universität wien

MASTERARBEIT / MASTER'S THESIS

Titel der Masterarbeit / Title of the Master's Thesis

"Truly Implicit, Implicit Theories of Intelligence – The Mediating Role of Task Enjoyment between Growth Mindset and Learning"

verfasst von / submitted by

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angestrebter akademischer Grad / in partial fulfilment of the requirements for the degree of

Master of Science (MSc)

Wien, 2023 / Vienna 2023

Studienkennzahl lt. Studienblatt / degree programme code as it appears on the student record sheet:	UA 066 840
Studienrichtung lt. Studienblatt / degree programme as it appears on the student record sheet:	Masterstudium Psychologie
Betreut von / Supervisor:	Univ.-Prof. Dr. Veronika Job Sutnar

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Introduction

In the past two decades, there has been interest in the use of growth mindset research for educational outcomes among not only researchers, but also policymakers and educators (Dweck & Yaeger, 2020). Seemingly, there is huge potential for growth mindset research to aid in improving learning outcomes. So, what is a growth mindset and what aspects does it encompass?

It is common sense that people react differently when faced with challenges or obstacles (Dweck, 1988). Why do some individuals thrive in the face of challenges, and some individuals avoid them altogether? The answer to that question could lie in different mental representations of abilities and beliefs about one's own intelligence: Mindsets (Dweck, 1999).

The way that individuals internally view their intelligence and how they attribute success and failure plays a huge role in how they approach challenges, response to obstacles or criticism and even to successes of other people (Dweck, 1999; Wolcott et al., 2021). Past decades of research in developmental- and social psychology have emphasized huge benefits of holding a mindset which helps people push through obstacles and thrive through challenges: a growth mindset (Dweck, 1999). Individuals with a growth mindset believe that intelligence is *malleable* and that it can be *developed* through experiences, learning strategies or through support from others (Dweck & Yaeger, 2019). A growth mindset is shown to be related to different positive outcomes such as challenge seeking, resilience, less fear of failure and improved motivation (Dweck & Yaeger, 2019; Lewis et al., 2020; Sarrasin et al., 2018).

Over the last years, the concept of the growth mindset gained wide popularity by being presented as a desirable mindset in the media, in bestselling books, or in corporate cultures (e.g., Dweck, 2017; Bakirli, 2020; Johnston, 2017). In 2017, Carol Dweck's book "Mindset – changing the way you think to fulfill your potential" turned into a million-copy bestseller. When searching for the word "growth mindset" on the internet, a variety of books, audiobooks and courses claiming to aid in developing or training a growth mindset appear: "Growth Mindset – Learn how successful people think" (Moore, 2019) or "Growth Mindset Coach – the ultimate step by step guide to personal growth" (Miller, 2020) are some of many promising associations that are presented in the media in connection to a growth mindset. However, a growth mindset is not only supposed to be beneficial for the single individuum, but also for businesses

(Han & Stieha, 2020; Bakirli, 2020; Johnstin, 2017). A scoping literature review by Han & Stieha (2020) suggests that mindset research is expanding rapidly into workplaces with significance in many fields, such as human research development. Their research shows that growth mindset furthers work engagement and organizational citizenship behavior. The idea is that one employee's mindset can influence others and therefore cause changes in the organizational culture, which then increase growth mindset outcomes (Han & Stieha, 2020). In line with that, companies with a growth mindset culture often outperform those with a fixed mindset culture (Bakirli, 2020; Johnston, 2017).

Altogether, these circumstances indicate that a growth mindset can be viewed as a socially desirable construct – as something individuals aim to hold, especially in work-related contexts.

In past research, growth mindset has almost exclusively been measured with self-reported scales (e.g., Dweck's Implicit Theories of Intelligence Scale, 1999). It is well known that research using self-reported scales can be biased by socially desirability effects (Van de Mortel, 2008). Consequently, validity of a questionnaire can be negatively affected by social desirability bias (Huang et al., 1998) as it can cause systematic response distortion (Stocké, 2004). Consequently, findings of past studies which assessed growth mindset with self-reported scales may have been confounded by socially desirable effects.

Especially with socially desirable or ethically sensitive topics, Chung & Monroe (2003) suggest that researchers should focus on using methods to reduce social desirability biases. One example for such a method is the *implicit measurement.* This measurement aims to decrease participants' ability to strategically control their responses and therefore aims to overcome the limits of explicit measures (Gawronski & Hahn, 2018) such as, in this case, self-reported questionnaires to assess growth mindset. In line with these suggestions, the presented research work uses an implicit measurement to capture growth mindset.

Individuals with a growth mindset seek learning challenges almost three times as often as individuals with a fixed mindset (Dweck, 1988). Seemingly, a growth mindset can be beneficial for increasing individual's motivation. Next to growth mindset, there is another big variable to come across during literature research in the field of motivation: Task Enjoyment (Amabile et al., 1994; Fishbach & Choi, 2012; Ryan 1982). Task Enjoyment is not only the most important measure for intrinsic

motivation (Lee, 2012), it is also necessary to build long-term interests (Hidi & Renninger, 2006). Since the early 90's, task enjoyment has been a huge part of research in the field of motivation (Amabile et al., 1994; Fishbach & Choi, 2012; Ryan 1982). Motivation, in turn, is shown be related to growth mindset (Dweck, 1988). For this reason, we implemented task enjoyment into the research model to help assess this study's objective: investigating whether a growth mindset is connected to the amount of effort individuals put into a learning task, and whether task enjoyment plays a mediating role in this connection. Therefore, the presented research work discusses the question:

Will a growth mindset make people enjoy tasks more and thus result in more psychophysiological effort during a learning phase?

This research question is investigated through a quantitative correlational setup in the experimental laboratory of the University of Vienna. Here, participants go through IQ tasks with different levels of hardness as well as a learning task, where results from previous IQ tasks are presented. During the study procedure, physiological parameters for exerted effort are documented. At the beginning of the procedure, participants' internalized intelligence mindset beliefs are assessed through an implicit measurement to later examine possible connections between a growth mindset and the exerted effort during the learning task.

As self-report measures of effort are shown to be susceptible to self-presentational effects (Gendolla, Wright & Richter, 2019; Pyszczynski & Greenberg, 1983; Rhodewalt & Fairfield, 1991), we used a physiological measurement to assess psychophysiological mental effort during tasks. This measurement assesses parameters such as heart rate, blood pressure and pre-ejection period. Per definition, the pre-ejection period (in the following stated as *PEP*) is he time interval between the onset of electrical stimulation of the left ventricle and the opening of the aortic valve (Lanfranchi, Pépin & Somers, 2017). Research frequently uses myocardial sympathetic activity to test effort-related predictions (Mazeres, Brinkmann & Richter, 2021), and PEP has proven the be the best non-invasive indicator of myocardial sympathetic activity available (Sherwood et al., 1990; Mazeres et al., 2021). It can thus provide information about how much resources the body mobilizes to keep up with a task and therefore how much psychophysiological mental effort is put into a task (Gendolla et al., 2019; Gendolla & Wright, 2009).

To investigate whether task enjoyment mediates the relation between a growth mindset and exerted effort during the learning phase, test subjects are additionally asked how much they enjoyed working on each of the different blocks. Results, as well as limiting factors and suggestions for future research will be discussed.

Theoretical Background

Attribution Theory and Achievement Goal Theory

According to Dweck & Yaeger (2020), mindset theory grows out of *attribution theory* and *achievement goal theory*. Attribution theory postulates that individuals' attributions (explanations or causes) for successes or failures can shape their reactions towards that event (Weiner & Kukla, 1970). According to Manusov & Spitzberg (2008), a typical definition of "attributions" is the internal (thinking) and external (saying) process of comprehending what motivates our own and other people's behavior. The first scientist to bring up the theory of attribution models was Fritz Heider (1958). Heider paid specific attention to an action's "causal locus", meaning whether an individual is more likely to see a behavior's cause as internal or external. When individuals attribute their failure internally (e.g., to a lack of personal ability, dispositions, or personal talent/lack of talent) and their successes externally (e.g., fortunate circumstances such as easy questions in an exam or simply luck), it consequently takes the power away from the individual itself and causes negative effects on motivation and persistence at tasks (Manusov & Spitzberg, 2008; Heider, 1958). On the other hand, individuals could attribute failure to external reasons such as bad teachers or classroom circumstances, while attributing successes to internal, personal factors such as their own performance capability (Heider, 1958).

In achievement contexts, the degree to which future successes will be expected is determined by beliefs about the attribution of prior failure. Stable causes for example reinforce the assumption that the future will be aligned with what happened in the past (Heider, 1958). Attributions of failure to lack of aptitude, lack of support or an unpleasant school environment improve the expectancy of future failures (Heider, 1958). Consequently, this causes negative impact on individual's motivation and increases their tendency for future task avoidance (Heider & Weiner, 2002). On the contrary, attribution to flexible (changing) factors indicate that the future might differ from the past. This means the cause of the prior failure is seen as unstable or changing

(e.g., a teacher is leaving, lack of effort) and the expectancy of future failures therefore decreases (Heider & Weiner, 2002).

Research conducted on students around attribution models was able to show that students with similar ability could differ in their tendency to show these attributions and responses (Diener & Dweck, 1978, Dweck & Repucci, 1973). Later, *achievement goal theory* was developed to determine *why* students with equal ability can show different responses and attributions to failure. Elliott & Dweck (1988) found these circumstances to be related to learning goals versus performance goals, which will be further characterized in the following chapter.

Implicit Theories of Intelligence

In the late 90's, Carol Susan Dweck and colleges developed the idea that individuals have implicit theories about their intelligence which direct them towards certain goals (Dweck, 1999; Dweck & Leggett, 1988; Diener & Dweck, 1978). In their early work between the years 1973 and 1980, Dweck and colleges identified two different types of cognition-affect-behavior. Firstly, there is the *maladaptive* "helpless" response. According to Dweck (1975), it is characterized by an avoidance of challenge and a decrease in performance when it comes to obstacles. In contrast, there is a second, more *adaptive* "mastery-oriented" response which is defined by seeking challenging tasks and maintaining effectiveness in the face of failure (Dweck & Leggett, 1988; Diener & Dweck, 1978; Dweck, 1975; Dweck & Reppucci, 1973).

Within the framework of their research with children, Dweck and colleagues observed that those children who avoided challenges were on par in their performance with the children who sought challenge and showed perseverance. Those children who were most concerned with their abilities (i.e., the children with the helpless pattern) behaved in ways that interfered with their own effectiveness and potential for growth. Even some of the most skilled individuals showed the maladaptive pattern (Dweck & Leggett, 1988).

Why do children who are facing the exact same task and disposing of equal abilities behave in completely different ways and thus generate different outcomes? In attempt to answer this question, Dweck & Elliott (1983) first focused on a conceptualization of goals. The general idea was that the goals which individuals follow provide the framework in which they interpret and respond to events. The researchers differentiated between two types of goals. Firstly, *performance goals*, which aim to receive positive judgements of one's own competence by others.

Secondly, *learning goals*, which in contrast aim to increase one's own competence. Studies testing these hypotheses confirmed that a focus on performance goals (gaining positive competence judgments) creates a proneness to the helplessness pattern, while in the same situation pursuing learning goals (increasing competence) promotes the mastery pattern (Leggett & Dweck, 1988).

After these findings, the remaining question was why would individuals in the same situation even pursue such different goals? There had to be another major factor that takes effect even before the pursuit of different goals. This led the researchers to the hypothesis that different theories about oneself would orient individuals towards different goals by generating different concerns (Dweck, 1975). In particular, Dweck and colleagues showed that the conception of one's intelligence as a fixed or a malleable trait is associated with the two different goal types: individuals who perceived their own intelligence as fixed were more likely to pursue performance goals, whereas individuals who considered their intelligence as malleable were more likely to strive for learning goals (Leggett & Dweck, 1988). These two implicit theories were initially called *entity* and *incremental* theories but were later changed to the terms of *fixed mindset* and *growth mindset* (Dweck & Yaeger, 2019). These two mindsets will be further characterized in the chapter *Growth Mindset and Fixed Mindset*.

The Problem with Validity of Self-Reported Data

In empirical research, it is well known that human behavior underlays certain biases (Kendal et al., 2015, Miller & Gelman, 2020), which can cause difficulties in generating high quality data, especially when it comes to self-report questionnaires. Self-report measures are susceptible to self-presentation and socially desirable responding (Crowne & Marlowe, 1960). Chung & Monroe (2003) describe *social desirability bias* as a difference of one's own perception and the perception of his or her peer group. In other words, individuals underreport socially undesirable behaviors or intentions and overreport socially desirable ones due to self-representation concerns (Krumpal, 2013). Consequently, social desirability bias can cause systematic response distortion (Stocké, 2004).

Chung & Monroe (2003) further investigated the effect of gender, ethical evaluation, and religiousness on the social desirability bias. Results showed, that when it comes to sensitive topics which are seen as unethical, social desirability bias was higher. That means participants underestimated their own intention more than they would in less sensitive topics. Additionally, religiousness was shown positively

correlate with the social desirability bias. The more religious subjects were, the higher their bias scores. The study also provides indications for a bigger distribution of social desirably behavior in women than in men.

To conclude, Chung & Monroe (2003) suggest that for ethically sensitive or socially desirable topics, researchers should focus on using methods to reduce social desirability biases. Our study's method goes in line with this suggestion, as we used an implicit measurement to assess growth mindset. Therefore, less falsified data was expected.

Theory of Explicit and Implicit Measurement

In general, there seems to be a divergence between the terminology *explicit* and *implicit*, which manifests itself in a disagreement about what is being measured (Gawronski & Hahn, 2018). Some researchers believe that in an explicit measure, subjects are aware of the test subject, whereas in implicit measurements they are unaware of what the test captures (Petty, Fazio, & Briñol, 2009). Still other researchers believe that the two measures reflect different memory representations (Greenwald & Banaji, 1995).

Gawronski & Hahn (2018) offer the following conceptualization of the two measurements: if the effects of a mental content on participants' responses is not intentional, resource-dependent, conscious, or controllable, then the outcome of the measurement is considered *implicit*. On the other hand, if the effects of a mental content on participants' responses is intentional, resource-dependent, conscious, or controllable, then the outcome of the measurement is considered *explicit*.

Psychologists have developed performance-based instruments to overcome the limitations of self-report measures: implicit measures. These implicit instruments aim to decrease participants' *ability to strategically control their responses*, and furthermore *do not rely on introspection* for the measurement of thoughts and feelings (Gawronski & Hahn, 2018). Although it has been assumed that implicit measures can overcome the limits of explicit measures in capturing sensitive or socially desirable topics, available evidence suggests that the relation between implicit and explicit measures cannot be reduced to motivational bias or lack of access to introspection (Gawronski & Hahn, 2018). Gawronski & Hahn (2018) name strategic control of answers as just one factor contributing to the dissociation between implicit and explicit measurements, among many others. The authors' findings present a challenge to the common practice of interpreting dissociation between implicit and explicit measures

as indicators of either socially desirable responding or lack of introspective awareness. While it is certainly possible that in some cases this may be true, current evidence suggests that such blanket statements are inaccurate. It is important to consider other potential explanations for discrepancies between different types of measures before drawing conclusions about individuals' motives or their level of self-awareness.

Empirically, different meta-analyses show relatively low correlations between implicit and explicit measures (Cameron, Brown-Iannuzzi, & Payne, 2012; Hofmann, Gawronski, Gschwendner, Le, & Schmitt, 2005). Such findings suggest that implicit and explicit measures assess conceptionally distinct constructs (Nosek & Smyth, 2007). However, Gawronski & Hahn (2018) suggest that the average correlations of meta-analyses are suppressed by various methodological factors and therefore underestimated. Gawronski & De Houwer, (2014) state that there is a low internal consistency of many implicit measures, which could contribute to methodological issues suppressing effects (Gawronski & Hahn, 2018). Gawronski & Hahn (2018) also postulate that, in addition to methodological reasons, there are a variety of psychological reasons for low correlations between explicit and implicit measures. For self-reported *emotional* judgements (e.g., feelings or affective reactions), correlations between implicit and explicit measures seem to be larger than for self-reported *cognitive* judgements (Gawronski & LeBel, 2008; Smith & Nosek, 2011).

When it comes to practical relevance, it is important to investigate which measure predicts behavior more effectively. Implicit measures tend to be more effective than explicit ones in forecasting spontaneous behavior, whereas explicit methods tend to surpass their implicit counterparts when it comes to predicting deliberate action (Fazio, 1990). In line with suggestions from literature (Chung & Monroe, 2003) as well as regarding a research gap of implicit mindset measures, our study uses an implicit measurement to assess intelligence mindset beliefs. This could show another, more automatic layer of growth mindset.

Growth Mindset and Fixed Mindset

Earlier, we explained two implicit theories which were initially called *entity* and *incremental* theories but were later changed to the terms of *fixed mindset* and *growth mindset* (Dweck & Yaeger, 2019).

Individuals with a fixed mindset view their intelligence and ability as fixed and therefore tend to pursue performance related goals and show a bigger tendency to avoid challenges (Dweck & Yaeger, 2019). The fixed mindset is characterized by a

focus on performance rather than learning, an avoidance of challenges, giving up quickly when being faced with obstacles, and a negative perception of effort, as it indicates a lack of talent (Wolcott et al., 2021). Dweck & Yaeger (2019) asked new students at the university of Hong Kong if they would be interested in participating in a high-quality English course which would help them better prepare for exams and materials which would all be in English. They found that students with a fixed mindset were less enthusiastic about taking such a course than students with a growth mindset, even when their English proficiency was low. It seemed like students with a growth mindset were willing to display a deficit to then be able to correct it (Dweck & Yaeger, 2019). Why does the growth mindset seem to generate better outcomes?

Individuals with a growth mindset hold the belief that intelligence is malleable and that it can be developed for example through experiences, learning strategies or through support from others (Dweck & Yaeger, 2019). It refers to the epitomization of the brain as a muscle which can get bigger and develop through training (Dweck & Yaeger, 2019). According to Wolcott et al. (2021) the focus of a growth mindset is to learn. Therefore, challenges are embraced, and obstacles are persisted. Criticism and feedback in general are often used to help the learning process and others' successes tend to be used as a source of inspiration (Wolcott et al., 2021). Growth mindset plays a huge role in social and personality development research as well as developmental psychology (Dweck, 2017).

In line with assumptions about a promising potential the growth mindset holds, it was shown to predict positive outcomes such as challenge seeking, resilience, less fear of failure and improved motivation (Dweck & Yaeger, 2019; Lewis et al., 2020; Sarrasin et al., 2018). A growth mindset is also related to a higher well-being (Zeng et al., 2016) and life-long learning (Wolcott et al., 2021). Furthermore, literature reveals a positive correlation of growth mindset with increased performance in a variety of tasks (Barbouta et al., 2020; Dweck, 2009; Brougham & Kashubeck-West, 2017). Consistent with these findings, Dweck (1988) found that individuals with incremental theory (growth mindset) seek learning challenges almost 3 times as often as individuals with entity theory (fixed mindset). Therefore, a higher mental effort exertion from individuals with a growth mindset in the setting of the presented study could be assumed.

An increase in effort during a learning phase can be assessed through cardio-vascular measures. When faced with a task, the body is mobilizing resources to

accomplish this task by altering blood pressure (Seery, 2013). In the presented study, we measured psychophysiological mental effort during a learning phase, where solutions to a previous task were presented to the participants.

The exact mechanism behind psychophysiological mental effort as well as its' measurement will be displayed later in this work. With knowledge about the effort exerted during the learning phase, conclusions about the relation between growth mindset and learning can be made. In line with the previous chapters on problems with self-reported data and suggestions from literature to use implicit measures for socially desirable or ethically sensitive constructs (see Chung & Monroe, 2003), growth mindset was assessed through an implicit measurement. Therefore, the following hypothesis was developed:

H1a: *The implicit score of growth mindset is predictive for the psychophysiological mental effort during the learning phase.*

Reviewing current literature, it becomes apparent that there is a replication crisis where researchers fail to replicate previously found positive effects of growth mindset (see Bahnik & Vranka, 2017; Li & Bates, 2019). Furthermore, there are no studies that examine the effects of growth mindset on psychophysiological mental effort yet. Therefore, we also included the explicit score of growth mindset into our analysis to check for a correlation between the explicit growth mindset score and effort during a learning phase. The following hypothesis was conducted:

H1b: *The explicit score of growth mindset is predictive for the psychophysiological mental effort during the learning phase.*

Learning

According to Weinstein & Underwood (1985), effective learners are such who actively process information, interpret it, and use different strategies to store and retrieve information later.

For a long time, learning was simply seen as a mechanical, physiological response to stimuli simply (Weinstein & Underwood, 1985). This implies that there is little room for the learner to influence his or her information processing and storage. In 1956, George Miller was one of the first scientists to examine people's information processing mechanisms. He postulated that people "code" incoming stimuli into units (chunks) to better process them (Miller, 1956). Dweck (2009), was able to show that, because of their focus on learning, students with a growth mindset feature higher

performance. Robinson (2017) postulates, that building a classroom culture of growth mindset changes students' approach to learning.

In the presented study, learning is operationalized as the psychophysiological effort which is exerted during a learning phase. We use a psychophysiological measure of effort that includes an electrocardiogram to assess participants' heart rate, as well as a blood pressure machine (see Mlynski et al., 2021). Therefore, electrodes (to generate data for the electrocardiogram) and an arm cuff (to assess blood pressure) are placed on participants' upper bodies. The psychophysiological effort is measured through the *pre-ejection period* (PEP), which is the time point between the onset of electrical stimulation of the left ventricle and the opening of the aortic valve (Lanfranchi, Pépin & Somers, 2017). The pre-ejection period is computed as the difference between electrocardiogram Q-point (onset of ventricular depolarization) and B-point (opening of aortic valve) (see Mlynski et al., 2021).

Task Enjoyment

Task Enjoyment has been a huge part of research mostly in the fields of *motivation* (Amabile et al., 1994; Fishbach & Choi, 2012; Ryan 1982), but also in *economics* (Eckartz, 2014; Fisher, 2010), *health* (Frederick & Ryan, 1993; Yoo & Kim, 2002) and *education* (Clark & Svinicki, 2015; Grasten et al., 2016; Jaakkola, 2015). Lee (2012) describes task enjoyment as "representative positive emotions experienced during a task" (Lee, 2012, p. 370) and as the key index of intrinsic motivation. In line with this view, Ryan (1982) describes task enjoyment as the most important measure for intrinsic motivation and Hidi & Renninger (2006) emphasize it's necessity in building long-term interests.

Over the past years of research, task enjoyment was found to encourage different positive outcomes. Puca & Schmalt (1999) observed task enjoyment as a mediator between the achievement motive and performance. The achievement motive differed between failure-motivated individuals and success-motivated individuals. Success or failure motivation is based on classical concepts of achievement motivation (McClelland, Atkinson, Clark & Lowell, 1953) and is characterized as global personality attributes, meaning the motive to achieve success (success-motivated individuals) or the motive to avoid failure (failure-motivated individuals). The authors were able to show that success-motivated individuals reported more task enjoyment during performance than failure-motivated individuals, and that task enjoyment mediates the relationship between achievement motivation and performance. The

differentiation between success-motivated and failure-motivated individuals is reminiscent of Carol Dweck's (1999) division into individuals with an adaptive "mastery-oriented" response and individuals with a maladaptive "helpless" response and in further consequence such individuals with a growth mindset or a fixed mindset.

Frondozo et. al (2020) examined the growth mindset of teachers regarding their teaching abilities. Results showed that holding a growth mindset about one's teaching ability positively predicted teaching enjoyment, which in turn predicted engagement.

Despite of its' huge role in research, task enjoyment has been almost exclusively measured at a state level. Current research around task enjoyment aims to stretch the context further, as for example the researchers Czikmantori, Hennecke & Brandstätter were able to show in 2021. They followed the goal of developing a trait task enjoyment scale, called the *TTES* (Trait Task Enjoyment Scale). During their research the authors demonstrated that there are stable individual differences in the tendency to enjoy tasks in general and that these differences predict the momentary enjoyment of a variety of tasks. Wolcott et al. (2021) state that individuals with a growth mindset perceive effort positively and as necessary for success. Therefore, it could be expected that, because individuals with a growth mindset perceive effort more positively, they most likely also enjoy the task they are working on. Therefore, we included task enjoyment into our analyses as a mediating variable. Task enjoyment will be attributed a mediating effect since it has been shown to be influenced by a growth mindset (Frondozo et al., 2020; Puca & Schmalt, 1999), which in turn influences variables like performance, attention and persistence which could be related to learning. As the research question illustrates, this research work aims to explore *how* and *in which way* the effect is mediated.

Summing up these findings, all in all task enjoyment was able to show a connection to different positive outcomes such as performance, motivation, engagement, and persistence (Puca & Schmalt, 1999; Hidi & Renninger, 2006; Frondozo et al., 2020) which could all be related to learning. Based on previous research, both the growth mindset and task enjoyment are related to motivation (Puca & Schmalt, 1999; Hidi & Renninger, 2006; Frondozo et al., 2020; Amabile et al., 1994; Fishbach & Choi, 2012; Ryan 1982). Logically, when individuals with a growth mindset show higher motivation and persistence at a task, chances are high that they also enjoy the task more, which in turn could cause positive effects on learning. Based on these conclusions from literature, we analyzed the connection between explicit growth

mindset and learning with task enjoyment as a mediator. To assess a more automatic part of the mindset belief, we conducted the mediation analysis with the implicit score of growth mindset. Therefore, the following hypotheses were conducted:

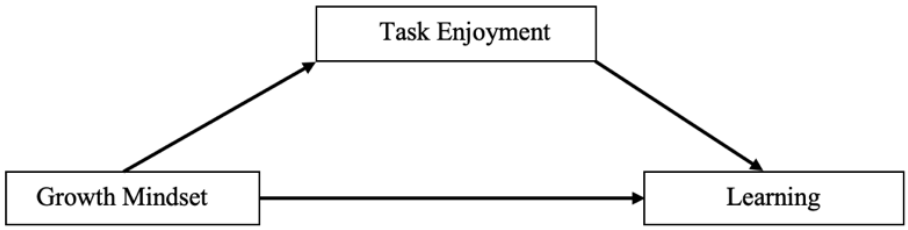
H2a: *The relation between implicit growth mindset and the psychophysiological mental effort during the learning phase is mediated by task enjoyment.*

H2b: *The relation between explicit growth mindset and the psychophysiological mental effort during the learning phase is mediated by task enjoyment.*

Based on the theoretical background and derived hypotheses, the research model illustrated in Figure 1 was developed.

Figure 1

Research Model (own illustration)



Note. Growth Mindset = Independent Variable, Learning = Dependent Variable, Task Enjoyment = Mediator

Self-Efficacy

Human behavior is influenced by their own self-efficacy and perceived behavioral control (Ajzen, 2005). Self-efficacy refers to how strongly we believe in our ability to achieve a certain outcome through our actions (Maddux, 2016; Maddux & Gosselin, 2012), while perceived behavioral control covers the difficulties we anticipate facing when trying to engage in a particular behavior (Ajzen, 2005). Having strong self-efficacy and positive perceptions of behavioral control are essential for determination and perseverance – two key ingredients for success (Bandura, 1994).

The concept of "self-efficacy" was first introduced by Albert Bandura in 1994. A strong sense of self-efficacy enhances accomplishment and well-being, intrinsic interest, and engrossment in activities (Bandura, 1994). Bandura characterizes individuals with high self-efficacy as follows: they set challenging goals and show high

levels of commitment towards them. They continue to work hard even when facing obstacles and setbacks. They are able to quickly regain their confidence after a failure. They see failures as opportunities to learn new things or improve their skills, rather than giving up. Even when facing challenges, they remain optimistic and believe that they have the power to overcome them. This mindset often leads to success in various areas of life, while also reducing stress levels and vulnerability to depression (Bandura, 1994).

On the other hand, individuals with low self-efficacy are characterized as people who doubt their capabilities and tend to shy away from difficult tasks, viewing them as personal threats. They have low aspirations and weak commitment to the goals they choose to pursue. When faced with difficult tasks, they dwell on their personal deficiencies and the obstacles they will encounter rather than concentrating on how to perform successfully. They lower their efforts and give up quickly in the face of difficulties. Recovery following failure or setback is slow due to inadequate faith in capabilities being viewed as deficient aptitude. As a result, stress and depression are common experiences (Bandura, 1994).

Self-efficacy can be developed through four main sources of influence, with *mastery experiences* being the most effective one (Bandura, 1994). The second way of developing and strengthening self-efficacy beliefs is through successes of *social role models*, followed by *social persuasion* and *reducing stress reactions* (Bandura, 1994). Bandura also states that physiological indicators of self-efficacy play a huge role in health and physical activities.

According to Zimmermann (2000), self-efficacy has been shown to be a highly effective predictor for students' learning and motivation. The author also found a mediating role of self-efficacy between motivating persistence and students' academic achievement. Zimmermann & Kitsantas (1999) were able to show a correlation between self-efficacy and student's rated intrinsic interests in a (motoric) learning task.

Salomon (1984) included a self-report of mental effort in his study about self-efficacy. Results showed that self-efficacy is positively related to self-rated mental effort and students' achievement during a learning task that was perceived as difficult. Self-efficacy proved to be related to variables which are also connected to growth mindset, such as motivation, achievement, and persistence (Zimmermann, 2000; Barbouta et al., 2020; Dweck & Yaeger, 2019). Zarrinabadi et al. (2021) found that

growth mindset positively predicts self-efficacy. These findings explain why self-efficacy has been included in our study as a confounding variable.

Method

Participants and Design

In a previous exploratory study, an effect of the implicit score of growth mindset (β = 0.16), controlling for participant's self-efficacy (β = 0.18) regarding an IQ task, was found (Sik, Cummins & Job, in preperation).The required sample size for our study was calculated with the program *G-Power*. Therefore, a power of .8 and an α = of .05 was used. The analysis resulted in a sample size of 237 participants. To determine the required sample size for investigating a mediating effect of task enjoyment between growth mindset and psychophysiological effort during a learning phase, the rule of thumb according to Fritz & MacKinnon (2007) was used. A previous study by Donovan et al. (2018) found a correlation between task enjoyment & growth mindset of r = .30, which was used for the alpha-path in the analysis. For the beta-path, a correlation between task enjoyment and learning of r = .21 (Zarrinabadi, 2021) was used. These calculations resulted in a required sample size of 558 participants. Considering the high experimental expense, this sample size was not feasible.

The final sample consisted of a total of 170 participants (MAge = 22, SDAge = 3.46, 40% male, 58.8% female, 0.6% diverse), ranging in age from 18 to 49 years. Only those who were over 18 years old, fulfilled the inclusion criteria and achieved at least 80% in the implicit task were included into our study. Participants received 6 credit points as a compensation for their participation. The experiment took place at the labor oft the department for motivational psychology of the University of Vienna.

In total, we had 188 observations on Qualtrics. 18 participants had to be excluded because of missing values or because the specified inclusion criteria have not been met. Thus, 170 participants' data remained for analysis. For the measure of PEP, data from 170 participants was available. For 6 of those participants, the PEP score was calculated up until the point where the procedure had to be interrupted due to problems with the electrodes. For the implicit measure, 152 participants' data remained for the analysis after removing those who did not achieve the set 80% of inclusion criteria or showed missing values. The manually generated markers were only used for the baseline measure, not for the learning block and the difficult block. When there was no baseline marker, the manual files were used, since Qualtrics did not include a timestamp for that timepoint. This was the case for three participants.

Procedure

The presented work is a correlational study. Growth mindset is used as the independent variable. The dependent variable is learning, which is operationalized as the psychophysiological effort exerted during a learning phase (learning block). Task enjoyment was included as the mediator. We controlled for self-efficacy performing statistical analyses.

To obtain necessary information for hypotheses testing, participants were invited to the experimental labor to attend the experiment. Design of our study is similar to Nagy et al. (2021). The testing started with informed consent, data protection declaration, and a question about previous IQ-tests. Afterwards, electrodes and arm cuff were applied to the participants to measure the physiological parameters. These parameters are used to operationalize the psychophysiological effort during the different task blocks. Signals were checked. This was followed by the baseline measure, i.e., measurement of the physiological parameters in a relaxed state without confrontation with tasks.

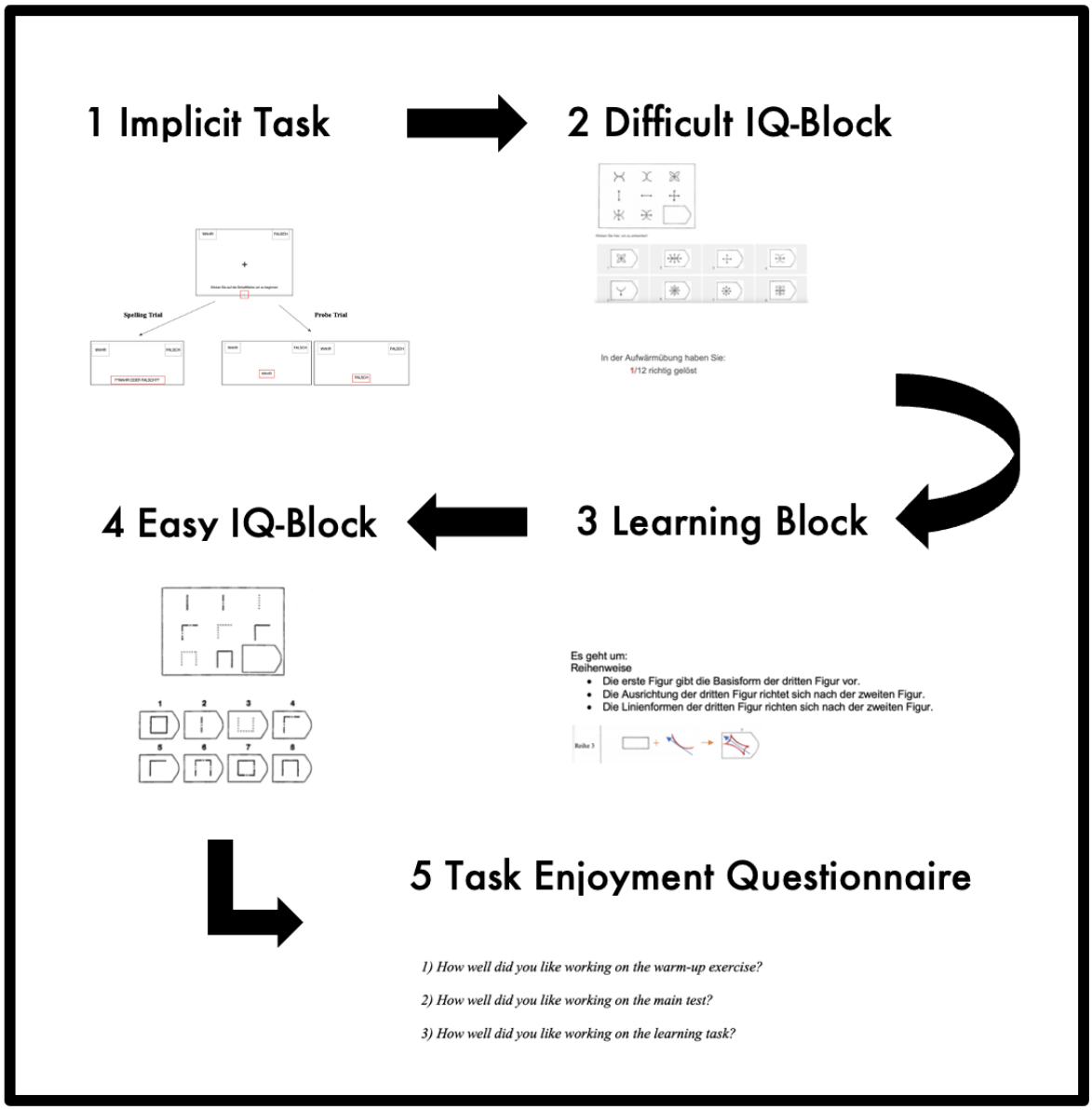
As a first active step, the test subjects were then guided through the implicit task adapted to intelligence mindset (Cummins & De Houwer, 20201). This part of the experiment is necessary for the operationalization of implicit growth mindset. Afterwards, explicit growth mindset beliefs were also recorded with a scale to capture subjective beliefs about conditions of success in learning and performance contexts by Spinath & Schöne (2003). Six items were adapted and included in this study (e.g., “when you learn new things, your intelligence stays the same”).

Subsequently, participants started with the difficult IQ-task, consisting of difficult Progressive Raven Matrices (Raven, 2000), each of which was given a time frame of 45 seconds for solving. At the end of the difficult IQ-block, there was performance feedback included which signalized participants how many right answers they were able to give. With this part, we aimed to make participants experience failure. Next, subjects' anxiety was recorded using a short form of the state scale of the Spielberger State-Trait Anxiety Inventory (Marteau & Bekker, 1992). Afterwards, participants went through a learning block where they were shown the solution approach for each matrice, again with a 45 second timer running for each one. After the solutions, there was the main block consisting of easy raven matrices without a time limit but including performance feedback at the end. Next, task enjoyment was assessed for the difficult IQ-block, the learning block as well as the easy IQ-block with three questions.

The experiment ended with demographic questions and the participants were asked what they think the different tasks measured and how. One experimental run took approximately 90 minutes, and the test persons were compensated with six test subject credits. Figure 2 depicts the sequence of tasks.

Figure 2

Sequences of the Measurement Procedure (own illustration)



Note. This visualization does not include all the tasks and questionnaires which were implemented into this study. Participants start with the baseline before the implicit task and receive other questionnaires between and after the pictured tasks. Due to simplicity, this visualization only includes central parts regarding our research question.

Measures

Implicit Measure

This research work uses an adapted version of Cummins & De Houwer's (2021) implicit measuring method. The aim of this adapted version is to assess implicit intelligence mindset beliefs through mouse tracking by measuring participants' intuitive, automatic reaction. The idea is that pace and direction of the mouse movements give away the implicit agreement to a presented sentence. In our adapted version, sentences regarding intelligence beliefs were used (e.g., "Intelligence is malleable").

Cummins & De Houwer's (2021) implicit task includes *probe* trials and *catch* trials. In probe trials, participants were instructed to move the mouse from a starting point at the bottom-center of the screen to either *true* or *false* (displayed at the upper left corner and upper right corner). Each trial consisted of a sentence which is presented word by word. After each sentence, there was a prompt. In the probe trials, after the sentence was shown, there was either the statement "TRUE" or "FALSE" appearing. In these trails, participants were instructed to ignore the sentence and answer based on the statement that was shown afterwards (e.g., click "TRUE" even if the sentence was incorrect). Probe trials separated in *consistent* and *inconsistent* trials. Consistent trials being the sentence shown and the statement after (true or false) matching. Inconsistent trails are such trails, where the sentence and the statement did not match (e.g., correctly spelled sentence but the statement "FALSE" afterwards). Incorrect or slow responses (on both trials) were followed by an error feedback.

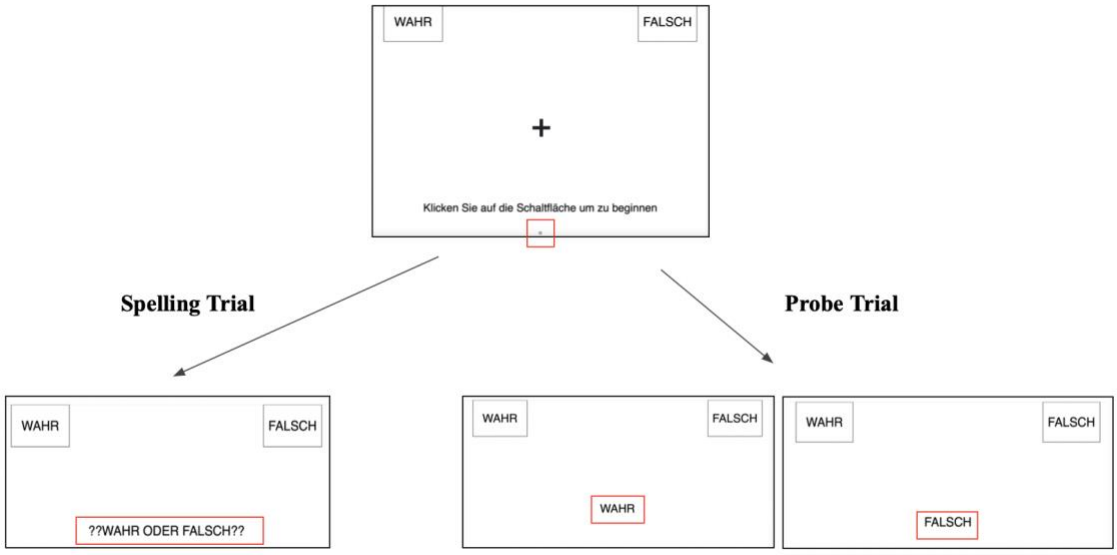
Catch trials on the other hand presented participants with the choice: "??TRUE OR FALSE??". After each sentence they had to choose whether the sentence, based on its' spelling, was true or false. The idea is that participants' automatic, quick reaction gives away their implicit agreement to the intelligence mindset belief.

Because the time window for giving an answer is so small, participants' answers could implicitly refer to their actual agreement to the sentence instead of the spelling of it. This means, information about implicit intelligence beliefs can be assessed without directly asking for participants' agreement to intelligence mindset statements. By consequence, this measure of intelligence beliefs becomes less susceptible to falsified answers. In both probe and catch trials, error feedback as well as feedback for not answering quick enough was provided. This aims to ensure that participants' immediate automatic reaction is assessed.

At the beginning of the implicit measure, there is an exercise block for participants to get used to the mechanism of the task. The sentences included in this exercise block were not linked to intelligence beliefs (e.g., “Christmas is in December”). Their sole purpose was to make participants familiar with task operation. The exercise block also included probe and spelling trials. Figure 3 visualizes the setup of our implicit measure.

Figure 3

Implicit Measure (own illustration)



Note. The actual measurement does not include the red frames pictured in this model for visualization purposes. The sentences will appear word by word where the cross is depicted in the middle of the upper center screen. Participants are presented with this screen first, then they either pass the spelling trial or the probe trial. Probe trails show either the screen in the lower right picture or the one next to it, depending on the prompt.

Physiological Measure of Effort

The presented study focused on a physiological measure of effort. Self-report measures of effort are susceptible to self-presentational effects (Gendolla, Wright & Richter, 2019; Pyszczynski & Greenberg, 1983; Rhodewalt & Fairfield, 1991) and to ambiguity of self-assessment about how hard one is actually trying (Gendolla et al., 2019). In this study, psychophysiological effort was therefore assessed through a

physiological measure which is used in a variety of studies in the psychophysiological or biological field of psychology (e.g., Mlynski et al., 2021; Gendolla et al., 2019; Mazeres, Brinkmann & Richter, 2021). This measurement includes an assessment of blood pressure and an electrocardiogram to assess participants' heart and compute the pre-ejection period. PEP has proven the be the best non-invasive indicator of myocardial sympathetic activity available (Sherwood et al., 1990; Mazeres et al., 2021). To assess this physiological data, electrodes and an arm cuff for blood pressure were put on every participant at the start of the experiment. With the electrodes placed on participants' upper bodies (two on the chest area and two on the neck), we assessed their heart rate with an electrocardiogram, which measures the electrical activity of the heart (Geselowitz, 1989).

In the following, it is displayed how these physiological parameters relate to theory. Research frequently uses myocardial sympathetic activity to test effort-related predictions (Mazeres, Brinkmann & Richter, 2021). When faced with a task, the body is mobilizing resources to accomplish this task or sustain a behavior, which is related to the functioning of the cardiovascular system (Gendolla et al., 2019; Gendolla & Wright, 2009). Therefore, two different types of blood pressure were assessed: *systolic blood pressure*, which is the highest arterial blood pressure following a heartbeat (Rodgers & Heinzman, 2018) and *diastolic blood pressure*, which is the lowest arterial pressure following a heartbeat (Cramer, 2004). Systolic blood pressure was shown to increase with task difficulty (Richter, Friedrich & Gendolla, 2008). Furthermore, mean arterial blood pressure and the pre-ejection period was measured.

As already stated, PEP is he time interval between the onset of electrical stimulation of the left ventricle and the opening of the aortic valve (Lanfranchi, Pépin & Somers, 2017). When the heart needs to sustain a behavior or keep up with a task, the heart's contraction force increases (Gendolla et al., 2019; Mlynski et al., 2021). This increase can be measured through PEP, which shows how much effort is put into a task and how much resources are therefore mobilized. As PEP is a time interval, lower numbers mean more effort is exerted. This is because as that time interval gets shorter, the heart is collapsing more forcefully, pushing out more blood and thus mobilizing more glucose and more resources to get the task done.

To make a valid statement about changes in PEP during a task, it was necessary to include a baseline measurement as a reference point. Effort is represented through how much PEP increased or decreased from baseline, meaning

how much it changed from rest to activity. By that difference, we can tell how much more effort participants mobilized during a task and can thus draw conclusions about a connection with a certain mindset. It is assumed that decreasing numbers of PEP are connected to holding a growth mindset.

Heart rate and PEP were assessed using the program “Qualtrics”, which is connected to the electrodes placed on participants’ bodies. Systole and diastole blood pressure was measured using a simple blood pressure machine. Test instructors had to activate the blood pressure machine manually and note the data from Qualtrics onto an Excel Sheet every 10 seconds during the Baseline as well as the difficult block.

Task Enjoyment

To examine the mediating role of task enjoyment, it was operationalized through three simple questions regarding the enjoyment of each IQ-block. The response format consisted of a six-point Likert-Scale with proficiencies ranging from "not good at all" to "very good” (see *Appendix*). The following items were used to measure task enjoyment:

1) How well did you like working on the warm-up exercise?

2) How well did you like working on the main test?

3) How well did you like working on the learning task?

It hast to be noted that Cronbach`s Alpha for the task enjoyment items (α = .50) indicates poor internal consistency. [1]

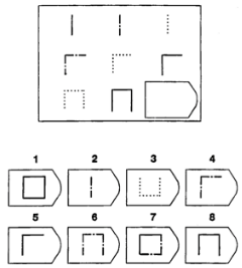
IQ-Blocks

For all three IQ-Blocks (difficult block, easy block and learning block), Progressive Raven Matrices (Raven, 2000) were used. Raven’s Progressive Matrices were developed for research in the field of intelligence. Ravens’ intention behind those matrices was developing tests which are easy to interpret and theoretically relevant (Raven, 2000). Figure 4 illustrates an example of a Progressive Raven Matrice.

[1] Note that, due to poor internal consistency, task enjoyment items were also used separately instead of a scale for analyses. Results did not differ so, for simplicity, results will only be reported with the scale. [1]

Figure 4

Example of an easy Progressive Raven Matrice (Raven, 2000)

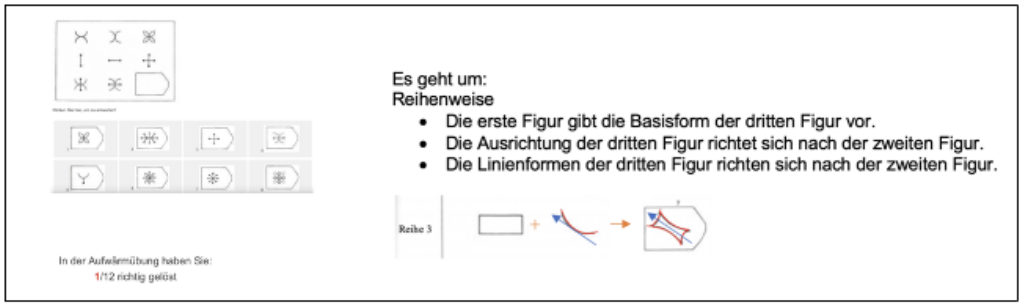


Note. Participants are presented with different options and are instructed to identify the right piece of the options below to complete the pattern on the top.

In this study, Raven Matrices are used in the easy IQ-block as well as the difficult IQ-block and the learning block. They vary in their complexity (easy block = easy matrices; difficult block = difficult matrices; learning block = same difficult matrices which were presented in the difficult block, depicted with solutions and an explanation for each). Figure 5 shows an example for a Raven Matrice in the difficult IQ-block (left), as well as in the learning block (right).

Figure 5

Example for Progressive Raven Matrices during difficult IQ-block and Learning Block (Own representation using figures from Raven, 2000)



Note. On the left side, there is an example for a matrice included in the difficult IQ-block. On the right side, there is an example for the explanation of a difficult matrice during the learning block. In this block, participants are presented with the solution for all matrices included in the difficult IQ-block. For both blocks, participants have 45 seconds per matrice to either complete the task (difficult IQ-block) or learn about the solution strategy (learning block).

Self-Efficacy

Self-efficacy was measured with the self-efficacy subscale of the "Motivated Strategies for Learning Questionnaire" (Pintrich & de Groot, 1990). The value for Cronbach`s Alpha for the self-efficacy questionnaire was α = .81, which can be interpreted as good internal consistency.

Analysis

Growth mindset, as the independent variable, was operationalized through a score resulting from the implicit measure for every participant. The dependent variable, learning, is operationalized as the psychophysiological effort exerted in the learning phase. Psychophysiological effort in the learning phase more precisely refers to the difference of the PEP value from the baseline measurement compared to the PEP value of the learning block. Task enjoyment was included as a mediation variable.

First, data from Qualtrics and Excel sheets filled out manually by test administrators were reviewed. Inaccurate data due to missing markers or problems with the electrodes was excluded or modified.

After clearing the data and excluding unusable records, descriptive characteristics of the sample were analyzed. Statistical analysis was carried out by

means of Qualtrics, R and IBM SPSS Statistics 27 software for Mac using linear regressions and mediation analysis. To examine how a growth mindset influences learning (H1a & H1b), a simple linear regression analysis was performed. To calculate the mediation analyses, the “PROCESS” macro for SPSS by Hayes (2018) was used. The significance level was set at .05 for all analyses. 5.000 bootstrap samples were used for the linear regression, and 10.000 bootstrap samples for mediation analyses. In addition, mean centering for all variables defining products was carried out for mediation analyses. Homoscedasticity was given. For both statistical analyses, we controlled for self-efficacy.

Results

Growth Mindset and Learning

Simple linear regression was calculated to predict learning based on *implicit* growth mindset. Results are depicted in Table 1. No significant regression equation was found (F (2,149) = 1.24, p = .33), with an R^2 of .02. Consequently, hypothesis 1a was rejected.

Table 1

Linear Regression with Learning as Dependent Variable, Implicit Growth Mindset as Independent Variable and Self-efficacy as Control Variable

Variables	B	SE	Beta	T	Sig.
Implicit GM	3.47	3.54	.08	.10	.33
Self-Efficacy	1.46	1.05	.11	1.40	.17

Note. N = 152. Implicit GM = Implicit Growth Mindset

The same simple linear regression was calculated to predict learning based on *explicit* growth mindset. No significant regression equation was found (F (2,164) = 1.00, p = .68), with an R^2 of .01. Hypothesis 1b was therefore rejected. Results are depicted in Table 2.

Table 2

Linear Regression with Learning as Dependent Variable, Explicit Growth Mindset as Independent Variable, and Self-efficacy as Control Variable

Variables	B	SE	Beta	T	Sig.
Explicit GM	.25	.61	.03	.41	.68
Self-Efficacy	1.27	1.00	.10	1.30	.21

Note. N = 152. Explicit GM = Explicit Growth Mindset

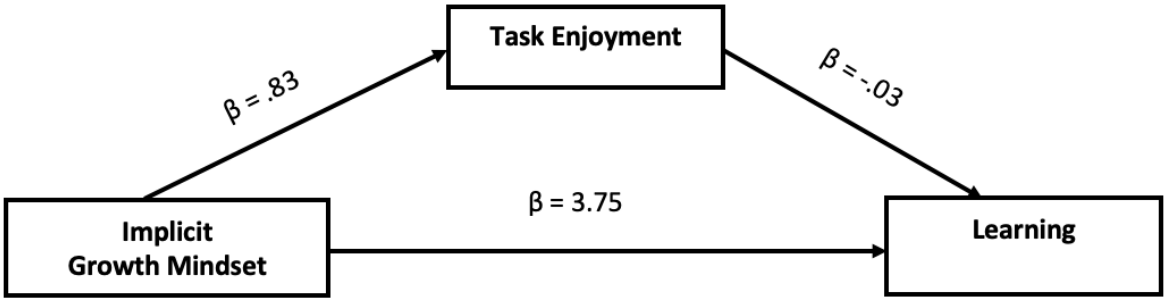
Task Enjoyment

A simple mediation analysis was performed to analyze whether an *implicit* growth mindset predicts effort in a psychophysiological learning phase and whether the direct path would be mediated by task enjoyment. Figure 6 illustrates the results.

The analysis revealed no significant indirect effect of implicit growth mindset on learning via task enjoyment; β = -.02, 95% CI [-.41, .82]. The direct effect of growth mindset on learning did not turn out significant; β = 3.77, *p* = .29. Consequently, this implies that the relation between implicit growth mindset and learning was not mediated by task enjoyment. Hypothesis 2a was rejected.

Figure 6

Mediation Analysis with Implicit Growth Mindset as Independent Variable, Learning as Dependent Variable and Task Enjoyment as Mediator



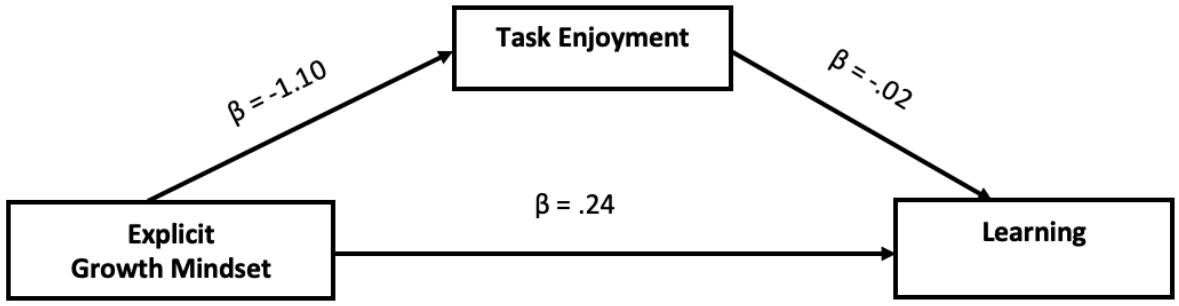
Note. Learning = Psychophysiological effort during learning phase; Direct effect: β = 3.77, 95% CI [-3.30, 10.83], Indirect effect: β = -.02, 95% CI [-.41, .82], Total effect: β = 3.75, 95% CI [-3.31, 10.80]

The same mediation analysis was performed to analyze whether an *explicit* growth mindset predicts effort in a psychophysiological learning phase and whether the direct path would be mediated by task enjoyment. Figure 7 illustrates the results.

The analysis revealed no significant indirect effect of explicit growth mindset on learning via task enjoyment; Indirect effect: β = .02, 95% CI [-.08, .16]. The direct effect of growth mindset on learning did not turn out significant; β = .22, *p* = .73. This implies that the relation between explicit growth mindset and learning was not mediated by task enjoyment. Therefore, hypothesis 2b was rejected.

Figure 7

Mediation Analysis with Explicit Growth Mindset as Independent Variable, Learning as Dependent Variable and Task Enjoyment as Mediator



Note. Learning = Psychophysiological effort during learning phase; Direct effect: β = .22, 95% CI [-1.00, 1.46], Indirect effect: β = .02, 95% CI [-.08, .16], Total effect: β = .24, 95% CI [-1.10, 1.48]

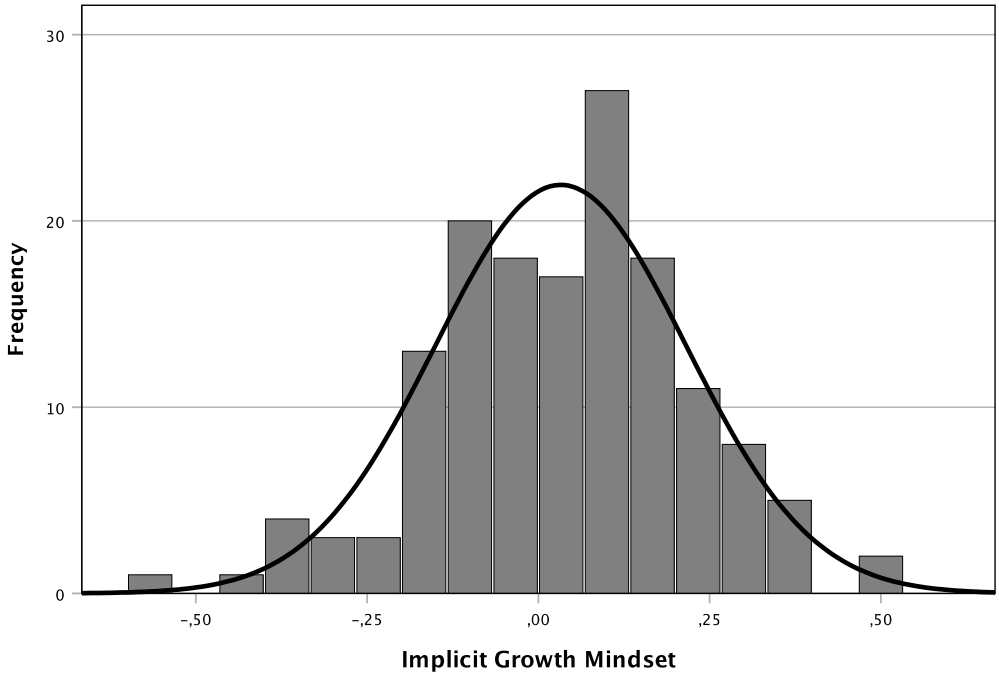
Furthermore, we checked for correlations between growth mindset and task enjoyment for each of the three blocks. From literature, it was expected that participants with a high growth mindset score would, in line with associations with challenge seeking, also show higher task enjoyment in the difficult IQ-block. Analyses revealed no correlation between the implicit growth mindset score and the task enjoyment of neither of the three blocks. The same applies to the explicit score of growth mindset. Generally, participants enjoyed the easy IQ-block (*M* = 4.73*, SD* = 1.12) more than the difficult IQ-block (*M* = 2.47*, SD* = 1.27). Participants enjoyed the learning block the most (*M* = 4.94*, SD* = .80).

Implicit versus Explicit Growth Mindset

Data analysis revealed differences in the distribution of implicit and explicit growth mindset. Generally, the implicit growth mindset has shown to be normally distributed. This has been confirmed through conducting the Shapiro-Wilk Test (*p* = .49). Contrary, the explicit growth mindset was not normally distributed *(p* = .000). Figure 8 and Figure 9 visualize the general distribution of implicit growth mindset and explicit growth mindset.

Figure 8

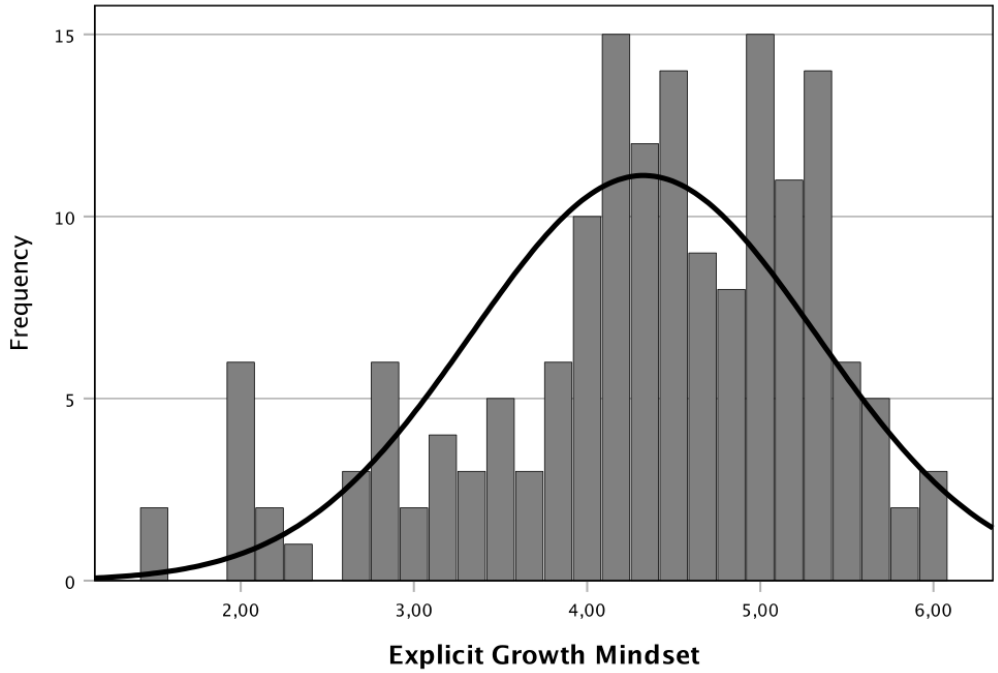
Histogram of the Distribution of Implicit Growth Mindset



Note. N = 152, M = .03, SD = .18

Figure 9

Histogram of the Distribution of Explicit Growth Mindset

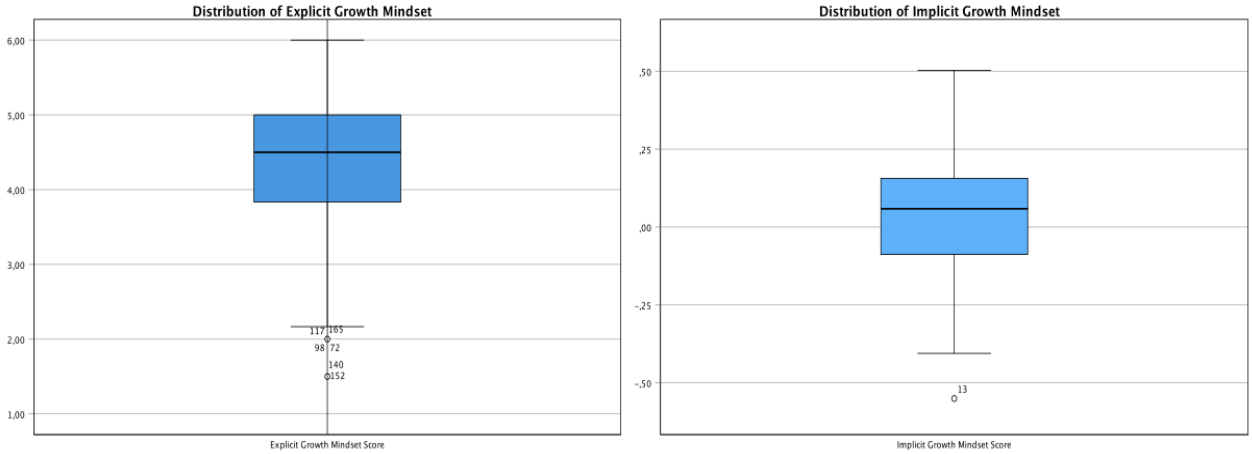


Note. N = 152, M = 4.34, SD = .99

Reviewing data, it becomes apparent, that participants differ in their growth mindset scores depending on whether the measure was implicit or explicit. In the following, Figure 10 illustrates the distribution of a growth mindset in the explicit measurement (left) and implicit measurement (right). It can be concluded that participants show overall low scores of implicit growth mindset (*M* = .03, *SD* = .18) and high scores of explicit growth mindset (*M* = 4.34, *SD* = .99).

Figure 10

Distribution of Explicit Growth Mindset and Implicit Growth Mindset



Note. Left side: explicit growth mindset (*N* = 167, *M* = 4.33, *SD* = 1.0)
Right side: implicit growth mindset (*N* = 151, *M* = 0.33, *SD* = 0.18)
Higher scores represent more of a growth mindset belief

Furthermore, the correlation between implicit mindset score and explicit mindset score was checked and is depicted in Table 3. Due to a lack of normal distribution in explicit growth mindset, Spearman's rho was assessed. No significant correlation between implicit growth mindset and explicit growth mindset (r = -.09, p = .29) was found.

Table 3

Correlations between Implicit and Explicit Growth Mindset

		Correlations	IGM	EGM
Spearman's rho	IGM	Correlation Coefficient	1.00	-.09
		Sig. (2-tailed)	.	.29
		N	152.00	152.00
	EGM	Correlation Coefficient	-.09	1.00
		Sig. (2-tailed)	.29	.
		N	152.00	152.00

Note. IGM = implicit growth mindset, EGM = explicit growth mindset.

Further Explorative Analyses

Furthermore, explorative analyses regarding a relationship between growth mindset and age as well as gender of participants were conducted. For implicit mindset, normal distribution was given, but the scaling of growth mindset and age as well as gender differed from each other. Due to these circumstances, directional measures using Eta were conducted. Results of these analyses are depicted in Table 4 and Table 5. To investigate the relationship between explicit growth mindset and age/gender, due to a lack of normal distribution, Spearman’s Rho was calculated. Results of these analyses are visualized in Table 6 and Table 7. Neither analysis (neither between implicit growth mindset and age/gender, nor between explicit growth mindset and age/gender) proved significant.

Table 4

Directional Measures of Implicit Growth Mindset and Age

		Variable	Value
Nominal by Interval	Eta	Implicit Growth Mindset	.36
		Age	1.00

Note. N = 151

Table 5

Directional Measures of Implicit Growth Mindset and Gender

		Variable	Value
Nominal by Interval	Eta	Implicit Growth Mindset	.04
		Gender	1.00

Note. N = 151

Table 6

Nonparametric Correlations between Explicit Growth Mindset and Gender

		Correlations	Explicit GM	Gender
Spearman's rho	Explicit GM	Correlation Coefficient	1.00	-.10
		Sig. (2-tailed)	.	.21
	Gender	Correlation Coefficient	-.10	1.00
		Sig. (2-tailed)	.21	.

Note. Spearman's rho for the correlation between explicit growth mindset and gender

Explicit GM = Explicit Growth Mindset; N = 167

Table 7

Nonparametric Correlations between Explicit Growth Mindset and Age

		Correlations	Explicit GM	Age
Spearman's rho	Explicit GM	Correlation Coefficient	1.00	.13
		Sig. (2-tailed)	.	.09
	Age	Correlation Coefficient	.13	100
		Sig. (2-tailed)	.09	.

Note. Spearman's rho for the correlation between explicit growth mindset and age

Explicit GM = Explicit Growth Mindset; N = 167

Discussion

The underlying research purpose of this study was to investigate whether a growth mindset positively affects learning and whether this relationship is meditated by task enjoyment. In summary, no significant results were found for both the relationship between growth mindset and learning as well as for the meditative effect of task enjoyment. Furthermore, no indications of a correlation between growth mindset and the age of the test subjects were found. Nor could significant statements be made about the relationship between growth mindset and gender of test subjects. As stated in the introduction to this work, in the past two decades, there has been interest in the use of growth mindset research for educational outcomes among not only researchers, but also policymakers and educators (Dweck & Yaeger, 2020). Seemingly, there is huge potential for growth mindset research to aid in improving learning outcomes. This assumption, in comparison with the results of this study, leads to the question why we then failed to find significant correlations between a growth mindset and variables such as learning or task enjoyment.

Reviewing latest literature, there seems to be a “replication-crisis” where researchers fail to replicate previously found positive effects of a growth mindset in the educational sector (e.g., Li & Bates, 2019; Bahnik & Vranka, 2017). In their original study, Mueller & Dweck (1998) praised 9 to 12-year-old children for being smart versus for being a hard worker. The first condition instilled more of a fixed mindset in the children whereas the second condition instilled more of a growth mindset. Afterwards, children had to perform moderately difficult tasks, followed by more difficult tasks where they received negative feedback. The goal was to determine, whether this failure would influence children’s performance on the next task. Intelligence beliefs were shown to influence the children’s post-failure performance (children in the growth mindset conditions outperformed those in the fixed mindset conditions) as well as their motivation for further learning experiences. Twenty-one years later, Li & Bates (2019) attempted to replicate these results. Results showed that children’s mindsets were not related to resilience to failure. Furthermore, growth mindset was not associated with improved grades as expected. Li & Bates (2019) suggest that intelligence mindset beliefs may not be related to resilience to failure or achievement in the school context.

Growth mindset manipulations were not associated with motivation and attribution measures by Mueller & Dweck (1998). In 2019, Dweck & Yaeger re-analyze the aforementioned study by Li & Bates (2019) to evaluate the failure to replicate. They

severely criticize the authors' replication practices and accuse them of not following replication standards, which, to them, represents a threat to scientific progress and generates misleading conclusions. By means of this debate, it is evident that further, standard-based research is needed. In 2017, Bahnik & Vranka conducted a study on a large sample of university applicants (*N* = 5653) to further examine the connection between mindset and academical achievement. They also failed to show a connection between growth mindset and changes in achievement or the number of test administrations students signed up for. Li & Bate's (2019) and Bahnik & Vranka's (2017) results go in line with our non-significant study results. These replication problems occurring in latest literature may indicate that the problem of our study lies more in its' theory than in its' method.

Regarding this method, it is furthermore important to discuss the theory behind implicit and explicit measurements. Although it has been assumed that implicit measures can overcome the limits of explicit measures in capturing sensitive or socially desirable topics, available evidence suggests that the relation between implicit and explicit measures *cannot* be reduced to motivational or social desirability biases or to a lack of access to introspection (Gawronski & Hahn, 2018). Consequently, our differences in the distribution of growth mindset in the two measurements go in line with past research but cannot clearly be attributed to social desirability effects. Furthermore, Gawronski & De Houwer, (2014) state that there is a low internal consistency of many implicit measures, which could contribute to methodological issues suppressing effects (Gawronski & Hahn, 2018). This could also aid in explaining the lack of significant effects in this study.

To put non-significant results into further perspective, in the following part, limitations of this study will be displayed. Firstly, the most obvious problems will be analyzed. Difficulties with the electrodes could have been contributing factors for non-significant results. Unfortunately, poor electrode quality caused repeated interruptions of the study procedure which led to inaccurate data and interrupted the test subjects from their task. This could generate negative side effects regarding participant's motivation and engagement in following tasks. Another limiting factor clearly is a low sample size (our sample size was lower than the power-analysis / rule of thumb suggested for both hypotheses). However, the high complexity of the study, which results from the relatively long test duration and the complex study design and

equipment, entails a low economy, and makes it difficult to test a large number of subjects quickly.

In line with this, it is important to highlight, that the general study setting of the experiment could have possibly caused some negative side-effects. Participants could have been distracted by the blood pressure measurement or in general be more aroused or anxious because of the electrodes and arm cuff. They might have experienced a sense of feeling “stuck” in the more or less “fixed” study setting. In line with this limitation, it was observed that some participants seemed to get frustrated during the implicit and difficult block, which could possibly generate a negative effect on the effort test persons put into the following tasks. Another area causing frustration in test persons seemed to be the high sensitivity of the mouse which was used to operate the test computers. As previously mentioned, six test subjects had to be excluded from analysis because they did not achieve the set 80% in the implicit task due to difficulties with operating the mouse. In addition, the mouse sensitivity was set differently on the two test stations, which may have led to a bias.

Finally, the mean age of all participants was 22 years. Regarding future research, it would be interesting to measure growth mindset not only in students, but in a wider range of generations as well as educational and cultural groups. This study mainly tested students, from which all studied or have had studied psychology. Current literature gives indications for cultural differences in the effects of a growth mindset on motivation and academical successes (Sun et al., 2021).

Regarding the non-significant results of the mediation analysis, the following concerns were contemplated. Firstly, the sample size was too small to back up the mediation analysis. The required sample size according to the rule of thumb by Fritz & MacKinnon (2007) was more than three times higher than the sample size we used for analyses. This, again, results from an elaborate study procedure and limited equipment to test more than two participants at the same time. A further point, as previously stated, is that the mediator task enjoyment, could, just as growth mindset, be susceptible to socially desirable effects and therefore to social desirability biases causing falsified data. This should be kept in mind when it comes to interpreting effects. In addition, the items that were used to assess task enjoyment showed poor internal consistency. This could be due to a difference in the enjoyment of the blocks. Analysis revealed that participants generally enjoyed the easy IQ-block but did not enjoy the difficult IQ-block. They generally enjoyed the learning block the most. In line

with previous results from literature, it could be expected that a high score of growth mindset goes in line with challenge seeking (Rege et al., 2021). Regarding our study, this would apply to the expectation that participants with a high score of growth mindset would also show high task enjoyment of the difficult IQ-block. Against our expectations, growth mindset showed no correlation with task enjoyment of the difficult block, neither with the two other blocks.

Another striking problem lays in the measurement of PEP, which may not be representative for actual learning. As explained in the method, PEP indicates how much resources the body is mobilizing during a specific task, what makes it simply a number of “physiological arousal”. Whether this increased physiological arousal indicates increased learning as a result of increased effort remains unsure. As already mentioned, task characteristics or the general study setting could also influence physiological arousal.

Furthermore, there are issues with the use of the term “learning”, as the learning task in this study (learning-block) only represents one part of the learning process: the processing of information, without incorporating the storage and retrieval of information. Learning does not only consist of increased arousal and attention during the learning phase (Weinstein & Underwood, 1985). It also includes actively processing information, interpreting it, and using different strategies to store and retrieve information later (Weinstein & Underwood, 1985). This indicates that psychophysiological arousal during the learning phase cannot be clearly attributed to learning as it is perceived in the common sense. To determine whether subjects really learn more as a function of their growth mindset, our study would consequently need to be extended with multiple follow-up measurement time points and a memory task that includes reproducing learned information.

Despite non-significant results, it became apparent that there are big differences in the distribution of growth mindset, depending on whether it was explicitly or implicitly measured. Participants in general showed high scores of explicit growth mindset and low scores of implicit growth mindset. This discrepancy in distribution goes in line with the previously described theory that growth mindset, because of its’ high popularity in media, bestselling books, and corporate culture, could be viewed as a socially desirable construct and could consequently be increasingly reported by participants on self-reported scales. Effects of a social desirability bias producing discrepancy in

data depending on its' measurement method can be found in a variety of studies (e.g., Gamberini et al., 2014; Richman et al., 1999).

Overall, there seem to be low correlations between implicit and explicit measurements (Gawronski & Hahn, 2018; Cameron, Brown-Iannuzzi, & Payne, 2012; Hofmann, Gawronski, Gschwendner, Le, & Schmitt, 2005), as well as a low internal consistency of many implicit measures (Gawronski & De Houwer, 2014). As it became apparent in our analysis, no correlation between the explicit and the implicit growth mindset scores could be found. Our results therefore go in line with literature. Due to these discrepancies, it cannot be clearly stated that the implicit score of growth mindset in this study is more relevant than the explicit score only because the explicit growth mindset was not normally distributed. Through literature, it became clear that the social desirability bias may be just one of many reasons for a discrepancy between implicit and explicit results (Gawronski & Hahn, 2018). In order to determine which data is more practically relevant, the question that should be asked is: is one of these measurements more predictive for behavior then the other? Fazio (1990) shows that implicit measures tend to be more effective than explicit ones in forecasting *spontaneous* behavior, whereas explicit methods tend to surpass their implicit counterparts when it comes to predicting *deliberate action*. In terms of practical relevance and implications such as growth mindset training, future research could investigate the behavioral component more deeply and ask the question if one of the two growth mindset scores (implicit or explicit) is more effective in predicting actual behavior.

Implications

In 2020, Dweck & Yeager revisited the growth mindset with special attention to implementations and interventions. They highlight that the mindset theory discusses how to react to difficulties or failures. It does not claim to explain the majority of the variation in grades or test scores and is not a hypothesis about academic accomplishment in general. This, together with a current failing to replicate previous effects of growth mindset (see Li & Bates, 2019; Bahnik & Vranka, 2017), indicates a need for further research on whether a growth mindset is predictive for academic success and to which degree. Li & Bates (2019) state that, if growth mindset research results are replicable, they are clearly important for future implications. However, their results also suggest that intelligence mindset beliefs may not be related to resilience to failure or achievement in the school context. In line with Li & Bate's (2019), a study conducted by Bahnik & Vranka (2017) shows similar results. The researchers tested nearly six thousand university applicants to investigate the relation between mindset and academic achievement. Results also failed to predict changes in achievement based on mindset. In fact, there was a slightly negative correlation between growth mindset and achievement. The authors suggest that „the strength of the association between academic achievement and mindset might be weaker than previously thought." (Bahnik & Vranka, 2017, p.139). This problem of theory should be further examined, especially as the replication research and with that, the replication crisis, is still very young.

However, there is also a large body of research suggesting positive effects of growth mindset in the classroom, which is practically relevant (e.g., De Kraker-Pauw et al., 2022; Robinson, 2017). De Kraker-Pauw et al. (2022) found a connection between student's beliefs about intelligence and learning with their academic achievement, their motivation, and their in-class behavior. Robinson (2017) showed that a classroom culture of growth mindset can help change students' approach to learning. This indicates that growth mindset interventions based on such findings could also be helping to improve classroom climate.

In 2019, the "National Study of Learning Mindsets" (NSLM; Yaeger, 2019) performed a short online growth mindset intervention with almost 12.5 thousand students in the U.S. The intervention was able to generate improved grades among lower-achieving students compared to a control group. Also, the rate at which students chose and persevered in harder math classes increased. Similar effects were found in

independent evaluations and replications of the NSLM Study (Rege et al., 2021). Given these positive findings, intelligence mindset research could build the foundation for future practical interventions such as growth mindset trainings.

Moreover, assessing growth mindset with implicit measures could provide first indications for a more realistic distribution of growth mindset. Future research should examine the distribution of implicit growth mindset within larger samples. Furthermore, for practical relevance, future research could assess differences in behavior depending on implicit versus explicit growth mindset scores via follow-up studies with a focus on actual behavior or success in the academic context. This would help to understand whether the implicit score of growth mindset is actually more relevant for behavioral consequences than the explicit score and shows a more automatic layer of the growth mindset.

Moreover, latest studies by Sun et al. (2021) suggest that there might be severe cultural differences between how students associate intelligence mindsets with academic success and motivation. This indicates that holding a growth mindset does not necessarily produce a positive effect on student motivation generally and across cultures, as was shown with Chinese students in the aforementioned study. Future research should focus on a broader spectrum of samples internationally to further investigate cultural differences and boarders of growth mindset effects.

Regarding future research on task enjoyment, it can be noted that current studies develop scales for task enjoyment as a trait criterion rather than a state criterion (e.g., the TTES Scale by Czikmantori et al., 2021). It would be interesting for further research, especially since there is a research gap in this area, to use such a scale and push the frame of task enjoyment even further by looking at it as a trait rather than a state criterion.

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Appendix

Abstract

This research work examines the connection between intelligence mindset beliefs (about holding a growth mindset) and psychophysiological effort during a learning phase. It further investigates a mediating role of task enjoyment between growth mindset and learning. In line with recommendations from literature, this study uses an implicit measure to assess implicit growth mindset, aiming to overcome the limits of explicit measures and reveal a more automatic layer of growth mindset. Measurement of physiological parameters was included to assess effort. During the study procedure, physiological arousal was captured through test person's heart rate and blood pleasure by using mechanical devices such as electrodes and a blood pressure machine.

To answer the research question whether holding a growth mindset makes people enjoy tasks more and thus results in a higher psychophysiological arousal during a learning phase, a quantitative correlational study was conducted on university students (N = 170) at the labor for motivational psychology of the University of Vienna.

The results of the study failed to demonstrate a significant correlation between growth mindset and the psychophysiological effort during a learning phase. Nor could a mediating role of task enjoyment be found. Further, there was no connection between growth mindset and age as well as gender. However, differences in the distribution of explicitly and implicitly measured growth mindset were found and are discussed. To put non-significant results into perspective, limiting factors as well as practical relevance of this research field are debated.

Keywords: Implicit theories, growth mindset, task enjoyment, motivational psychology

Abstract in German Language

Ziel dieser Arbeit ist es, den Zusammenhang zwischen Intelligenzüberzeugungen (Growth Mindset) und physiologischer Erregung während einer Lernphase zu untersuchen. Darüber hinaus wird eine vermittelnde Rolle der „Freude an der Aufgabe“ (Task Enjoyment) zwischen dem Growth Mindset und dem Lernen untersucht. Im Einklang mit den Empfehlungen aus der bisherigen Literatur wird in dieser Studie eine implizite Messung zur Beurteilung der Ausprägung des impliziten Growth Mindsets verwendet, mit dem Ziel die Einschränkungen expliziter Messinstrumente zu überwinden. Zur Beantwortung der Forschungsfrage, ob das Vorhandensein eines Growth Mindsets zu mehr Freude an Aufgaben und damit zu einer höheren psychophysiologischen Erregung während einer Lernphase führt, wurde eine quantitative Korrelationsstudie mit Universitätsstudenten (*N* = 170) am Labor für Motivationspsychologie der Universität Wien durchgeführt. Während des Studienverlaufs wurde die psychophysiologische Erregung über die Herzfrequenz und den Blutdruck der Proband*innen mit Hilfe von mechanischen Hilfsmitteln wie Elektroden oder einem Blutdruckmessgerät erfasst. Die Ergebnisse der Studie konnten keinen signifikanten Zusammenhang zwischen Growth Mindset und der psychophysiologischen Anstrengung während einer Lernphase nachweisen. Auch eine vermittelnde Rolle der Freude an der Aufgabe konnte nicht festgestellt werden. Auch gab es keinen Zusammenhang zwischen dem Growth Mindset und dem Alter sowie dem Geschlecht der Testpersonen. Es wurden jedoch Unterschiede zwischen der Verteilung von explizit und implizit gemessenem Growth Mindset gefunden, die ausführlich diskutiert werden. Um die nicht-signifikanten Ergebnisse besser einzuordnen, werden einschränkende Faktoren sowie die praktische Relevanz dieses Forschungsfeldes diskutiert.

Stichworte: Implizite Theorien, Growth Mindset, Aufgabenfreude, Motivationspsychologie

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Index of Acronyms

GM Growth Mindset

IGM Implicit Growth MIndset

EGM Explicit Growth Mindset

PEP Pre-ejection period

TE Task Enjoyment

Questionnaires

Explicit Growth Mindset: adapted explicit growth mindset items from Spinath & Schöne (2003)

	Stimme gar nicht zu (1)	Stimme überwiegend nicht zu (2)	Stimme eher nicht zu (3)	Stimme etwas zu (4)	Stimme überwiegend zu (5)	Stimme völlig zu (6)
Jeder besitzt ein bestimmtes Ausmaß an Intelligenz, das nicht verändert werden kann. (1)	○	○	○	○	○	○
Jeder besitzt ein bestimmtes Ausmaß an Intelligenz, das verändert werden kann. (2)	○	○	○	○	○	○
Wenn man neue Dinge lernt, bleibt die Intelligenz gleich. (3)	○	○	○	○	○	○
Wenn man neue Dinge lernt, verändert sich die Intelligenz. (4)	○	○	○	○	○	○
Intelligenz ist etwas, das kaum verändert werden kann. (5)	○	○	○	○	○	○
Intelligenz ist etwas, das verändert werden kann. (6)	○	○	○	○	○	○

Heart Conditions:

	Ja (1)	Nein (2)
Wurde bei Ihnen Bluthochdruck diagnostiziert? (1)	○	○
Wurde bei Ihnen eine Herzinsuffizienz diagnostiziert? (2)	○	○
Wurde bei Ihnen eine Herzrhythmusstörung diagnostiziert? (4)	○	○
Wurde bei Ihnen eine andere Herzkrankheit diagnostiziert? (5)	○	○
Wurde bei Ihnen irgendeine Art von Schlaf-störung diagnostiziert? (6)	○	○
Wurden Sie am Herzen operiert? (7)	○	○
Nehmen Sie Betablocker? (8)	○	○
Nehmen Sie Methamphetamine ein? (9)	○	○
Tragen Sie einen Herzschrittmacher? (10)	○	○

Self-Efficacy: Self-efficacy subscale of the Motivated Strategies for Learning Questionnaire (Pintrich & de Groot, 1990)

	Stimme gar nicht zu (1)	Stimme überwiegend nicht zu (2)	Stimme eher nicht zu (3)	Stimme etwas zu (4)	Stimme überwiegend zu (5)	Stimme völlig zu (6)
Im Vergleich zu anderen StudienteilnehmerInnen erwarte ich, dass ich gut abschneide. (1)	○	○	○	○	○	○
Ich erwarte, dass ich in dem folgenden Test über intellektuelle Fähigkeiten sehr gut abschneiden werde. (2)	○	○	○	○	○	○
Meine intellektuellen Fähigkeiten sind im Vergleich zu anderen StudienteilehmerInnen ausgezeichnet. (4)	○	○	○	○	○	○
Ich denke, ich werde im folgenden Test intellektueller Fähigkeiten eine hohe Punktzahl erhalten. (3)	○	○	○	○	○	○
Ich bin sicher, dass ich die Probleme und Aufgaben in diesem Test gut lösen kann. (5)	○	○	○	○	○	○
Verglichen mit anderen StudienteilnehmerInnen bin ich ein/e gute/r StudentIn. (6)	○	○	○	○	○	○
Ich weiß, dass ich in der Lage sein werde, die im Test gestellten Aufgaben zu verstehen. (7)	○	○	○	○	○	○

Task Enjoyment:

	Überhaupt nicht gut (1)	Überwiegend nicht gut (2)	Eher nicht gut (3)	Eher gut (4)	Überwiegend gut (5)	Sehr gut (6)
Wie gut hat Ihnen die Bearbeitung der Aufwärmübungen gefallen? (1)	○	○	○	○	○	○
Wie gut hat Ihnen das Lernen mithilfe der Lösungswege gefallen? (4)	○	○	○	○	○	○
Wie gut hat Ihnen die Bearbeitung des Haupttestes gefallen? (2)	○	○	○	○	○	○

Lay theories of the world: Implicit theories and their role in judgments and reactions, Dweck et al. (1995)

	Stimme gar nicht zu (1)	Stimme überwiegend nicht zu (2)	Stimme eher nicht zu (3)	Stimme etwas zu (4)	Stimme überwiegend zu (5)	Stimme völlig zu (6)
Obwohl wir einige Ereignisse verändern können, ist es unwahrscheinlich, dass wir die Grundzüge unserer Welt verändern können. (1)	○	○	○	○	○	○
Unsere Welt hat eine grundlegende und tief verwurzelte Beschaffenheit, und man kann wirklich nicht viel tun, um diese zu ändern. (2)	○	○	○	○	○	○
Einige gesellschaftliche Trends mögen für eine Weile dominieren, aber die grundlegende Natur unserer Welt kann nicht bedeutend geändert werden. (3)	○	○	○	○	○	○

Self-transcendent motives for learning: (Yaeger et al., 2014)

	Trifft gar nicht zu (1)	Trifft überwiegend nicht zu (2)	Trifft eher nicht zu (3)	Trifft etwas zu (4)	Trifft überwiegend zu (5)	Trifft völlig zu (6)
Ich möchte Dinge lernen, die mir helfen, einen positiven Einfluss auf die Welt zu haben. (1)	○	○	○	○	○	○
Ich möchte Fähigkeiten erwerben, die ich in einem Beruf einsetzen kann, der anderen hilft. (4)	○	○	○	○	○	○
Ich möchte ein gebildeter Bürger werden, der einen Beitrag zur Gesellschaft leisten kann. (3)	○	○	○	○	○	○

Self-perceived talent: Bauer, Job & Hannover (under review)

	Stimme gar nicht zu (1)	Stimme überwiegend nicht zu (2)	Stimme eher nicht zu (3)	Stimme etwas zu (4)	Stimme überwiegend zu (8)	Stimme völlig zu (11)
Ich denke, dass ich begabt bin. (1)	○	○	○	○	○	○
Ich denke, dass ich talentiert bin. (89)	○	○	○	○	○	○

Trait Anxiety: Behavioural inhibition system scale (BIS), Poythress et al.2008)

	Stimme gar nicht zu (1)	Stimme überwiegend nicht zu (2)	Stimme eher nicht zu (3)	Stimme etwas zu (4)	Stimme überwiegend zu (5)	Stimme völlig zu (6)
Kritik oder Tadel verletzt mich zutiefst. (1)	○	○	○	○	○	○
Ich habe Angst, Fehler zu machen. (2)	○	○	○	○	○	○
Ich fühle mich ziemlich besorgt oder aufgebracht, wenn ich denke oder weiß, dass jemand wütend auf mich ist. (3)	○	○	○	○	○	○
Wenn ich denke, dass etwas Unangenehmes passieren wird, dann werde ich normalerweise ziemlich angespannt. (4)	○	○	○	○	○	○

State Anxiety: Six-item short-form of the state scale of the Spielberger State—Trait Anxiety Inventory (STAI), Marteau & Bekker (1992)

	Stimme gar nicht zu (1)	Stimme überwiegend nicht zu (2)	Stimme eher nicht zu (3)	Stimme etwas zu (4)	Stimme überwiegend zu (5)	Stimme völlig zu (6)
Ich fühle mich ruhig (1)	○	○	○	○	○	○
Ich fühle mich angespannt (4)	○	○	○	○	○	○
Ich fühle mich betrübt (5)	○	○	○	○	○	○
Ich fühle mich entspannt (6)	○	○	○	○	○	○
Ich fühle mich zufrieden (7)	○	○	○	○	○	○
Ich fühle mich besorgt (8)	○	○	○	○	○	○

Achievement Goals:

	Stimme gar nicht zu (1)	Stimme überwiegend nicht zu (2)	Stimme eher nicht zu (3)	Stimme etwas zu (4)	Stimme überwiegend zu (5)	Stimme völlig zu (6)
… möglichst alle Aufgaben richtig zu lösen. (1)	○	○	○	○	○	○
… keine Fehler zu machen. (6)	○	○	○	○	○	○
… meine Leistung von Aufgabe zu Aufgabe zu verbessern. (7)	○	○	○	○	○	○
...mich möglichst stark anzustrengen. (9)	○	○	○	○	○	○
...mit voller Anstrengung mein Bestes zu geben. (10)	○	○	○	○	○	○
... mich möglichst wenig anzustrengen. (11)	○	○	○	○	○	○
... zu vermeiden, dass ich mich zu sehr verausgabe. (12)	○	○	○	○	○	○

Effort Enjoyment Sik, K., & Job, V. (in preparation). Effort Importance and Effort Enjoyment in the Context of Math.

	Stimme gar nicht zu (1)	Stimme überwiegend nicht zu (2)	Stimme eher nicht zu (3)	Stimme etwas zu (4)	Stimme überwiegend zu (8)	Stimme völlig zu (11)
Ich strenge mich sehr gerne an. (1)	○	○	○	○	○	○
Ich hasse es, mich anzustrengen. (71)	○	○	○	○	○	○
Es macht Spaß, sich anzustrengen. (73)	○	○	○	○	○	○
Es ist unangenehm, mich anzustrengen. (74)	○	○	○	○	○	○
Ich mag es, mich anzustrengen. (89)	○	○	○	○	○	○
Es fühlt sich gut an, sich anzustrengen. (90)	○	○	○	○	○	○