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Examining the generalizability of a Willpower Belief
Manipulation across individual differences in Achievement
Motivation and Emotionality

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Abstract

Willpower, defined as the ability to exert self-control, plays a crucial role in pursuing long-term objectives, such as maintaining a healthier lifestyle or achieving academic success. The impact of Willpower is significantly influenced by individuals' beliefs about their own Willpower, known as Willpower Beliefs. Yet, no study tested the impact of individual differences on the effectiveness of the frequently used Willpower manipulations. This study tests whether the effectiveness of Willpower Belief manipulations varies in Achievement Motivation and Emotionality. Participants ($N = 296$) completed questionnaires assessing their Initial Willpower Beliefs, Achievement Motivation, and Emotionality before undergoing a Willpower manipulation. We hypothesized that participants in congruent conditions (high Achievement Motivation/non-limited condition, low Achievement Motivation/limited condition, high Emotionality/limited condition, low Emotionality/non-limited condition) would experience the greatest manipulation effect. The results revealed that high Achievement Motivation in the non-limited condition led to a greater manipulation effect ($\beta = -.40, p < .001$), while low Achievement Motivation in the limited condition did not show a similarly strong effect. When controlling for Initial Willpower Beliefs, the interaction effect remained robust ($\beta = -.40, p < .001$). Additionally, the manipulation effect was influenced by Emotionality, with high Emotionality enhancing the effect in the limited condition ($\beta = .29, p = .007$) and low Emotionality in the non-limited condition. Initial Beliefs were more significant in the context of Emotionality ($\beta = -.12, p = .026$) than Achievement Motivation. These findings highlight the importance of personalized approaches to enhance Willpower Beliefs and self-control interventions.

Keywords: *Willpower Beliefs, Achievement Motivation, Emotionality*

Introduction

Imagine resisting the temptation of a delicious dessert when you are on a diet or pushing through fatigue to finish studying for an important exam. Achieving long-term goals often hinges on our ability to resist short-term temptations. All these examples are somehow connected to the concept of self-control. Self-control is crucial in various aspects of life, such as effective functioning in society (Vohs & Baumeister, 2004), overall well-being and interpersonal relationships by benefiting of greater impulse control (Tangney et al., 2004), and various behavioral aspects like health and risk behavior (de Ridder et al., 2012). Willpower, characterized as the capacity for self-control (Job et al., 2010), therefore also plays an important role in achieving established goals by resisting immediate temptations. The impact of Willpower, however, is not solely determined by one's self-control abilities but is significantly influenced by individuals' beliefs about their own Willpower, known as Willpower Beliefs.

Changing one's Willpower Beliefs is advantageous as it can facilitate numerous life pursuits, including adopting a healthier lifestyle, preparing for exams without procrastination (Job et al., 2015), or making environmentally conscious choices (Jankowski & Job, 2023). Therefore, it has become prominent to manipulate Willpower Beliefs.

The aim of this thesis is to test the stability of a popular Willpower Belief manipulation by looking at two dimensions of human variability: Achievement Motivation and Emotionality. This study explores how these aspects interact with and potentially shape the effectiveness of interventions designed to manipulate Willpower Beliefs. By exploring this relationship, this study aims to not only deepen our understanding of the psychological intricacies governing Willpower but also pave the way for targeted and personalized approaches to enhance a non-limited Willpower Belief. Before diving into the current design for the study the three relevant variables, which are Willpower Beliefs, Achievement Motivation, and the personality trait of Emotionality will be further explained in a brief overview. More importantly, after introducing these constructs, the interaction between them and their relevance for further improving Willpower Belief interventions will be discussed. By exploring their links to each other, this will then subsequently lead to the hypotheses of this work.

Willpower Beliefs

Willpower is defined as the ability to perform self-control (Ainslie, 2021; Job et al., 2010) or the psychological function to resist temptations (Ainslie, 2021). It is often used

synonymously to self-control (e.g. Inzlicht et al., 2014). However, more recent literature has argued that Willpower should not be seen as synonymous to, but rather as a subset of self-control, arguing that Willpower is a key component, but not the only aspect of self-control, since there are many other strategies that individuals can use to enhance their self-control beyond simply relying on Willpower alone (Ainslie, 2021; Kristal & Zlatev, 2021). To put it into more detail, Ainslie (2021) defined Willpower as a specific type of self-control that involves resisting immediate temptations, while self-control can also involve proactive strategies for avoiding or minimizing the impact of future temptations. The discourse on Willpower extends to individuals' perceptions of their own capabilities, as their beliefs about Willpower can shape subsequent efforts in self-control (Francis & Job, 2018).

Types of Willpower Beliefs

When discussing Willpower Beliefs, it is essential to differentiate between limited and non-limited beliefs. Initially, research followed Baumeister et al.'s (1998) strength model of self-control, which posited that self-control is a limited resource that becomes depleted after use. For instance, in one of their studies, participants who resisted eating cookies and chose healthy alternatives exhibited decreased persistence in subsequent self-control tasks compared to those who did not face such a temptation. This reduction in self-control capacity was termed 'ego depletion' (Baumeister et al., 1998, 2007).

However, in subsequent years, the notion of self-control as a limited resource has faced criticism. Inzlicht and colleagues (2014) pointed out inconsistencies in empirical evidence supporting the depletion model. They proposed that behavior regulation is more about prioritizing tasks rather than relying on a limited self-control resource. Furthermore, Job et al. (2010) introduced the idea that whether self-control is depleted depends on individuals' beliefs about Willpower. Their research demonstrated that participants who believed Willpower is limited exhibited ego depletion, whereas those who viewed Willpower as non-limited did not experience such depletion. The distinction between limited and non-limited beliefs about Willpower has significant implications.

These lay theories of Willpower, whether individuals perceive Willpower as limited or non-limited, can profoundly impact various life domains (Francis & Job, 2018). For instance, believing in non-limited Willpower can enhance productivity and motivation in work or academic settings (Job et al., 2015) and positively influence health behaviors (Bernecker & Job, 2015). Additionally, individuals with a non-limited Willpower Belief report higher

subjective well-being and are more successful in goal pursuit, further enhancing their well-being (Bernecker et al., 2017).

Considering the benefits of a non-limited perspective on Willpower Beliefs suggests that this viewpoint could be a fruitful angle for psychological interventions. There are already attempts to manipulate Willpower Beliefs. Basic interventions where participants read passages that were either biased towards a limited or non-limited belief were already successful (Mukhopadhyay & Johar, 2005). More extensive approaches, for example a study by Burnette et al. (2020), included three modules delivered over approximately 45 minutes in the form of videos, scientific articles, and real-world examples. This study also includes a Willpower Belief manipulation that is based on biased text examples. The study will be explained in more detail throughout the method section.

Individual Differences

In this study we want to explore how differences in traits where humans tend to differ can influence the effectiveness of Willpower manipulations. Therefore, Achievement Motivation and Emotionality, the individual difference traits we focus on in this study, and their link to Willpower will be further explored in the following sections.

Achievement Motivation

Consider a student who consistently seeks out challenging academic tasks, engages in extracurricular activities, and strives for top grades. This individual is likely to demonstrate typical traits of a person with a high Achievement motive, such as perseverance, taking on challenges willingly (Sagie & Elizur, 1999), and finding intrinsic satisfaction in achieving academic excellence (Pintrich & De Groot, 1990). For those reasons, a high Achievement Motive is also associated with superior learning outcomes (Walidaini et al., 2018).

Achievement motivation has been a dominant theme in motivational psychology for centuries now, even gaining traction in the 19th century (e.g. James, 1890). It is defined as the desire to maintain one's competence as high as possible in achievement situations (Heckhausen, 1965). A comprehensive examination of the psychological factors and processes contributing to the development of Achievement Motivation in specific performance situations was undertaken by Atkinson (1957) in his Risk-Taking Model of Achievement Motivation. This model has garnered substantial attention, primarily owing to the clarity of empirical predictions it facilitates. Atkinson further described that whenever a situation arises in which performance is likely to be evaluated, one can have two different

motivational tendencies, the motive to achieve and the motive to avoid failure, a distinction that still holds relevance to this day.

Emotionality

The construct ‘Emotionality’ gained traction as one of the subscales of the HEXACO personality questionnaire (Ashton & Lee, 2018). The authors describe individuals who score high on the Emotionality subscale as more fearful, experiencing a greater amount of anxiety, seeking emotional support from others frequently, and being able to form more empathetic and sentimental connections with others than individuals scoring low in the subscale.

Emotionality is linked to Neuroticism, a personality trait characterized by frequent and intense negative emotions in response to stress, often associated with a perceived lack of control (Barlow et al., 2014). Neuroticism is commonly included as a subscale in personality assessments, such as the Five Factor Model of Personality (FFM, Costa & McCrae, 1985). High scores in Neuroticism are associated with challenges in interpersonal relationships due to heightened negative emotional responses (Costa & McCrae, 2010), and it has been correlated with mental health conditions, including Borderline Personality Disorder (Morey et al., 2002).

However, even though the definitions are familiar, the subscale ‘Emotionality’ from the HEXACO is not synonymous to Neuroticism. In a paper from Ashton and colleagues (2014) the authors explained that FFM Neuroticism (Costa & McCrae, 1985) and HEXACO Emotionality (E) roughly correspond to rotated variants of each other. This suggests that there is some overlap between the two constructs, as both assess tendencies towards negative affectivity and emotional instability. The authors further indicated that the HEXACO model demonstrates superior predictive validity for Emotionality related criteria compared to the FFM. Examples include vocational interests (McKay & Tokar, 2012), phobic tendencies (Ashton et al., 2008), and psychopathy scores (Gaughan et al., 2012), where HEXACO consistently outperforms FFM scales. Because of the proposed superiority the Emotionality subscale from the HEXACO will be used as a questionnaire in this study.

In the next paragraph the association between Willpower and the two constructs Achievement Motivation and Emotionality will be reviewed. Note that since Willpower is often defined as a more specific type of self-control or even used synonymously, that the following literature review occasionally uses the term self-control instead of Willpower.

Willpower and Achievement Motivation

Several studies have explored the link between self-control and Achievement motivation. A study on achievement motivation and self-control in students showed that higher self-control is associated with higher achievement value orientation (Grund & Senker, 2018). In another study (Schüler et al., 2019) it is also suggested that self-control and Achievement Motivation are related. Specifically, the study found that people with high trait self-control were less affected by the negative effects of motive-goal incongruence. Self-control and Achievement Motivation are closely related constructs, however they capture different cognitive and motivational aspects (Degol & Bachman, 2023). According to the authors, self-control is more important for resisting temptation and staying focused, while achievement motivation is necessary for setting goals and persisting in the face of challenges.

Moreover, a finding that is also important for the understanding of the subsequent hypotheses, Sheldon and Elliot (1999) have shown that whenever people set goals that do not fit with their personal motives, their motivation and personal well-being get negatively affected. Therefore, whenever a person seeks motive-incongruent tasks that do not match their personal motives, for example achievement motives, it drains their resources (Brunstein, 2010).

Willpower and Emotionality

Emotionality is defined by traits like higher anxiety, irritability, and impulsivity (Costa & McCrae, 1985; Lee & Ashton, 2018), comparable to the better-known concept of Neuroticism. Prior research showed negative associations between Emotionality (or Neuroticism) with self-control, possibly due to less adaptive emotion-regulation (Liao et al., 2022) which can result in less developed self-control skills (Hoyle et al., 2019). From an applied perspective, this was exemplified by relating higher Neuroticism with an increased tendency for procrastination (Steel, 2007).

Current Study

This study tests the generalizability of a Willpower Belief manipulation across individual differences (Achievement Motivation & Emotionality). Specifically, we test whether the (mis-)match of individual and condition affects the magnitude of the effect. Based on the existing literature exploring the association between Willpower, Achievement Motivation and Emotionality, these considerations give rise to the hypotheses of this study.

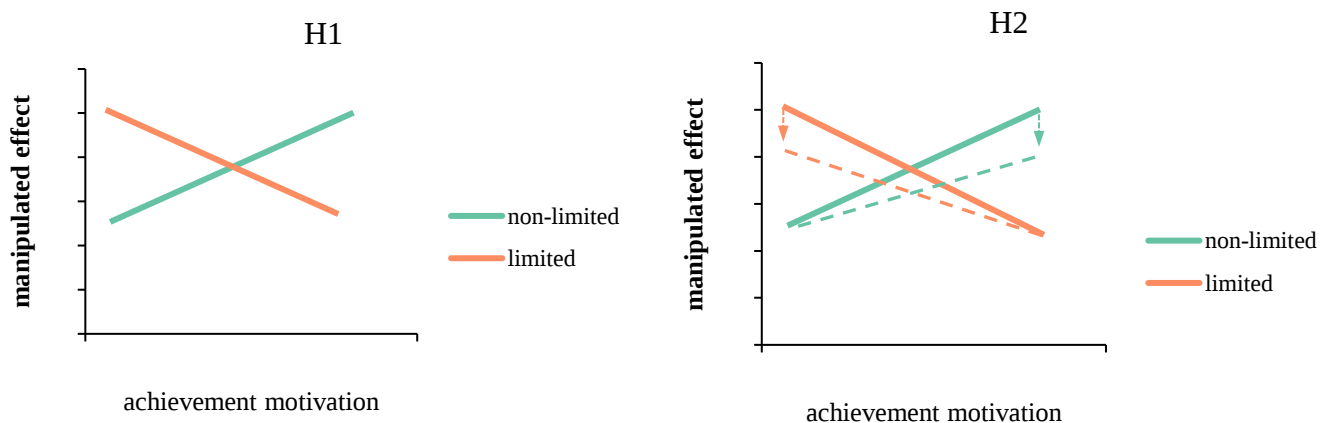
Hypotheses – Achievement Motivation

The first hypothesis (Figure 1) postulates that the manipulation effect is a function of condition (limited/non-limited) and individual Achievement Motivation. We expect that people with high Achievement Motivation who are assigned to the non-limited Willpower Belief condition, and participants with low Achievement Motivation assigned to the limited Willpower Belief condition will have a stronger manipulation effect. This is because their achievement motive is congruent with the manipulated belief of Willpower and therefore intensifies it. The change in Willpower Beliefs will be assessed as how much the participants deviate from the mean of the respective scale.

In the second hypothesis (H2, see Figure 2), we control for Initial Willpower Beliefs and therefore expect a weakened interaction compared to H1 because Initial Beliefs would explain further variance. The first two hypotheses are depicted in the figures below, note how the expected interaction is weaker in the second graphic:

Figure 1 and 2

Graphic Illustration of H1 and H2 – Interaction between Achievement Motivation and Willpower Manipulation



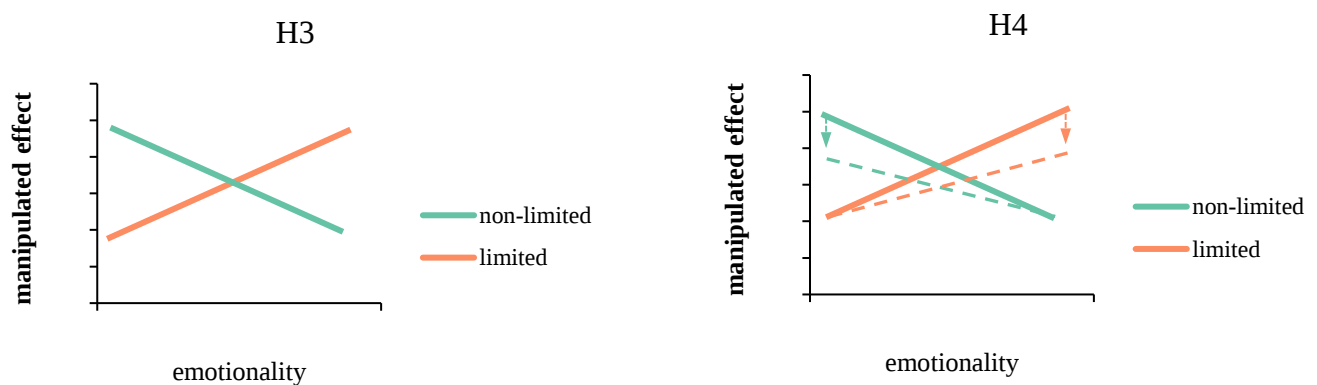
Hypotheses – Emotionality

Similar to the first hypothesis, the third Hypothesis (H3, Figure 3) posits that the manipulation effect is a predicted by condition (limited/non-limited) and individual Emotionality. We expect a greater manipulation effect (deviance from scale mid-point) in the congruent conditions with individuals scoring high in Emotionality allocated to limited Willpower Belief condition, and participants with low Emotionality assigned to the non-limited Willpower Belief condition experiencing the strongest manipulation effect.

Finally, in the H4 (Figure 4) we once again control for Initial Willpower Beliefs and hypothesize that this will lead to a weakened interaction. The final two hypotheses are depicted in the figures below.

Figure 3 and 4

Graphic Illustration of H3 and H4 – Interaction between Emotionality and Willpower Manipulation



Methods

This study was integrated into a broader project exploring self-control by Roth et al. (2023). Throughout the method part only the measurements relevant for this thesis will be further elaborated on.

Sample

Power was computed, using the ShinyApp by Baranger et al. (2023) for cross-sectional two-way interactions. Using 1,000 simulations, the indicated power was .811 for $N = 260$ participants ($\alpha = .05$). The specifications of the simulation are stored in the supplemental material and can be replicated here: <https://mfinsaas.shinyapps.io/InteractionPowerR/> using the seed = 17, the exact calculations can be found in the supplemental material. The participants were recruited through prolific.co (<https://www.prolific.com/>). By using this platform, participants were guaranteed a fair compensation while also ensuring high data quality. This enabled us to ensure that the expected effect is robustly supported. The sampling procedure took place from 24th of April 2024 until 7th May 2024.

Procedure

Participants started the study by reading the instructions and consenting to the study procedure. Next, we collected the participants' Initial Willpower Beliefs (Job et al., 2010), Achievement Motivation (Lang & Fries, 2006) and Emotionality (Lee & Ashton, 2018). Then, the Willpower Belief manipulation started, participants read text examples that were either biased towards a limited or non-limited belief. Manipulating Willpower Beliefs with text passages has already been effectively done in previous research (e.g. Mukhopadhyay & Johar, 2005). After reading either one of those articles, they had to summarize the respective article and answer five questions that checked their comprehension about it. With those check-ups we ensured that they understood the article accurately. Afterwards the participants filled out the biased Willpower questionnaire which assessed the manipulated effect. Since this questionnaire was biased towards either a limited or non-limited viewpoint, each of the two manipulation groups had their own questionnaire based on which condition they were assigned to. Finally, the demographic information was collected at the very end of the study. The manipulation articles and applied scales can be found in the Supplemental Material.

Measures

Demographics. Participants provided information on their age (in years), nationality and gender identity (female, male, other).

Willpower. As stated above, one of the measurements concerned the participants Willpower Beliefs. To assess that, a scale by Job et al. (2010) which uses 12 items on a 7-point scale (1 = 'strongly agree', 7 = 'strongly disagree') was utilized. An example item of the scale stated 'After a strenuous mental activity, you feel energized for further challenging activities'.

Achievement Motivation. The Achievement Motives Scale (AMS), originally developed by Gjesme and Nygard in 1970 and then further revised by Lang and Fries (AMS-R, 2006) was applied to assess Achievement Motivation. The questionnaire is structured into the two subscales 'Hope of Success (HS)' and 'Fear of Failure (FF)'. The participants stated their answer on a 4-point scale, ranging from 1 = 'strongly disagree' to 4 = 'strongly agree'. An example included 'I am afraid of failing in somewhat difficult situations, when a lot depends on me'. The internal consistencies (Cronbach's α) were higher than .70 in all samples for both revised scales.

Emotionality. Participants filled out the Emotionality subscale of the 100-Item Version of the HEXACO questionnaire (Lee & Ashton, 2018). The scale consists of 16 items on a 5-

point Likert-scale (1 = ‘strongly disagree’, 5 = ‘strongly agree’). The Emotionality subscale itself is further structured into the facets ‘Anxiety’, ‘Fearfulness’, ‘Dependence’ and ‘Sentimentality’. For example, an item assessing ‘Anxiety’ was ‘I sometimes can't help worrying about little things.’ The authors report good internal consistency reliability, obtaining alpha reliabilities in the .80s for the factor-level scales and averaging above .70. The Emotionality subscale specifically has good reliability in terms of consistency between self-reports and observer reports.

Biased Willpower Questionnaire. The last measurement was conducted to assess the Manipulation effect. After the participants read the respective article that either confirmed a limited or non-limited viewpoint, they received a biased Willpower questionnaire after the manipulation took place. The participants therefore received a questionnaire with questions that were formulated in a way that was congruent with the text passages they read. If the participants were manipulated towards a non-limited viewpoint, one of the items for example stated ‘After concentrating fully on something for a while, I sometimes feel energized for more challenging activities.’ Participants had to answer seven of those items on a 6-point scale (1 = ‘strongly agree’, 6 = ‘strongly disagree’).

Data analysis

The final data was cleaned and processed with RStudio (2023.06.2). Reversed items were recoded. The descriptive statistics of the respective scales and demographic data were also calculated and plotted, such as mean and standard deviation. Furthermore, all measurements were correlated with one another. Moreover, the reliability of all the scales of the study were calculated. We used one-sample one-sided *Welchs t*-test to find out if the participants significantly deviated from the scale midpoint (= 3.5) in the biased questionnaires by group.

To test the hypotheses, we ran four different multiple regression models with each of them including an interaction effect. Beforehand the requirements for regressions were tested using the ‘performance’ package in RStudio (e.g. homoscedasticity, multicollinearity). The plots of the requirements can be found in the supplemental material. The models 1-4 are summarized below (dependent variable predicted by independent variables):

Table 1*Planned Hypothesis Regression Models*

Hypothesis	Model
H1	$DV^1 \sim \text{Condition}^2 * \text{Achievement Motivation}$
H2	$DV \sim \text{Condition} * \text{Achievement Motivation} + \text{Initial Belief}$
H3	$DV \sim \text{Condition} * \text{Emotionality}$
H4	$DV \sim \text{Condition} * \text{Emotionality} + \text{Initial Belief}$

Note. ¹effect of Willpower Belief manipulation; ²condition of Willpower Belief manipulation (limited or non-limited)

Results**Sample Description**

The final sample included 296 participants, recruited through Prolific.co. As all participants completed the entire questionnaire and passed the comprehension checks, none were excluded from the analysis. This confirmed that they understood the instructions and the manipulation correctly.

Our sample consisted of 179 females (60.5%) and 107 males (36.1%). Nine participants did not want to answer the question regarding their gender (3%) and one person skipped over the question entirely. The mean age of our sample was around 31 years old ($M = 30.98$, $SD = 9.44$). It ranged from 18 up to 67 years old.

We also collected demographic data on the participants' current occupation status, which is summarized in table 2.

Table 2*Current Occupation Status*

Status	<i>N</i>
Student	106
Employed (Full-Time)	135
Employed (Part-Time)	34
Unemployed	46

Descriptives and Correlations

Scale Descriptives

The descriptive statistics for the scales used in this study (AMS-R for Achievement Motivation, HEXACO for Emotionality and Initial Willpower Beliefs) are summarized in table 3. Added to table 3 are also the Cronbach's Alpha reliability values for each scale. Besides the descriptives for the overall scales, we also tested if the two manipulation groups (non-limited and limited) differed in their response styles for the respective scales. However, the two groups did not differ in their answers, showing only minor differences (see table 4).

Table 3

Scale Descriptives

Scale	Mean	SD	Skewness	Kurtosis	Alpha
AMS-R	2.75	0.47	.17	-.05	.80
HEXACO	3.46	0.60	-.23	.19	.81
Willpower Beliefs	4.05	0.90	-.36	.46	.81

Table 4

Scale Descriptives by Manipulation Group

Scale	Group	N	Mean	SD
AMS-R	1	149	2.74	0.46
	2	147	2.76	0.47
HEXACO	1	149	3.43	0.56
	2	147	3.50	0.63
Willpower Beliefs	1	149	4.05	0.90
	2	147	4.04	0.90

Note. Group 1 refers to the non-limited willpower belief group, and Group 2 refers to the limited willpower belief group.

Correlations

Before conducting the analysis for the main hypothesis, the correlations between all the relevant variables were calculated. In the theoretical part of this thesis, it was already suggested that Achievement Motivation would be positively correlated with self-control due to the relatedness of the constructs per se (Degol & Bachman, 2023). This was confirmed by the correlational analysis, which showed a significant negative correlation between Achievement Motivation and Initial Willpower Beliefs ($r = -.44$, 95% CI $[-0.53, -0.35]$, $t = -8.46$, $p < .001$). This indicates that higher Achievement Motivation is associated with less limited Willpower Beliefs (a higher score in the Initial Willpower Belief questionnaire indicated a more limited Willpower Belief) and therefore positively associated with a non-limited viewpoint.

Moreover, it was already discussed that Emotionality is expected to be negatively associated with a non-limited Willpower Belief possibly because of less adaptive emotion-regulation skills (Liao et al., 2022) or the correlation of procrastination and high Emotionality (Steel, 2007). This was also confirmed, the results shielded a positive significant correlation between Emotionality and Willpower Beliefs ($r = .21$, 95% CI $[0.10, 0.32]$, $t = 3.74$, $p < .001$). This indicates that more limited Willpower Beliefs are associated with higher levels of Emotionality.

Lastly, Achievement Motivation and Emotionality showed a significant negative correlation ($r = -.32$, 95% CI $[-0.42, -0.22]$, $t = -5.86$, $p < .001$). This suggests that higher levels of Achievement Motivation are associated with lower levels of Emotionality. The full correlational matrix can be found in the supplemental material.

Manipulation Check

To determine whether the manipulation groups (limited or non-limited) differed significantly from the scale midpoint of the biased Willpower questionnaire and therefore to check if the manipulation itself worked, we conducted one-sided t -tests comparing each groups mean score to the midpoint value of 3.5 (on a 6-point scale).

For the limited group, the results indicated a statistically significant and large effect. The mean score of the limited group was 5.22, which was significantly higher than the midpoint value of 3.5, ($t = 25.20$, $p < .001$). The effect size, measured by Cohen's d , was 2.08, indicating a large effect.

Similarly, for the non-limited group, the mean score was 4.49, which was also significantly higher than the midpoint value of 3.5, ($t = 13.81$, $p < .001$). The effect size for

the non-limited group was 1.13, also indicating a large effect. These results demonstrate that both manipulation groups (limited and non-limited) scored significantly higher than the scale midpoint of the biased Willpower questionnaire, indicating that the manipulation was effective in both groups.

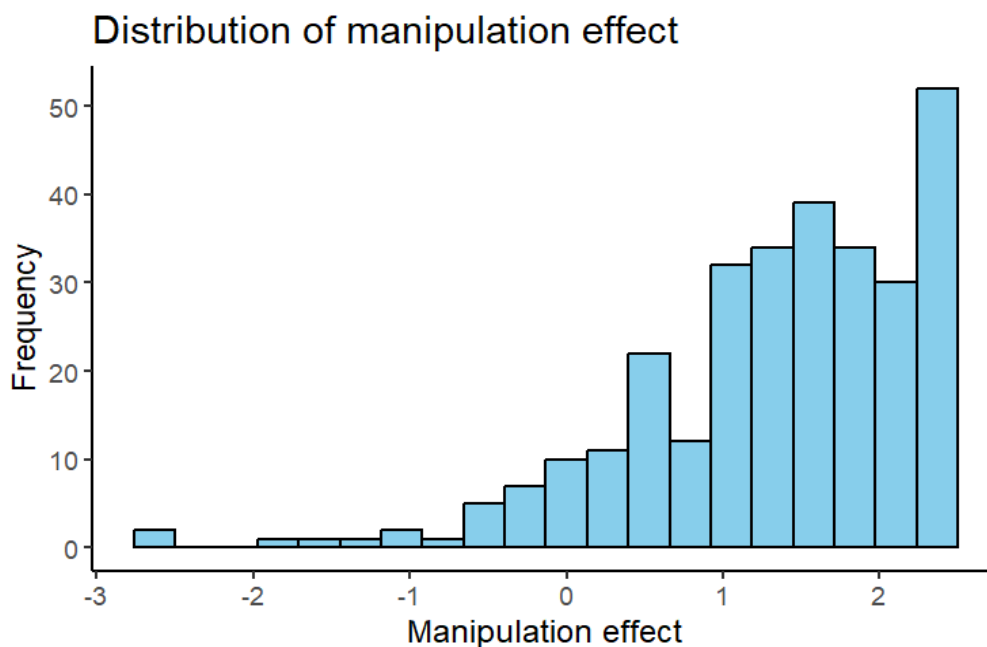
Manipulation Effect variable

Before testing our hypotheses, we calculated the dependent variable, the manipulation effect. First, we combined the two existing manipulation variables by calculating the mean score for each participant. This step aimed to create a single measure capturing the overall manipulation effect, regardless of the condition.

Next, we calculated the manipulation effect by subtracting the scale midpoint value of 3.5 from the combined scores. The midpoint of 3.5 was used because the biased willpower questionnaire had a 6-point scale. Subtracting 3.5 provided a measure of deviation from the midpoint: positive values indicated stronger agreement with the manipulated belief, while negative values indicated weaker agreement. A histogram illustrating the distribution of the manipulation effect is shown in Figure 5.

Figure 5

Distribution of the Manipulation Effect



Hypothesis Results

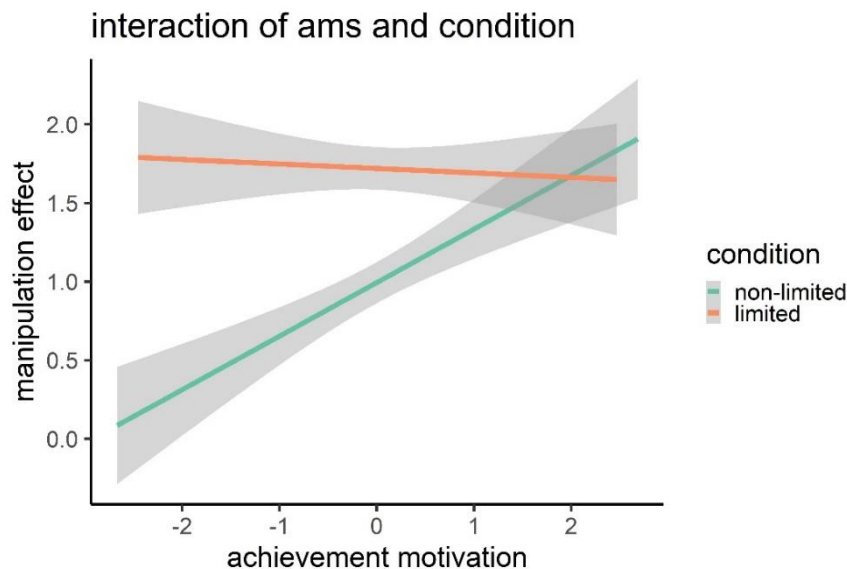
In the following part the results of the four regression models will be presented. The models were calculated in RStudio, the requirement plots for multiple regressions can be found in the supplemental material.

Hypothesis 1

Hypothesis 1 focused on the relationship between Willpower Beliefs and Achievement Motivation. We postulated that participants who were assigned to the non-limited condition and showed high Achievement Motivation would experience a bigger manipulation effect. Similarly, we anticipated that the manipulation would be more effective on participants with low Achievement Motivation allocated to the limited condition, since their achievement motive is congruent with the manipulated belief of Willpower and therefore intensifies it.

The results from the multiple regression analysis partially supported our hypothesis. The analysis revealed significant main effects of Achievement Motivation ($\beta = .37, t = 5.03, p < .001$) and the condition ($\beta = .79, t = 7.64, p < .001$, main effect of condition), as well as a significant interaction effect between these variables ($\beta = -.40, t = -3.87, p < .001$).

The significant interaction suggests that the manipulation worked better for participants with high Achievement Motivation in the non-limited condition. However, the graphic visualization (see below in Figure 6) indicates that this effect was not as pronounced for participants with low Achievement Motivation in the limited condition. To summarize, the manipulation was more effective for those with high Achievement Motivation in the non-limited condition, while in the limited condition, the effect remained relatively constant across different levels of Achievement Motivation and did not show a similarly strong effect for those with low Achievement Motivation. The regression model explained a significant portion of variance in the manipulation effect ($R^2 = .23$, adjusted $R^2 = .22$). This indicates that approximately 23% of the variability in the manipulation effect can be accounted for by the predictors included in the model. An R^2 value of .23 is considered a moderate effect size, suggesting that the predictors have a meaningful impact on the manipulation effect. The adjusted R^2 value, which accounts for the number of predictors in the model, shows that the explained variance is still substantial even after adjusting for potential overfitting.

Figure 6*Graphic of Hypothesis 1****Hypothesis 2***

In the second hypothesis we focused on controlling for participants Initial Willpower Beliefs. We predicted that when adding their Initial Willpower Beliefs as another predictor into our model, the interaction between Achievement Motivation and Willpower Manipulation would get weakened, due to congruence of Initial Beliefs and manipulation condition.

The regression model revealed that the interaction between Achievement Motivation and the manipulation condition remained significant and as strong as in the first hypothesis ($\beta = -.40, t = -3.85, p < .001$), even after controlling for Initial Willpower Beliefs. The main effect of Achievement Motivation also remained significant ($\beta = .36, t = 4.54, p < .001$). The Initial Willpower Beliefs did not significantly predict the manipulation effect ($\beta = -.03, t = -0.45, p = .65$). Moreover, the second regression model also did not explain more variance than before. We therefore could not confirm this hypothesis.

Hypothesis 3

We hypothesized that participants in the limited Willpower condition who also reported high Emotionality scores will experience a greater manipulation effect, as would the participants in the non-limited condition with low Emotionality scores, also due to the congruence of the constructs.

The regression model revealed that the main effect of Emotionality was not significant ($\beta = -.07, t = -0.93, p = .35$). The main effect of condition stayed significant ($\beta = .79, t = 7.44, p < .001$), suggesting a stronger manipulation effect in the limited condition. The interaction between Emotionality and the manipulation condition was significant ($\beta = .29, t = 2.74, p = .007$). This interaction suggests that the manipulation effect was influenced by the level of Emotionality in both conditions. Specifically:

Limited Condition (Group 2, Orange Line in Figure 7): The manipulation effect was stronger for participants with high Emotionality scores, supporting our hypothesis.

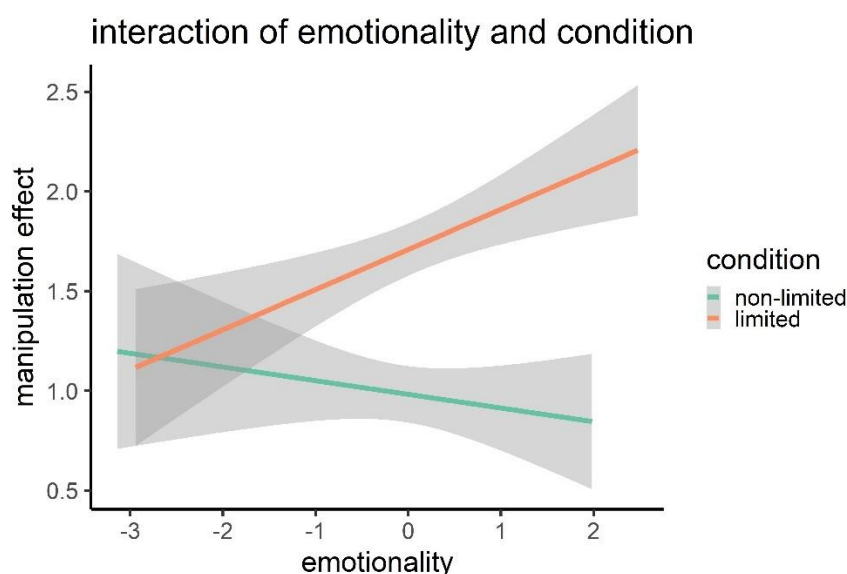
Non-Limited Condition (Group 1, Green Line in Figure 7): The manipulation effect was stronger for participants with low Emotionality scores, also supporting our hypothesis.

The regression model explained a significant portion of the variance in the manipulation effect ($R^2 = .19$, adjusted $R^2 = .18$), a moderate effect size suggesting that approximately 19% of the variability in the manipulation effect can be accounted for by the predictors included in the model.

The attached plot visualizes these results. For participants in the limited condition, the manipulation effect increases with higher Emotionality scores. Conversely, for participants in the non-limited condition, the manipulation effect decreases with higher Emotionality scores. This pattern supports our hypothesis that the manipulation effect is stronger when the participants Emotionality aligns with the Willpower Belief condition they were assigned to.

Figure 7

Graphic of Hypothesis 3



Hypothesis 4

Lastly, we also controlled for participants Initial Belief in the fourth hypothesis. Interestingly, the main effect of Initial Willpower Beliefs significantly predicted the manipulation effect in this hypothesis ($\beta = -.12$, $t = -2.24$, $p = .026$), indicating that stronger Initial Beliefs in limited Willpower (higher scores) were associated with a lower manipulation effect.

However, the interaction between Emotionality and the manipulation condition remained significant even after controlling for Initial Willpower Beliefs ($\beta = .31$, $t = 2.94$, $p = .004$). This suggests that the interaction effect is robust and not entirely explained by Initial Willpower Beliefs.

In comparison to Hypothesis 2, where Initial Willpower Beliefs did not significantly predict the manipulation effect ($p = .65$), Hypothesis 4 showed that Initial Beliefs did play a significant role. This difference suggests that Initial Willpower Beliefs are more relevant in the context of Emotionality and its interaction with the manipulation condition than they are in the context of Achievement Motivation. Our hypothesis can therefore be seen as partially supported, Initial Beliefs did explain additional variance, however the interaction between Emotionality and Willpower Belief Condition stayed robust and did not get any weaker.

Discussion

Summary

The goal of this study was to explore how individual differences in Achievement Motivation and Emotionality influence the effectiveness of Willpower Belief manipulations. Specifically, we aimed to determine whether participants with congruent traits (high Achievement Motivation/non-limited condition, low Achievement Motivation/limited condition, high Emotionality/limited condition, and low Emotionality/non-limited condition) would experience a stronger manipulation effect. The results revealed that high Achievement Motivation in the non-limited condition led to a significantly greater manipulation effect while low Achievement Motivation in the limited condition did not show a similarly strong effect. When controlling for initial Willpower Beliefs, the interaction effect remained robust. Additionally, the manipulation effect was influenced by Emotionality, with high Emotionality enhancing the effect in the limited condition and low Emotionality in the non-limited condition. Initial Beliefs were significant in the context of Emotionality.

Interpretation of Results

The first hypothesis (H1) postulated that the interaction between Willpower Beliefs and Achievement Motivation would predict the manipulation effect. Specifically, we anticipated that participants assigned to the non-limited condition with high Achievement Motivation would experience a greater manipulation effect, as their achievement motives would align with the non-limited Willpower Belief, thereby intensifying it. Similarly, we expected that participants with low Achievement Motivation assigned to the limited condition would also exhibit a stronger manipulation effect due to the congruence of their low achievement motives with the limited Willpower Belief. The first hypothesis was partially supported.

We found a significant interaction between Achievement Motivation and the manipulation condition, indicating that the overall manipulation effect is predicted by the interaction of these factors. However, the effect was more pronounced for participants with high Achievement Motivation in the non-limited condition. This supports our hypothesis that aligning the manipulation with participants achievement motives enhances the effect. Specifically, the positive main effect of Achievement Motivation and the significant interaction term suggest that participants with higher Achievement Motivation showed a greater manipulation effect when assigned to the non-limited condition.

However, the anticipated stronger manipulation effect for participants with low Achievement Motivation in the limited condition could not be found in the results. The manipulation effect did not show the same pattern for low Achievement Motivation in the limited condition, as indicated by the relatively flat interaction plot. The limited condition shows a relatively flat line, indicating the manipulation effect is not strongly influenced by Achievement Motivation. The flat line starts higher than the non-limited condition but doesn't change much with varying Achievement Motivation levels. This suggests that while the non-limited condition effectively leads to a greater manipulation effect, the same could not be found for the limited condition and its interaction with low Achievement Motivation.

The second hypothesis (H2) explored whether the interaction between Achievement Motivation and Willpower Condition would weaken when controlling for participants Initial Willpower Beliefs. We hypothesized that the congruence between Initial Beliefs and the manipulated Willpower condition would explain additional variance, thereby reducing the interaction effect observed in Hypothesis 1.

The second hypothesis could not be confirmed. Even when controlling for Initial Beliefs with adding them into the regression model as a further predictor, the interaction between Achievement Motivation and Willpower condition did not get weaker and remained significant. This suggests that the interaction between these factors play a crucial role in explaining the manipulation effect even when controlling for participants Initial Beliefs.

The Initial Beliefs themselves when looking at their main effect in the results did also not significantly predict the manipulation effect. This finding was unexpected, as we anticipated that Initial Beliefs would contribute to explaining the variance in manipulation effects. The lack of significance for Initial Beliefs in this hypothesis suggests that the context of the manipulation and the specific interaction between Achievement Motivation and the manipulation condition are more influential than pre-existing beliefs.

In the latter two hypothesis we explored the relationship between Emotionality and Willpower manipulation. Similarly to the first hypothesis, in H3 we predicted that the manipulation effect is influenced by the interaction between Emotionality and Willpower manipulation. Specifically, participants in the limited condition with high scores in the Emotionality questionnaire and participants in the non-limited condition with low scores were expected to experience the greatest manipulation effect.

The results supported the H3. We found a significant interaction between Emotionality and Willpower Beliefs. The positive interaction ($\beta = .29$) and the visualization of the results of H3 suggest that the manipulation worked more effectively for participants in the congruent conditions, as we hypothesized. Unlike the first hypothesis, where the manipulation worked best on participants in the non-limited condition with high Achievement Motivation but not so much for participants in the limited condition with low Achievement Motivation, here in the third hypothesis the pattern could be observed in both congruent conditions. However, the effect was more pronounced for participants with high Emotionality in the limited condition. These findings support the notion that congruence between personality traits and situational manipulations can enhance Willpower interventions.

Lastly, we also accounted for Initial Beliefs in the H4 and hypothesized that when controlling for them the interaction between Emotionality and Willpower manipulation would get weakened, considering that Initial Beliefs would add a further explanatory value to the manipulation effect.

The results partially supported this hypothesis. While the interaction between Emotionality and the manipulation condition remained significant and as strong as before, Initial Willpower Beliefs did significantly predict the manipulation effect. This suggests that Initial Beliefs about Willpower do have an influence in the context of Emotionality, although they do not fully account for the interaction effect between Emotionality and the manipulation condition nor weaken the interaction.

When comparing these results with those of the similar formulated H2, several differences can be found. In Hypothesis 2, Initial Willpower Beliefs did not significantly predict the manipulation effect, indicating that they did not contribute to explaining the variance in the context of Achievement Motivation. Conversely, in Hypothesis 4, Initial Willpower Beliefs were significant, suggesting that Initial Beliefs play a more important role when interacting with Emotionality. Despite this, in both hypotheses, the interaction between the personality trait and the manipulation condition remained significant even after controlling for Initial Beliefs, demonstrating the robustness of these interactions. The persistence of the interaction term in both contexts underscores the critical role of those traits in influencing the manipulation effect.

Limitations

Some limitations arise with the study design: The first one concerns the nature of the questionnaires used, which are all in the form of self-reports. Since especially a non-limited Willpower Belief and high Achievement Motivation are desirable characteristics to possess, there could be a bias in the participants answers towards social desirability. Especially with Achievement Motivation studies have shown that there are weak correlations between the self-reports and behavioral measurements of the construct (Dang et al., 2020). Including behavioral tasks could provide more objective data on the impact of Willpower Beliefs manipulations.

Another limitation concerns the hypothetical models used in this study. Ideally, addressing the research question would involve examining a three-way interaction among Willpower Beliefs, Achievement Motivation, and Emotionality. This approach would allow for a more comprehensive understanding of how these factors interact to influence the manipulation effect and could reveal more dynamics that a simpler two-way interaction model might miss. However, due to resource constraints, it was impractical to pursue this approach for this thesis. Examining three-way interactions requires a substantially larger sample size to achieve the needed statistical power (Wahlsten, 1991).

Furthermore, even though the sample was recruited through prolific.co, a platform that guarantees high data quality, our sample could not be representative of the general population. A significant proportion of participants were from South Africa, which may introduce cultural differences that could influence the results. Cultural norms and beliefs about Willpower, Achievement, and emotional expression may differ in South Africa compared to other regions, potentially affecting how participants responded to the manipulations and questionnaires.

Moreover, the study has only one time point of assessing the change in Willpower Beliefs, limiting the ability to explore long-term changes. The effectiveness of Willpower Belief manipulations might vary over time. The approach of this study might not capture potential changes in participants beliefs beyond the immediate post-manipulation assessment. Assessing participants at multiple time points post-manipulation could provide insights into the persistence of the effects.

A surprising result was Initial Beliefs not explaining further variance in this study, especially in the context of Achievement Motivation. The limited predictive power of Initial Willpower Beliefs suggests that immediate contextual factors and specific personality traits play a more significant role in determining the manipulations effectiveness. However, there may be other unmeasured factors or variables that could explain additional variance in the manipulation effect, which were not accounted for in the current study. Future research could consider more factors or personality traits that are highly associated with self-control or Willpower itself, such as self-esteem and generalized self-efficacy, which were found to be among the best dispositional predictors for self-control (Judge & Bono, 2001).

This study focused on Willpower manipulations in the form of text passages. However, there are already more elaborate ways of manipulating Willpower, such as the study by Burnette et al. (2020) which lasted approximately 45 minutes and included videos, scientific articles, and real-world examples to manipulate Willpower. Further research could therefore consider more pronounced ways of manipulating Willpower and compare if the results we found in this study also apply in the context of different manipulation techniques.

Lastly, we did not control for any potential confounding variables, such as current mood or stress levels, which could have influenced the participants responses. Current mood can significantly influence how individuals perceive outcomes and their cognitive abilities (Eldar et al., 2016). Controlling for participants mood or stress levels could therefore help explain additional variance in the manipulation effect. This is especially relevant in the

context of Willpower Beliefs, as the type of belief that aligns best with an individual's current mood might enhance or diminish the effectiveness of the manipulation. Future research should consider including such measures to provide a more nuanced understanding of how these factors interact with Willpower Beliefs and their manipulations.

Contributions

In this study, we tested the robustness of a popular and efficient method for manipulating Willpower. By examining two well-known moderators of self-control, the findings of this research can contribute to designing more reliable and robust manipulation techniques. This could help to reinforce the belief in non-limited Willpower.

A non-limited viewpoint of Willpower offers numerous benefits. As discussed in the introduction, these benefits include increased productivity and motivation in various domains (Job et al., 2015), improved health behavior (Bernecker & Job, 2015), and heightened subjective well-being (Bernecker et al., 2017). Given these advantages, it is crucial to explore effective methods for shifting peoples Willpower Beliefs towards a non-limited perspective.

Our study contributes to this goal by investigating potential moderators, which can support the development of more comprehensive interventions that consider individual differences. By understanding these moderators, future research can create tailored strategies to promote the belief in non-limited Willpower, ultimately leading to better outcomes in productivity, health, and overall well-being.

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Supplemental Material

Abstract (English)

Willpower, defined as the ability to exert self-control, plays a crucial role in pursuing long-term objectives, such as maintaining a healthier lifestyle or achieving academic success. The impact of Willpower is significantly influenced by individuals' beliefs about their own Willpower, known as Willpower Beliefs. Yet, no study tested the impact of individual differences on the effectiveness of the frequently used Willpower manipulations. This study tests whether the effectiveness of Willpower Belief manipulations varies in Achievement Motivation and Emotionality. Participants ($N = 296$) completed questionnaires assessing their Initial Willpower Beliefs, Achievement Motivation, and Emotionality before undergoing a Willpower manipulation. We hypothesized that participants in congruent conditions (high Achievement Motivation/non-limited condition, low Achievement Motivation/limited condition, high Emotionality/limited condition, low Emotionality/non-limited condition) would experience the greatest manipulation effect. The results revealed that high Achievement Motivation in the non-limited condition led to a greater manipulation effect ($\beta = -.40, p < .001$), while low Achievement Motivation in the limited condition did not show a similarly strong effect. When controlling for Initial Willpower Beliefs, the interaction effect remained robust ($\beta = -.40, p < .001$). Additionally, the manipulation effect was influenced by Emotionality, with high Emotionality enhancing the effect in the limited condition ($\beta = .29, p = .007$) and low Emotionality in the non-limited condition. Initial Beliefs were more significant in the context of Emotionality ($\beta = -.12, p = .026$) than Achievement Motivation. These findings highlight the importance of personalized approaches to enhance Willpower Beliefs and self-control interventions.

Keywords: *Willpower Beliefs, Achievement Motivation, Emotionality*

Abstract (Deutsch)

Willenskraft, definiert als die Fähigkeit zur Selbstkontrolle, spielt eine entscheidende Rolle bei der Verfolgung langfristiger Ziele wie einem gesünderen Lebensstil oder akademischem Erfolg. Der Einfluss der Willenskraft wird maßgeblich von den Überzeugungen der Individuen über ihre eigene Willenskraft beeinflusst. Allerdings wurde in bislang keiner Studie untersucht, wie sich individuelle Unterschiede auf die Wirksamkeit der häufig verwendeten Willenskraftmanipulationen auswirken. Diese Studie untersucht, ob die Wirksamkeit von Willenskraft-Überzeugungsmanipulationen in Abhängigkeit von der Leistungsmotivation und Emotionalität variiert. Die Teilnehmer*innen ($N = 296$) füllten Fragebögen zu ihren anfänglichen Willenskraft-Überzeugungen, ihrer Leistungsmotivation und Emotionalität aus, bevor sie einer Willenskraft-Manipulation unterzogen wurden. Wir nahmen an, dass Teilnehmer*innen in kongruenten Bedingungen (hohe Leistungsmotivation/non-limited Bedingung, niedrige Leistungsmotivation/limited Bedingung, hohe Emotionalität/limited Bedingung, niedrige Emotionalität/non-limited Bedingung) den größten Manipulationseffekt erfahren würden. Die Ergebnisse zeigten, dass hohe Leistungsmotivation in der non-limited Bedingung zu einem stärkeren Manipulationseffekt führte ($\beta = -.40, p < .001$), während niedrige Leistungsmotivation in der limited Bedingung keinen ähnlich starken Effekt zeigte. Beim Kontrollieren der anfänglichen Willenskraft-Überzeugungen blieb der Interaktionseffekt robust ($\beta = -.40, p < .001$). Zusätzlich wurde der Manipulationseffekt durch Emotionalität beeinflusst, wobei hohe Emotionalität den Effekt in der limited Bedingung verstärkte ($\beta = .29, p = .007$) und niedrige Emotionalität in der non-limited Bedingung. Anfängliche Überzeugungen waren im Kontext der Emotionalität ($\beta = -.12, p = .026$) bedeutender als in der Leistungsmotivation. Diese Ergebnisse unterstreichen die Bedeutung personalisierter Ansätze zur Verbesserung der Willenskraft-Überzeugungen und Selbstkontrollinterventionen.

Schlüsselwörter: *Willenskraft-Überzeugungen, Leistungsmotivation, Emotionalität*

Appendix A: Scales

Willpower Beliefs (Job et al., 2010)

12 Items on a 7-point scale (1 = “strongly agree”, 7 = “strongly disagree”)

1. When situations accumulate that challenge you with temptations, it gets more and more difficult to resist the temptations.
2. It is particularly difficult to resist a temptation after resisting another temptation right before.
3. After a strenuous mental activity, you feel energized for further challenging activities.
4. When you have completed a strenuous mental activity, you cannot start another activity immediately with the same concentration because you have to recover your mental energy again.
5. Strenuous mental activity exhausts your resources, which you need to refuel afterwards (e.g. through taking breaks, doing nothing, watching television, eating snacks).
6. Resisting temptations activates your willpower and you become even better able to face new upcoming temptations.
7. If you have just resisted a strong temptation, you feel strengthened and you can withstand any new temptations.
8. After a strenuous mental activity, your energy is depleted and you must rest to get it refuelled again.
9. Resisting temptations makes you feel more vulnerable to the next temptations that come along.
10. When you have been working on a strenuous mental task, you feel energized and you are able to immediately start with another demanding activity.
11. Your mental stamina fuels itself. Even after strenuous mental exertion, you can continue doing more of it.
12. Your capacity to resist temptations is not limited. Even after you have resisted a strong temptation you can control yourself right afterwards.

Achievement Motives Scale revised (AMS-R, Lang & Fries, 2006)

10 Items, four answer possibilities ranging from 1 = “strongly disagree” to 4 = “strongly agree” for each item

1. I like situations, in which I can find out how capable I am.

2. When I am confronted with a problem, which I can possibly solve, I am enticed to start working on it immediately.
3. I enjoy situations, in which I can make use of my abilities.
4. I am appealed by situations allowing me to test my abilities.
5. I am attracted by tasks, in which I can test my abilities.
6. I am afraid of failing in somewhat difficult situations, when a lot depends on me.
7. I feel uneasy to do something if I am not sure of succeeding.
8. Even if nobody would notice my failure, I'm afraid of tasks, which I'm not able to solve.
9. Even if nobody is watching, I feel quite anxious in new situations.
10. If I do not understand a problem immediately I start feeling anxious.

Emotionality Subscale – HEXACO (Lee & Ashton, 2018)

16 Items, five answer possibilities ranging from 1 = “strongly disagree” to 5 = “strongly agree” for each item

1. I would feel afraid if I had to travel in bad weather conditions.
2. I don't mind doing jobs that involve dangerous work.
3. When it comes to physical danger, I am very fearful.
4. Even in an emergency I wouldn't feel like panicking.
5. I sometimes can't help worrying about little things.
6. I worry a lot less than most people do.
7. I rarely, if ever, have trouble sleeping due to stress or anxiety.
8. I get very anxious when waiting to hear about an important decision.
9. When I suffer from a painful experience, I need someone to make me feel comfortable.
10. I can handle difficult situations without needing emotional support from anyone else.
11. Whenever I feel worried about something, I want to share my concern with another person.
12. I rarely discuss my problems with other people.
13. I feel like crying when I see other people crying.
14. When someone I know well is unhappy, I can almost feel that person's pain myself.
15. I feel strong emotions when someone close to me is going away for a long time.
16. I remain unemotional even in situations where most people get very sentimental.

Appendix B: Willpower Manipulation

Manipulation – limited group

You can only concentrate for so long before you need a break by Dr. Nina Trentemann

October 5, 2021

Can't concentrate on your work? Everyone has experienced this: you've been sitting at your desk for half an hour and find it difficult to devote yourself fully to your task. You can't concentrate, you feel exhausted and your mind wanders. Although you have a lot of work to do, you just can't bring yourself to get it done. So take a little break - check your messages, social media or emails, grab a cup of tea or coffee - and you'll feel refreshed and ready to get back to work.

The science of concentration. Scientists from the fields of psychology and biology have been studying the concept of willpower for many years. This refers to our mental strength to resist things we like but should avoid in the moment in order to stay focused. Willpower is the mental energy that enables us to do what is necessary to tackle difficult tasks immediately instead of putting them off.

A limited amount of mental energy. Over the last 20 years, scientists have investigated how strong our willpower is and under what circumstances it works best. In 157 different experiments, scientists from all over the world have established that humans only have a certain amount of willpower. Even if you have concentrated on a task for just five minutes, this uses up willpower and you can no longer concentrate as well as before.

The biology of limited willpower. Scientists found that our brain uses glucose while we concentrate, which leads to a drop in blood sugar levels. As a result, there is less glucose left for the next task. If you feel exhausted after half an hour of desk work, this feeling of exhaustion is real - your measured blood glucose level will be lower.

Research findings. One experiment concluded that people who had worked on a difficult task requiring a lot of concentration solved fewer math problems afterwards and scored lower on a general intelligence test than those who had previously worked on an easy task. In another study, students who had worked for 10 minutes on a task that required a lot of concentration had lower blood sugar levels and were less able to concentrate on a difficult task afterwards. In contrast, students who had worked for 10 minutes on a task that did not require high concentration did not have a drop in blood glucose levels and were better able to concentrate on a difficult task afterwards.

Take frequent breaks. How do you manage to concentrate on a task for a long time? The best strategy is to take frequent breaks. Researchers at Purdue University found that taking breaks restores willpower and allows you to get back to work effectively. When the researchers allowed people to take a 5-minute break between two difficult tasks, they performed significantly better than when they worked on the two tasks without a break. It seems that our willpower is limited, but it can recover when we take a break from work.

What you should do. Of course, you shouldn't take constant or overly long breaks. But to be productive, you need to use your limited mental energy wisely. So the next time you feel the need to take a break, even if you've only been working for a short time, give your mind a break. Allow your mental energy to recover before you get back to work - you'll be more productive.

Biased Questionnaire – limited group

Seven Items on a 6-point scale (1 = “strongly agree”, 6 = “strongly disagree”)

1. Sometimes it can be very tiring to concentrate on something.
2. If I've been concentrating hard on something for a while, I eventually become exhausted and less productive.
3. Sometimes thinking intensely about something exhausts me. Afterwards I need to recharge my batteries (e.g. by taking breaks, doing nothing, watching TV or eating) before I can concentrate on something else.
4. If I have been mentally exerting myself for a while, I sooner or later need a break to recover.
5. Strenuous mental activities (e.g. thinking about a difficult question, concentrating hard on something) can exhaust my energy resources, which I then need to replenish.
6. After working for several hours on a strenuous mental task, I sometimes get tired and need to recover before I can start a new task.
7. Strenuous mental activity can exhaust willpower and requires you to take a break before you can tackle further tasks.

Manipulation – non-limited group

You can concentrate for longer periods of time before you need a break by Dr. Nina Trentemann

October 5, 2021

Can't concentrate on your work? Everyone experienced this before: you've been sitting at your desk for half an hour and find it difficult to devote yourself fully to your task. You can't concentrate, you feel exhausted and your mind wanders. Although you have a lot of work to do, you just can't bring yourself to start working on it. So you take a little break - you check your messages, social media or emails, make yourself a cup of tea or coffee. You thought you'd feel refreshed after a break and be able to get back to work, but no! After a break, it's even harder to continue working than before. Translated with DeepL.com (free version)

The science of concentration. Scientists from the fields of psychology and biology have been studying the concept of willpower for many years. This refers to our mental strength to resist things we like but should avoid in the moment in order to stay focused. Willpower is the mental energy that enables us to do what is necessary to tackle difficult tasks immediately instead of putting them off.

An unlimited amount of mental energy. Over the last 20 years, scientists have investigated how strong our willpower is and under what circumstances it reaches its full potential. In 157 different experiments, scientists from all over the world have found that people have an unlimited amount of willpower. Even when concentrating on a task for 2 hours, people's willpower is still strong and they can concentrate just as well as when they started.

The biology of unlimited willpower. Scientists have discovered that our brain uses glucose while we concentrate, which leads to a drop in blood sugar levels. However, our body has a clever mechanism that constantly supplies our brain with energy. When our blood sugar levels drop, the hormone glucagon is released, which stimulates our liver to produce more glucose. With the help of this additional glucose, we usually work even better and more concentrated than before. In psychology, this complete absorption in a task is known as the "flow effect".

Research findings. A recently conducted experiment showed that people who worked on a difficult task that required concentration for 60 minutes had higher blood sugar levels and were able to solve math problems better afterwards. People who had worked on an easy task showed no increase in their blood sugar levels and solved fewer math problems. So if you feel exhausted after half an hour's work at your desk, that feeling of exhaustion is an illusion - your blood sugar levels will be higher.

Stay focused. This research shows that it is important to overcome fatigue, especially if you want to take a break shortly after starting work. The best strategy for getting things done is to stay focused on the task at hand. Researchers at Purdue University found that taking a break lowers glucose levels in the brain and makes it harder to resume work.

What you should do. When a task is difficult, we are often tempted to put it off. But a difficult task can motivate you and boost your performance on subsequent tasks. Once your willpower has been activated by a difficult task, you are able to work hard for a long time. According to researchers, our willpower is stimulated by difficult tasks. This enables us to perform even better following those. Therefore, actively seek out challenging tasks instead of avoiding them and you will be more productive.

Biased Questionnaire – non limited group

Seven Items on a 6-point scale (1 = “strongly agree”, 6 = “strongly disagree”)

1. Sometimes it can be inspiring to concentrate on something.
2. Strenuous mental activity (e.g., thinking about a difficult question, concentrating hard on something) can activate willpower and you become even better at managing other tasks.
3. It is possible to be in such a productive working state that you don't need much rest between different, mentally demanding tasks.
4. Sometimes it fills me with energy when a challenging task completely absorbs me.
5. I have experienced it to be energizing to fully concentrate on a mental activity so that I was able to stay with it for a very long time.
6. Sometimes I feel full of energy after working on a strenuous mental task. I am then able to immediately tackle a new challenging task.
7. After concentrating fully on something for a while, I sometimes feel energized for more challenging activities.

Appendix C: Power Analysis (Baranger et al., 2023)

InteractionPowerR
Power Analysis for Interactions in Linear Regression
Shiny app by Megan Flinnsaas, Package by David Baranger

Simulation Parameters

of Simulations: 1000

Alpha: 0.05

of Clusters: 1

Seed: 17

Sample Size (separate multiple values by comma): 200

Correlations (separate multiple values by comma)

Predictor X1 with Outcome (X1-Y): .30

Predictor X2 with Outcome (X2-Y): .30

Interaction term with Outcome (X1X2-Y): .20

Predictor X1 with Predictor X2 (X1-X2): .30

Reliabilities (separate multiple values by comma)

X1: 1

X2: .80

Y: .80

Variable Type

X1: binary

X2: continuous

Y: continuous

☒ If variables are ordinal or binary, adjust correlations?

Target Power for Plot: 0.8

☐ Report detailed results? (Leave unchecked for speedier runs)

Run

Download Results

Instructions Results

N: 200,000

power: 0.811

Appendix D: Correlational Matrix

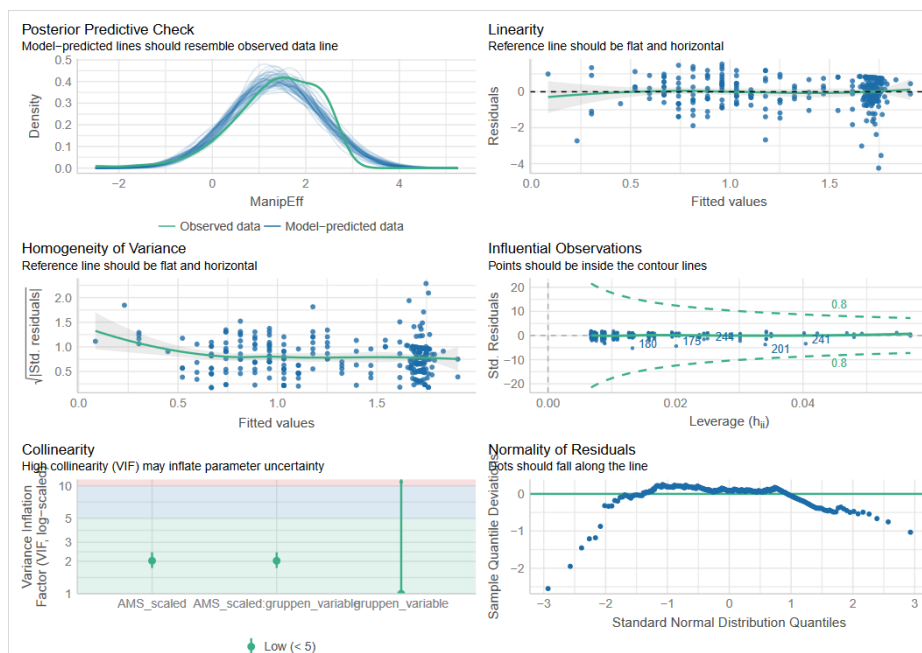
Means, standard deviations, and correlations with confidence intervals

Variable	<i>M</i>	<i>SD</i>	1	2
1. mean_InitialBeliefs	4.05	0.90		
2. mean_AMS	2.75	0.47	-.44** [-.53, -.35]	
3. mean_HEXAC O	3.46	0.60	.21** [.10, .32]	-.32** [-.42, -.22]

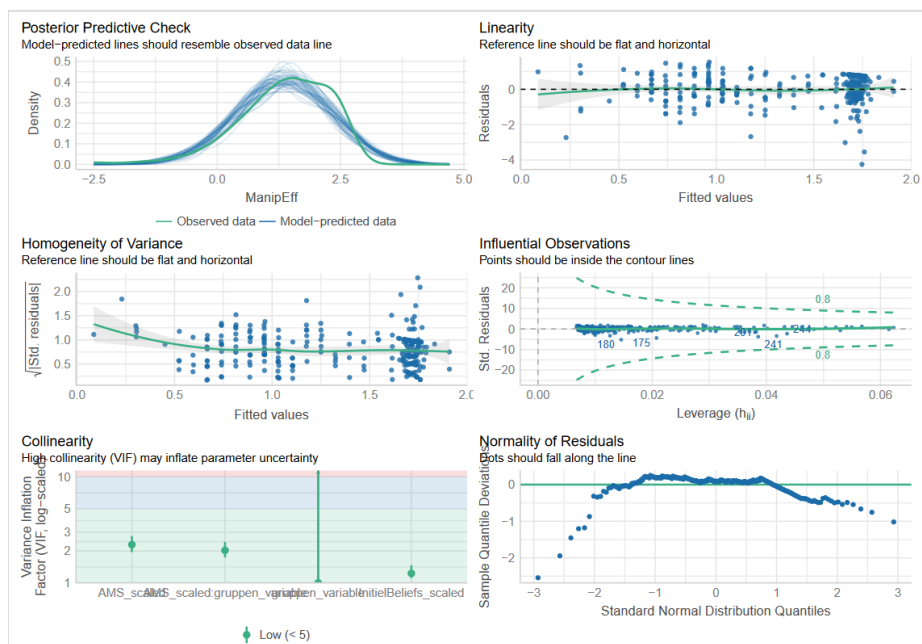
Note. *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (Cumming, 2014). * indicates $p < .05$. ** indicates $p < .01$.

Appendix E: Requirement Plots for the Regression Models

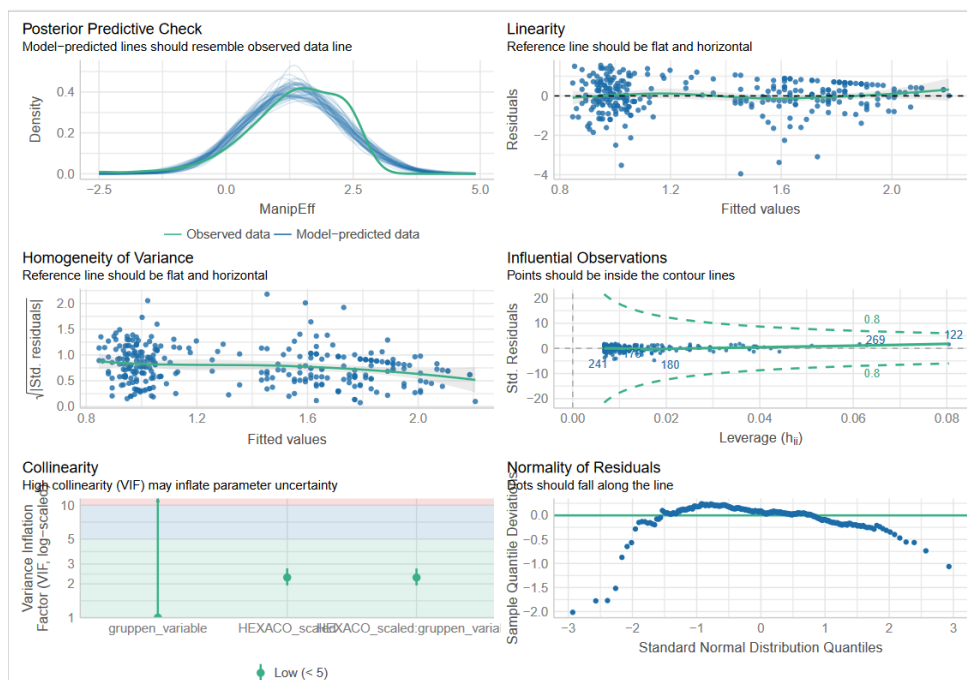
• H1



• H2



- H3



- H4

