similar university-based samples as this study also support this indication, as grit values ranged from 3.43-3.52 for males, and from 3.53-3.45 for females (Sigmundsson et al, 2020a; 2021). While mindset values ranged from 4.15 to 4.40 for males and from 4.28 to 4.23 for females (Sigmundsson et al, 2020a; 2021). These results are

more similar to the gender related results found in this study than in the study consisting of sports students, and can in this way indicate that there is a difference between both men and women in universities and in sports when it comes to grit and mindset. It is however important to remember that the fact that the sample was collected mainly in universities does not mean all participants in these studies were enrolled in universities and education when participating. Even though the average participant age was found to range from 22 in the research on young adults, 26 in the research on 14–77-year old's, and 30 in this study, indicating a young sample consisting mostly of people in university ages (Sigmundsson et al, 2020a; 2021).

Research question 3 (RQ3): Grit and mindset – relationship

In the theoretic framework the relationship between grit and mindset was given account for on a more general basis, and this proposed relationship was set up as a part of the third research question (RQ3). As shown in the results, there was found a statistically significant correlation at the 5% significance level between the mean scores of grit and mindset, $r = .083$, $p = .025$. When comparing this result to the other empirical studies and their findings, it can be described as a somewhat expected discovery. Previous research has often focused on the relationship between passion, grit, and mindset, and found small to medium correlations between grit and mindset, with higher correlation effect sizes often being found between passion and grit (Sigmundsson et al, 2020a; 2021; Barbouta et al, 2020). The findings in this study can thus contribute to strengthen the empirical evidence surrounding the indication that there exists a weak relationship between grit and mindset. Since grit involves perseverance and mindset involves having a fluid understanding of learning, one could assume that there would be a stronger correlation between the two factors, as research has

implied that they both are associated with success. This could indicate that these two psychological factors are relatively separated from each other.

Strengths and limitations

It can be claimed that the study that has been carried out has several strengths and limitations. Firstly, there are both positives and negatives related to the methodical background of the study. The sample size of 723 participants can undeniably be classified as a representative sample in terms of having enough participants to make the research statistically robust and representative for a larger group of the population. It is however important to mention that a large majority of the sample is based on students specifically at NTNU Trondheim in Norway, so it does not hold generalizability outside this sphere.

Furthermore, the research can be described as strong in terms of validity, as the instruments and scales used in the online questionnaire are standardized and statistically tested and proved to be consistent using a Cronbach's alpha test. However, it is important to mention that factors such as social desirability can influence the reported scores of participants. Maybe especially since questions around grit, mindset, perseverance, motivation and other aspects of expertise and learning are normally desired to want high levels of. Even though the anonymity of the survey can contribute to less social desirability.

The gender distribution in the sample can be seen as a statistical strength, where the participants consisted of 41% males and 59% females. This can be described as relatively representative of the population. An assumed weakness with the sample is that it consists mainly of people who have completed middle school or high school/vocational school, as 55% reported this as their highest accomplished education. In contrast only 15% reported masters or PHD as their highest accomplished degree. However, by choosing a post-hoc

which expects an uneven sample this is adjusted for and does not interfere too much with the generalizability of the results.

In terms of the results found in this research, there are strengths connected to the statistical analysis that has been carried out. The assumptions for using a variance analysis, t-test and correlation test were all checked and confirmed before selection. However, there is a particularly problematic aspect of the research design and result concerning grit and different education levels. As highlighted previously, research on grit is associated with findings indicating a relationship with age, where grit is believed to increase with age (Sigmundsson et al, 2020b). Statistical limitations with the study design made it difficult to examine this proposed relationship between grit and age. As the majority of people participating in this study are young people currently studying at university level. This means that it would be difficult to check grit and age without statistical problems concerning generalizability and validity, based on very uneven samples. When discussing the findings in this study, especially that people with higher education levels possesses higher mean scores of grit, it is important to factor in that this potentially can be partially explained by age.

Another problem associated with the data collected in the dataset was the fact that the education level was operationalized as the highest accomplished level. It can be argued that it would have been more desirable to reformulate the question as current education level being completed. This is problematic for several reasons, firstly people in their third year of studying can be much older than a person who just finished high school, and since research points to the finding that grit increases with age this can distort the results.

Implications for further research

Future research on grit and mindset with regards to success should focus on acquiring a more representative sample, especially towards an age representative sample where it is

possible with more certainty to disclose differences. Furthermore, regression checking for multiple dependent variables would be advantageous as to finding out whether or not grit and mindset can predict success in terms of academic or sports related samples (Calo et al, 2022).

In addition, there has been relatively limited research done on the relationship between mindset and grit. The limited research on these factors has often included passion and indicated that passion is a relevant factor in success (Sigmundsson et al, 2020a; 2020b; 2021). Based on this, future research should try to incorporate passion with grit and mindset to get a more complete representation on the relationship between these variables.

There has also been found extensive research providing indication that mindset interventions have had an improved effect on academic achievement (Yeager et al, 2019; Paunesku et al, 2015; Dweck & Yeager, 2019). Based on this it would be interesting for further research to set up experimental designs with control- and experimental groups, where only one groups gets a mindset intervention. Later followed by all participants getting the survey consisting of the same mindset scale-based items. This could potentially provide further empirical evidence on how such interventions effect peoples mindset, and perhaps provide indication on how a growth mindset can lead to more success.

Conclusion

This study sought out to try to provide more research on grit and mindset with the focus on three research questions. The first explored whether there existed differences in grit and mindset scores between people with different education. While the second explored the two factors and differences between genders, and the third was focused on the relationship between the grit and mindset.

When it comes to RQ1, it can be concluded from the results found in this study, that there exists a moderate difference in grit between people with higher education and people

with lower education. These results can indicate that people completing higher university education require more grit than people who are uneducated. However, this is somewhat of a problematic result, as previous empirical findings suggest that there is a relationship between grit and age, which possibly can explain some of the difference, especially between people with high education and people with low education where there is a relative age difference (Barbouta et al, 2020; Sigmundsson et al, 2020b).

Regarding mindset, it can be said that the study failed to find existing differences between education levels, perhaps indicating that all groups need high levels of mindset, which similar research also seem to highlight (Sigmundsson et al, 2020b).

With RQ2, it was not found any statistical confirmation providing any differences in grit nor mindset between the genders, which can be supported by other empirical findings on the field (Sigmundsson et al, 2020a; 2021). This indicates that grit and mindset are independent factors in relation to gender, meaning that gender is assumed to have no effect on the amount of grit or mindset a person has.

This study found a significant weak correlation between grit and mindset, which was the focus of RQ3. Empirical findings also indicated that there exists a moderate to low relationship between the two factors (Barbouta et al, 2020; Sigmundsson et al, 2020a). Providing more indication that the relationship between the two factors is to be assumed low, and that grit and mindset are relatively separated concepts.

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Appendix

The survey that was sent out to participants.

Invitasjon til spørreundersøkelse om lidenskap, pågangsmot og tankesett

Vil du delta i et forskningsprosjekt som handler om psykologiske faktorer som er viktige for positiv selvutvikling og læring? Vil du vite mer om hva som motiverer deg til å prestere godt og utvikle dine ferdigheter? Undersøkelsen tar ca. fem minutter.

Følg linken eller QR-kode for å delta!

<https://nettskjema.no/a/241161>

Spørreundersøkelsen er frivillig og anonym. Dataen vil bli benyttet i en større undersøkelse, og senere benyttet i artikler.

Har du spørsmål om undersøkelsen kan disse rettes til Hermundur Sigmundsson: hermundur.sigmundsson@ntnu.no





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