

Implicit Theories about Willpower and their Consequences for Achievement, Health, and Well-being

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Summary

Previous research suggests that beliefs about willpower are an important determinant for self-control, people's fundamental capacity to monitor and adapt their own responses to support the pursuit of long-term goals (Job, Dweck, & Walton, 2010). The present thesis demonstrates the consequences of people's beliefs about willpower—whether they believe it is a limited or nonlimited resource—for achievement, health, and well-being. Part I demonstrates that willpower theories predict students' self-control in everyday life, particularly when they face high self-regulatory demands (e.g., tests, social conflicts). Further, the way students view their willpower has consequences for their academic achievement: Students who believe their willpower is a limited resource earn lower grades than students who reject the view that willpower is limited. Results further suggest that students with a limited theory earn lower grades, because they procrastinate more in the weeks prior to their final exams.

Based on these initial findings, Part II examines willpower theories in a population for which high self-control demands are omnipresent, namely patients with type 2 diabetes. A cross-sectional study investigates the relationship between willpower theories, diabetes management, and psychological adjustment in a sample of type 2 diabetes patients. Results show that the belief that willpower is not limited is associated with better diabetes management (i.e., lower treatment adherence, unhealthy diet, less physical activity) and better psychological adjustment (e.g., lower well-being, lower life quality, higher diabetes-related distress). In line with the assumption that willpower theories are most important under high self-regulatory demands, the effects on diabetes-related distress and management of the disease are moderated by the duration of the diabetes. Patients with longer disease history profit less from a nonlimited belief. This pattern might be explained by the formation of habits that substitute self-control and let willpower beliefs become less important.

Building upon findings suggesting that willpower beliefs affect goal striving, and research linking goal progress to subjective well-being, Part III examines whether willpower beliefs also affect people's subjective well-being. Three studies document that a limited willpower belief is associated with lower subjective well-being and predicts negative change in subjective well-being over time. The effect seems to be driven by people's perceived availability of goal-relevant resources and their progress on personal goals. People with a limited theory believe to have less goal-relevant resources available and make less progress toward their personal goals which in turn undermines their subjective well-being.

Finally, the findings of Part IV suggest that beliefs about willpower can be changed to promote students' self-control in everyday life. Two intervention studies show that a brief psychological intervention can lead people to adopt nonlimited theory. But only if the message is combined with strategies that help students implement the idea of nonlimited willpower into their everyday life, the intervention promotes self-control (i.e., reduce procrastination and improve study habits).

To sum, the present thesis demonstrates the broad relevance of beliefs about willpower for variety of important real-world outcomes. Limitations of the present research are discussed and future directions for this line of research are proposed.

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Introduction

“Ideas set free beliefs, and the beliefs set free our wills [...]”

William James (1907, p. 329)

The human will and its power to overcome needs and desires has been subject of interest from the very beginning of psychology (e.g., Ach, 1935; James, 1890; Lewin, 1926). After the era of behaviorism, in which unobservable constructs like needs and will were abandoned from psychology’s agenda, the topic experienced a renaissance within the past four decades. Since then many monikers for the phenomenon were introduced, such as delay of gratification (Mischel, Ebbesen, & Raskoff Zeiss, 1972), willpower (e.g., Mischel et al., 2011), executive control (e.g., Kool & Botvinick, 2012), or self-discipline (Duckworth & Seligman, 2005). In the current literature the term *self-control* is most consistently used to describe the effortful self-government that enables people to regulate their emotions, thoughts, and behavior (Duckworth, 2011).

Within the year 2010 more than 3% of peer-reviewed psychology articles were referenced by the keyword “self-control” or a closely related term (Duckworth, 2011). This current interest in the phenomenon reflects two conflicting developments in modern Western societies. On the one hand, there is an increasing emphasis on self-actualization and the pursuit of personal goals. On the other hand, modern life provides more and more opportunities to satisfy people’s immediate needs due to the easy and inexpensive access to entertainment, recreational activities, food, alcohol, tobacco, and other luxury goods. Thus, a pressing question is what can help people to accomplish their long-term objectives in an environment that offers countless opportunities to fail? The answer is self-control. The clash between the normative importance of personal goal attainment and opportunities for distraction from goal pursuit calls for a better understanding of self-control and its underlying

processes. Therefore, it is on psychology's current agenda to examine determinants of self-control and develop conceptions and strategies to help people overcome self-control failure (Metcalf & Mischel, 1999).

It was over a century ago when William James (1907) argued that "Ideas set free beliefs, and the beliefs set free our wills [...]" (p. 329). James was convinced that many people live far beyond their actual potential and habitually fail to use their full powers, such as the power of inhibition and control (James, 1907). Recent research supports his notion and argues that people's beliefs about their willpower are an important determinant of their capacity to self-control (Job et al., 2010). Specifically, the culturally shaped belief that willpower is a limited resource seems to undermine people's self-control efforts and, thus, impedes their personal goal pursuit (Job et al., 2010). Based on these new insights into the relevance of beliefs about willpower for self-control, the present thesis examines whether beliefs about willpower affect self-control in everyday life and outcomes associated with self-control, such as achievement, health, and subjective well-being. Can the way people think about their willpower—whether they believe it is a limited or nonlimited resource—affect important outcomes, such as students' grades, patients' treatment adherence, or people's life satisfaction? And if so, is it possible to promote self-control in everyday life by changing people's beliefs about willpower? The present research aims to answer these important theoretical and practical questions. In four parts, I will present seven field studies that use cross-sectional, longitudinal, as well as experimental designs, and samples from different populations, such as students, diabetes patients, and working adults. Part I addresses the question whether beliefs about willpower predict students' self-control in everyday life and also shape their academic achievement. Part II examines willpower beliefs in a sample of diabetes patients and investigates the relationship with their treatment adherence and psychological adjustment to the disease. Part III investigates whether and how willpower beliefs affect people's subjective well-being. Finally, Part IV presents two field experiments

that address the question, whether changing beliefs about willpower with a targeted intervention can improve self-control in everyday life.

Conceptualizations of Self-Control

Within the past decades social psychologists have studied self-control from different perspectives and developed different conceptualizations of the phenomenon that either emphasize its underlying cognitive or motivational processes. Within the cognitive tradition, Walter Mischel and his colleagues defined self-control as the ability to forego an immediate reward for the sake of a larger future reward, known as *delay of gratification* (Mischel et al., 1972). Mischel's conceptualization grounds on the phenomenon of temporal discounting, which describes people's natural tendency to perceive delayed rewards as less attractive than immediate rewards (for an overview, see Green & Myerson, 2004). Self-control is the ability to overcome this tendency and to work towards a larger future reward in the face of an immediate but smaller reward.

In contrast, in the motivational tradition self-control is viewed as a canon of processes that allow people to pursue their long-term goals (Carver & Scheier, 1982; H. Heckhausen, 1989; Kanfer & Kanfer, 1991; Kuhl, 1992). Goals are cognitive representations of desired end states and reflect what the person strives for or tries to avoid in the current life situation (Austin & Vancouver, 1996). Within these goal theories the term self-control is used to describe a specific category of processes that foster the implementation and maintenance of self-chosen, goal-directed activities when challenges during goal pursuit arise, for instance, shielding the goal against other possible goals (Carver & Scheier, 1982; Heckhausen, 1989; Kanfer & Kanfer, 1991; Kuhl, 1992). Some of these processes are automatic and often referred to as self-regulation, while other conscious processes are referred to as self-control (Kuhl & Fuhrmann, 1998). Within the current literature the terms are often used interchangeably (Baumeister & Vohs, 2007; Hagger, Wood, Stiff, & Chatzisarantis, 2010).

More recent definitions of self-control are broader in the sense that they conceptualize self-control as conflict between impulses, thoughts, or emotions with some internal or external standard, such as social norms, expectations, or goals (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Baumeister & Heatherton, 1996; Baumeister, 2002). According to this conceptualization self-control is important for both: dissolving the conflict between one's own immediate needs and long-term goals, as well as the conflict between one's own needs and the needs of a group. The main function of self-control is thereby to suppress or inhibit responses that are not in line with the pursued individual or social standard (Baumeister et al., 1998; Baumeister & Heatherton, 1996; Baumeister, 2002).

The common thread running through all these different conceptualizations is that self-control is needed to solve an inner conflict between two incompatible behavioral responses (Duckworth, 2011; Fujita, 2011). Typically one response is regarded as being directed at long-term motives (e.g., future rewards, goals, or standards), while the other response is directed at short-term motives (e.g., immediate rewards, needs). This conflict can either be solved in accordance with one's long-term objectives, reflecting successful self-control, or with short-term motives reflecting self-control failure (Duckworth, 2011; Fujita, 2011).

In the present thesis, self-control is defined as the individual's capacity to engage in deliberate, conscious regulation of impulses, emotions, or thoughts in order to support the pursuit of long-term goals (Hagger et al., 2010; Vohs, 2006). The following section will highlight the relevance of self-control for different domains of everyday life.

Self-Control and Its Relevance for Achievement, Health, and Well-Being

Past research suggests that self-control is relevant for a large variety of everyday life contexts, such as academic and occupational achievement (e.g., Mischel, Shoda, & Rodriguez, 1989), physical and mental health (e.g., Moffitt et al., 2011; Tangney, Baumeister, & Boone, 2004), social relationships (e.g., Vohs, Finkenauer, & Baumeister, 2010), consumer

behavior (e.g., Hofmann, Strack, & Deutsch, 2008), or crime (Gottfredson & Hirschi, 1990). Most pertinent to the present research are studies linking self-control to achievement, health, and subjective well-being (Hofmann, Luhmann, Fisher, Vohs, & Baumeister, 2013; Moffitt et al., 2011; Tangney et al., 2004).

In the context of achievement, self-control is needed to engage and remain in strenuous mental activities (e.g., fixing attention on the task, controlling disruptive thoughts, and managing emotions). For instance, a student studying for an important exam needs to exert self-control to forego the impulse to give up in the face of difficulties or do something more pleasurable instead of studying. The student experiences self-control failure when deciding for recreation instead of studying. Thus, procrastination, the postponement of unpleasant tasks despite of expected negative consequences, can also be conceptualized as self-control failure (Steel, 2007; Tice & Baumeister, 1997).

A number of empirical findings demonstrate the importance of self-control for academic achievement. For instance, a longitudinal study suggests that preschool ability to delay gratification predicts academic performance and academic competence over more than one decade (Mischel et al., 1989). Children who were able to forego immediate rewards at the age of four achieved better grades and had higher academic competence (reported by their parents) when they entered college (Mischel et al., 1989). In a similar vein, another study proposes that students who discount future monetary rewards less, indicating better self-control, receive better officially assigned grades than their fellow students with larger discounting rates (Kirby, Winston, & Santiesteban, 2005). Further, longitudinal studies demonstrate that self-control outdoes intelligence in predicting achievement and explains more than twice as much variance in eight graders' grades, high school selection, and school attendance (Duckworth & Seligman, 2005).

Self-control is not only important for achievement, but also plays a role in promoting physical health. For instance, self-control helps people to monitor their behavior (e.g., diet,

exercise), to break unhealthy habits (e.g., smoking, alcohol abuse), and to engage in unpleasant, but health-promoting behaviors (e.g., adhere to a treatment regimen, do medical check-ups) (Baumeister & Heatherton, 1996; Hofmann, Friese, & Wiers, 2008). With these different functions self-control is relevant both for the prevention of diseases, but also for their treatment. For instance, self-control helps people not to resist tempting food and to engage in regular physical exercise (Adriaanse, Kroese, Gillebaart, & De Ridder, 2014; Oaten & Cheng, 2005). High calorie intake and insufficient physical activity are commonly viewed as the two main risk factors for prevalent chronic diseases such as obesity and diabetes (Seidell, 2000; Shaw, Sicree, & Zimmet, 2010). However, once people are diagnosed with a chronic disease, self-control also plays an important role to avoid further complications. For instance, patients with type 2 diabetes need to regulate their behavior to keep their blood sugar levels within a certain range. Often they need to follow a strict diet, engage in regular physical activity, and follow a complex self-care regimen that involves regular blood sugar monitoring, medication intake, or insulin injections (Boule, Haddad, Kenny, Wells, & Sigal, 2001; Brand-Miller, Petocz, Hayne, & Colagiuri, 2003; Turner, Cull, & Frighi, 1999). For diabetes patients adherence to the prescribed self-care regimen is highly important to avoid short-term complications and long-term comorbid diseases (e.g., Andersson & Svärdsudd, 1995; Klein, Klein, & Moss, 1996). And as long as these self-care behaviors have not turned into well-learned habits, self-control is crucial to follow the assigned treatment (Rothman, Sheeran, & Wood, 2009).

There are many empirical studies that support the relevance of self-control for health promotion. The Dunedin study, a prospective large-scale study, followed a cohort of 1000 children from birth to age 32 (Moffitt et al., 2011). Participants with better self-control within their first decade of life had better cardiovascular, respiratory, and dental health in young adulthood, as well as lower risk to smoke in adolescence. The effects were independent of childhood socioeconomic status or intelligence (Moffitt et al., 2011). Another longitudinal

study documents the importance of self-control for the recovery from surgery by promoting therapy adherence. A large sample of heart surgery patients was surveyed one week before, one week after, and six months after surgery (Schroder & Schwarzer, 2005). Compared to other trait variables (e.g., dispositional optimism, generalized self-efficacy beliefs, health locus of control beliefs), self-control emerged as superior predictor of dieting and exercise after surgery and explained 1–5% of unique variance in the longitudinal analysis. However, the study finds no effects of self-control on smoke status before or after the surgery (Schroder & Schwarzer, 2005). In sum, self-control seems to proactively promote health on the one hand and also foster recovery from illness on the other hand.

Despite the great interest in self-control and its consequences for various outcomes, surprisingly little is known about its relationship to subjective well-being. So far, only one set of studies systematically examined this relationship (Hofmann et al., 2013). The findings suggest that high self-reported trait self-control is related to higher affective well-being (i.e., presence of positive affect and absence of negative affect) and higher life satisfaction (Hofmann et al., 2013). However, the studies examined the relationship only cross-sectionally, which is why no conclusions about the direction of causality can be drawn. Thus, more research is needed to replicate these initial findings and show that self-control, perhaps under specific circumstances, promotes subjective well-being in the long-run.

To sum, the studies reviewed above document the significance of self-control for achievement, and health, and provide initial evidence for its relationship to subjective well-being. Importantly, self-control seems to have incremental value above other well-documented predictors of achievement and health, such as intelligence, self-efficacy, optimism, and socioeconomic status (Duckworth & Seligman, 2005; Moffitt et al., 2011; Schroder & Schwarzer, 2005). These findings call for the examination of (further) determinants of self-control and the development of interventions to promote it. In the following sections I will introduce some of the most influential models on self-control and

their proposed determinants before I will turn to the theoretical roots of the concept of beliefs about willpower, a recently proposed determinant of self-control.

Determinants of Self-Control

Self-control is a multifaceted phenomenon which is reflected in the large number of different theoretical approaches that have been proposed. In the following section I will focus on three of the most influential cognitive and motivational approaches, namely the hot/cool-system framework (Metcalf & Mischel, 1999), the construal-level approach to self-control (Fujita, Trope, Liberman, & Levin-Sagi, 2006), and the strength model of self-control (Baumeister et al., 1998).

In their seminal work, Mischel and colleagues (Mischel & Baker, 1975; Mischel et al., 1972) studied the cognitive and attentional strategies that allowed children to delay gratification. Their experiments indicate that focusing on the consummatory (“hot”) qualities undermines effective delay, while focusing on the non-consummatory (“cold”) qualities of the reward facilitates delay (Mischel & Baker, 1975; Mischel et al., 1972). Based on this early work, Metcalfe and Mischel (1999) propose the *hot/cool-system framework* to explain the mechanisms that underlie successful self-control, not only in delay of gratification problems, but also in situations that require resistance to temptations more generally. This model was the first dual-system approach to self-control (see also Hofmann, Friese, & Strack, 2009) and postulates that self-control is dependent on the dynamic interplay between a *hot emotional system* and a *cool cognitive system*. The hot emotional system is the basis for impulses and reflexive emotions, such as fears or passions, which are automatically triggered by conditioned stimuli. The cool cognitive system is the basis for complex temporal and episodic representation and thought, and allows the person to keep goals in mind and monitor their progress on these goals. This system is the basis for self-control. In a self-control conflict the balance between the two systems determines whether behavior is dominated by an impulsive,

automatic response (i.e., self-control failure), or a controlled, goal-driven response (i.e., successful self-control). The balance between the systems is regarded to underlie different determinants, such as dispositional factors (e.g., individual differences in the use of self-control strategies, temperament), developmental factors (e.g., maturity of prefrontal cortex, metacognitive knowledge), as well as temporal and chronic environmental factors (e.g., chronic or acute stress). According to the model, behavior is more likely to be driven by an automatic response when the person does not use self-control strategies or has an impulsive temperament, when the cool system is not yet fully developed, or when it is temporally or chronically impaired by stress (Metcalf & Mischel, 1999).

The construal level approach focuses on cognitive determinants of self-control. It proposes that people's *mental construal* of the situation determines whether the conflict between two conflicting behavioral tendencies is solved in favor or against a person's long-term objectives (Fujita et al., 2006; Fujita, 2008). The approach builds upon construal level theory (Trope & Liberman, 2003) which proposes that the same object or event can be mentally construed on different levels of abstraction. With a high-level construal people are more likely to perceive an event's superordinate, immutable features, those that ascribe a general meaning to the event. With a low-level construal people perceive the subordinate, incidental features of the event, those that make it special or unique. It is assumed that a high-level construal of a situation promotes self-control, because a high-level construal allows the person to perceive the situation to be connected to his or her global objectives (e.g., long-term goals, or values). Conversely, a low-level construal is assumed to undermine self-control, because the situation is perceived as unique and independent of higher-order objectives, which is why a decision is more likely to be guided by the person's short-term concerns (Fujita et al., 2006; Fujita, 2008). Thus, according to the construal level approach effective self-control requires people to be able to transcend the immediate situation and to see the long-term consequences and implications of their behavior (Baumeister & Heatherton, 1996).

In contrast to the hot/cool-system framework (Metcalf & Mischel, 1999), the construal level approach to self-control (Fujita et al., 2006) does not make any assumptions about determinants of a high versus low-level construal and therefore lacks guidance for the practical question of how self-control can be promoted. The hot/cool-system framework proposes that people can learn cognitive strategies that helped them focus on the “cool” features of a tempting stimulus. But the applicability of the framework is limited to these situations in which people need to resist temptations to reach their long-term objectives. A broader framework that addresses several domains of self-control, not only resisting temptations, would be of greater practical relevance.

One approach that refers to self-control in a broader sense and might therefore be of greater practical relevance is the *strength model of self-control*. The model focuses on failure of self-control and covers several domains of self-control, such as resisting temptations, controlling thoughts, or managing emotions (Baumeister, 2002). The model proposes that self-control is based on a limited resource akin to a strength or energy (Baumeister et al., 1998; Baumeister, Vohs, & Tice, 2007; Muraven & Baumeister, 2000). When self-control is exerted the inner resource gets depleted leading to a state called *ego depletion*. Within this state self-control failure is more likely and becomes at some point inevitable, because the person lacks the resources necessary to engage in self-control (Baumeister & Vohs, 2007). Advocates of the strength model often compare the capacity to self-control to a muscle that grows tired during exercise (Muraven & Baumeister, 2000). Importantly, the model assumes that different acts of self-control (e.g., controlling thoughts, resisting temptations, suppressing emotions) draw on the *same* inner resource. Thus, independent of domain (e.g., resisting temptations, controlling thoughts or emotions) exerting self-control undermines subsequent self-control. However, there are two additional assumptions that complete the muscle metaphor. First, self-control resources replenish at times when people do not exert self-control (Baumeister et al., 1998; Vohs & Heatherton, 2000). Second, self-control strength can also be

trained by regular self-control exertion, which is postulated to be enlarged and build up the critical resource (Muraven, Baumeister, & Tice, 1999). In a nutshell, the strength model proposes that the capacity to self-control is a function of the availability of self-control resources determined by previous self-control acts and the size of their reservoir to begin with.

To test their assumptions, Baumeister and colleagues (1998) developed the dual-task paradigm. In this paradigm, participants first engage in a task that demands high or low self-control to manipulate the amount of self-control resources available for subsequent tasks. Then participants engage in a second, presumably unrelated, self-control task to assess their self-control performance. In line with the strength model's predictions, studies using this paradigm found that when participants have to exert a lot of self-control in the first task (e.g., suppressing emotional expression), their self-control performance on the second task (e.g., squeezing a handgrip as long as possible) is usually diminished – also known as *ego depletion effect* (Muraven, Tice, & Baumeister, 1998). A meta-analysis of 83 studies estimated the averaged effect size to be medium to large ($d^+ = 0.62$, CI 95% [0.57, 0.67]; Hagger, Wood, Stiff, & Chatzisarantis, 2010), although a recent statistical re-examination of this meta-analysis suggests that the effect size is likely to be smaller than has originally been proposed (Carter & McCullough, 2013). Despite of the current discussion of the size of the ego depletion effect, overall the effect seems well-established in the self-control literature and supports the strength model's basic assumption of self-control being a limited resource.

Another, less well-established assumption of the strength model is that not only previous self-control attempts, but also coping with stress undermines people's capacity to self-control (Baumeister & Heatherton, 1996). Advocates of the strength model argue that coping with stress depletes self-control resources, because some aspects of coping with stress requires self-control, such as suppressing negative emotions or controlling one's thoughts (Baumeister & Heatherton, 1996; Oaten & Cheng, 2005). In support for this assumption a

field study, for instance, found that compared to less stressful phases of the semester, students' self-control performance is diminished within the final examination phase when students are more stressed (Oaten & Cheng, 2005). Thus it seems that not only in the lab, but also in everyday life, self-control exertion, such as coping with stress, diminishes self-control performance.

Despite the large amount of evidence for the ego depletion effect, the strength model has been subject of an ongoing debate regarding the proposed mechanism and possible alternative explanations. Alternative explanations, for instance, involve motivation, fatigue, self-efficacy, and negative affect (Hagger et al., 2010). The alternative explanation that has received most attention within recent years proposes that the ego depletion effect reflects a lack of *motivation* rather than a lack of resources (Hagger et al., 2010). Put simply, after an initial attempt of self-control people do not *want* to engage in further self-control and therefore performance drops in the second of two self-control tasks (Hagger et al., 2010; see also Inzlicht & Schmeichel, 2012). Corroborating this alternative explanation, studies found that when self-control performance on the second self-control task was contingently rewarded (to increase participants' motivation to engage in the task), people performed well regardless of preceding self-control efforts (Muraven & Slessareva, 2003). Other studies found depletion-like effects when a task was framed as depleting but not when it was framed as non-depleting (Martijn, Tenbült, Merckelbach, Dreezens, & de Vries, 2002). In a similar vein, Wan and Sternthal (2008) found that enhancing participants' self-monitoring on the second task through explicit performance feedback offset the ego depletion effect. Another set of studies suggests that after initial exertion of self-control people may start to conserve resources for future efforts and therefore their performance drops on a second self-control task (Muraven, Shmueli, & Burkley, 2006). When depleted participants were led to anticipate future self-control efforts (i.e., a third self-control task) their self-control performance in the second task was lower compared to depleted participants who were not to expect further self-

control efforts. The manipulation of expectation did not change performance in non-depleted participants (Muraven et al., 2006). Thus, the ego depletion effect may result from motivated resource conservation instead of a true lack of resources. If this was the case, however, the question remains *why* people should conserve resources. I will come back to that point. In sum, these studies suggest that motivation plays a critical role in the ego depletion effect and that the dual-task paradigm may create conditions under which motivation to exert self-control is systematically undermined, for instance, through low task incentives, lack of performance feedback, or by creating the expectation of subsequent self-control efforts.

In an attempt to integrate these empirical findings into the strength model advocates of the model began to argue that increased motivation might help individuals to shortly overcome their state of depletion and mobilize more resources to perform well (Baumeister & Vohs, 2007; Vohs, Baumeister, & Schmeichel, 2012). However, this argument immunizes the model and makes its falsification impossible, because both outcomes self-control failure and successful self-control can be explained. Thus, as long as self-control performance is used as indirect measure of the recruitment of resources instead of a direct measure of the proposed resource, the strength model can no longer be tested. Still, advocates of the strength model rightfully ask, what if not the existence of a limited resource then drives the ego depletion effect?

A recent approach argues that the capacity to self-control may not dependent on a limited resource but instead on people's beliefs—or implicit theories—about their willpower (Job et al., 2010). As challenge to the strength model, Job and colleagues propose that the ego depletion occurs, because people *believe* that their willpower is limited. Their approach provides an elegant alternative explanation for the ego depletion effect and has been regarded as “the most serious challenge to the resource model” (Inzlicht & Schmeichel, 2012, p. 485). The theoretical origins of this implicit theory approach and empirical evidence supporting it will be reviewed in the upcoming chapter.

Implicit Theories About Willpower

The study of implicit theories about personal attributes has a long tradition in social psychology (Dweck & Leggett, 1988; Dweck, 1986; Hong, Chiu, Dweck, Lin, & Wan, 1999; Molden & Dweck, 2006). Similar to scientists who develop theories to explain phenomena in the world, laypersons hold theories or beliefs about different personal characteristics, such as intelligence, personality, or health (Burnette, O'Boyle, VanEpps, Pollack, & Finkel, 2013; Dweck, Chiu, & Hong, 1995). These so called *implicit theories* organize the way people ascribe meaning to the world around them and affect their behavior (Ross, 1989). In contrast to scientific theories, laypersons' theories are often "implicit" in the sense that their beholders are not aware of them and their impact on behavior. However, implicit theories can be verbalized through targeted questionnaires.

The study of personal beliefs and their impact on behavior goes back to Jean Piaget who argued that children develop so called *meaning systems* that he regarded as important as logical thinking in guiding behavior (Piaget & Garcia, 1991; Piaget, 1928/1964). Likewise, Kelly (1955) in his theory of personal constructs proposed that people hold a unique set of *conceptual representations* that they use to construct meaning of the world. Building on these theoretical traditions, Carol Dweck (1975) began to examine children's persistence in difficult tasks. In cooperation with Ellen Leggett, she discovered that task persistence and reaction to setbacks is heavily determined by children's implicit theories about intelligence, whether they believe it is a fixed or malleable trait (Dweck, 1986). This line of research set the ground for the social-cognitive framework to motivation and self-regulation (Dweck & Leggett, 1988; Molden & Dweck, 2006). The framework proposes that implicit theories about intelligence channel different cognitive, affective, and behavioral patterns in achievement situations by shaping people's goals. People who believe that their intelligence is malleable are more likely to pursue learning goals (i.e., being concerned with increasing

their competence) and, thus, show mastery-oriented behavior in the face of setbacks. People who believe that their intelligence is fixed are more likely to pursue performance goals (i.e., being concerned with gaining favorable judgments of their competence from others) and show helpless behavioral patterns in the face of setbacks (Dweck & Leggett, 1988). Thus, the social-cognitive framework outlines a causal chain that begins with people's implicit theories about intelligence, which affect people's cognition, emotion, and behavior through goals they trigger.

Job and colleagues applied the idea of implicit theories to the context of self-control (Job et al., 2010). In their seminal paper, they argue that people hold different theories about their willpower and that these theories determine self-control performance. People with a *limited theory* believe that their willpower is a limited resource that gets depleted by acts of self-control. Further, they believe that the resource can be replenished by taking a break, eating, or engaging in relaxing activities. Thus, people with a limited theory believe that willpower functions as suggested by the strength model of self-control. In contrast, people with a *nonlimited theory* believe that their willpower is not limited and that their capacity to self-control is independent from previous self-control attempts or even gets activated by it. In short, these people refuse the view that willpower is highly limited and that exertion of self-control impairs their capacity to regulate behavior subsequently.

In three lab studies Job and colleagues (2010) found that implicit theories moderate the ego depletion effect. Only people with a limited theory perform worse in a self-control task (e.g., in a Stroop Task) when they engaged in previous self-control task (e.g., crossing out e's from a text according to a difficult rule). People with a nonlimited theory perform well on the second self-control task regardless of previous self-control efforts. The same findings occur when implicit theories about willpower are not measured but manipulated. Thus rules out the effect of confounding variables (e.g., individual differences in the capacity

to self-control) and suggests that implicit theories play a causal role in shaping self-control performance. In accordance with a broader conceptualization of self-control implicit theories about willpower were measured with regard to different self-control domains, such as persistence in strenuous mental activities or resisting temptations (Job et al., 2010). However, the findings indicate that implicit theories within different domains of self-control reflect one underlying factor (Job et al., 2010). The question of domain-specific predictions of self-control behavior has so far not been addressed.

But what are the proposed mechanisms behind implicit theories about willpower and their effect on self-control performance? One possible mechanism that was tested is that a nonlimited theory motivates people to “overuse” their resources, while they should actually conserve this limited commodity (Muraven et al., 2006). If this was the case, their better performance in the second task should come at costs of worse performance in a third self-control task. A second mechanism tested is that people with a nonlimited theory experience the initial self-control task as less exhausting and therefore perform better on the subsequent task. People with a nonlimited theory might simply be immune to exhaustion. In one experiment Job and colleagues (2010) examined these possible explanations and manipulated willpower theories before participants engaged in three self-control tasks. They measured participants’ experienced exhaustion from the first self-control task before participants engaged in *two* subsequent self-control tasks. Falsifying the overuse-hypothesis, depleted participants with an induced nonlimited theory performed better in both subsequent self-control tasks. Further, falsifying the exhaustion-hypothesis, there was no difference in perceived exhaustion between people with nonlimited and limited theory. However, implicit theories moderated the effect of the exhaustion on subsequent self-control performance. For people with a limited theory high exhaustion led to lower performance on the subsequent tasks, which was not the case for people with a nonlimited theory. When people endorse a

limited theory about willpower, exhaustion seems to signal low availability of resources and triggers the motivation to restore resources and reduce efforts on the subsequent self-control task (Job et al., 2010; see also Muraven et al., 2006). Thus, willpower theories seem to shape the interpretation of cues like exhaustion as signal to reduce (limited theory) versus remain/increase (nonlimited theory) efforts and thereby affect self-control performance.

In sum, these findings suggest that the ego depletion effect depends on people's beliefs about willpower instead of a true limited resource. Hence, self-control may not be as weak and vulnerable as the strength model suggests. The willpower theory approach is also of high practical relevance, because it suggests that self-control failure may be reduced by interventions that target people's beliefs about willpower. However, before such interventions are administered, studies should test the effect of people holding a limited versus nonlimited theory on important real-world outcomes.

The Present Research

The present research investigates the relationship of implicit theories about willpower and three outcomes that have previously been linked to self-control, namely achievement, health, and subjective well-being. The main idea is that implicit theories about willpower are an important determinant of self-control performance, not only in the laboratory but also in everyday life, and therefore should also affect important outcomes related to self-control.

Additionally, I assume that willpower theories are particularly influential for people who temporarily or chronically face high self-control demands. This prediction is based on previous research showing that willpower theories affect self-control performance only when self-control was taxed in a previous self-control task and within the final examination phase of the semester (Job et al., 2010). Advocates of the strength model argue that self-control is particularly likely to fail in times with high self-regulatory demands (Baumeister &

Heatherton, 1996; Oaten & Cheng, 2005). I argue that self-control only decreases in the face of high demands when people believe that their willpower is limited.

Finally, the present research investigates whether self-control in everyday life can be improved by changing people's willpower theories. Based on laboratory studies showing that willpower theories can be shortly induced (Job et al., 2010) and previous intervention studies (Aronson, Fried, & Good, 2002; Walton & Cohen, 2007, 2011), a willpower-theory intervention was developed to promote students' self-control in everyday life. Based on the previous findings demonstrating the effectiveness of a nonlimited theory for subsequent self-control acts, this intervention might be especially effective, when people face high self-regulatory demands in their everyday life.

Before I introduce the four parts of the present thesis in more detail, it is important to mention that the order of projects is based on theoretical considerations and does not reflect the chronological order in which the research was conducted.

Part I: Willpower theories and their consequences for self-control in everyday life and academic achievement

Advocates of the strength model argue that a nonlimited theory about willpower might be harmful for self-control in the face of high self-regulatory demands, because it undermines people's natural tendency to conserve resources (Vohs, Baumeister, & Schmeichel, 2013). Their argument is based on one laboratory study that replicates the finding that after an initial self-control task people with a nonlimited theory perform better than people with a limited theory. However, the pattern is reversed in a condition where participants engaged in four depleting tasks—here participants with a limited theory outperformed participants with a nonlimited theory. The authors speculate that a nonlimited theory might backfire in situations where people face severe self-regulatory demands (Vohs et al., 2013).

The present research aimed to test this assumption in a real-world setting, where compared to a laboratory setting, people face severe self-control demands and pursue personally meaningful goals. Thus, we measured self-control performance of students at a highly selective university during their final examination period. We figured that in those weeks prior to exams students have to cope with severe self-control demands, because they have to study for multiple exams. In this phase students' beliefs about their willpower should be most important and predict their self-control performance (e.g., procrastination). However, there might still be individual differences in demands (e.g., due to differences in course load), that might additionally moderate the effect of willpower theories on self-control performance.

There was already one field study conducted that tested these ideas. The study found that a limited theory predicted lower self-control performance during the final examination period, but not in the middle of the term, when self-control demands were supposedly lower (Job et al., 2010, Study 4). Compared to this study the present study has two critical improvements. First, the present study actually measures self-regulatory demands and can thus test whether individual differences in demands moderate the effect of willpower theories on self-control performance. Second, the study measures student's academic achievement (i.e., grade point average) to test whether differences in self-control translate into real-world outcomes. We hypothesize that students with a limited theory receive lower grades than their nonlimited fellow students and this relationship should be mediated by their better self-control performance (i.e., lower procrastination) in the pre-examination period.

Part II: Willpower theories and their consequences for health

While Part I addresses the question whether a nonlimited theory is (still) adaptive when self-control demands temporarily accumulate, Part II tests whether a nonlimited theory is also adaptive when people chronically experience high self-control demands. Patients with type 2 diabetes have to follow a strict health care regimen (e.g., monitoring their blood sugar,

keeping a healthy diet, or engaging in regular physical exercise) and thus chronically face high self-control demands (Boule et al., 2001). In the case of type 2 diabetes treatment adherence is particularly important in order to avoid severe short-term complications and concomitant diseases (Van der Does et al., 1996). Further, research suggests that patients with diabetes often suffer from heightened emotional distress caused by the disease (e.g., Welche, Jacobson, & Polonsky, 1997), and have significantly lower life quality and well-being compared to people without chronic disease (e.g., Glasgow, Ruggiero, Eakin, Dryfoos, & Chobanian, 1997; Rubin & Peyrot, 1999). Thus, a correlational study tested whether a nonlimited theory about willpower is related to better disease management (e.g., higher frequency of self-care activities, healthier diet, more physical activity) as well as psychological adjustment to the disease (e.g., lower diabetes-related distress, higher life quality, and higher subjective well-being) in a sample of type 2 diabetes patients.

Part III: Willpower theories and their consequences for well-being

Findings from a previous field study suggests that a limited theory predicts lower self-control with regard to a challenging personal goal (Job et al., 2010, Study 4). Among other variables, personal goal progress is a well-documented predictor of subjective well-being (Diener, Suh, Lucas, & Smith, 1999; for a meta-analysis, see Klug & Maier, 2014). Linking these two lines of research the three studies presented in Part III examined whether willpower theories affect people's subjective well-being. It is hypothesized that people with a limited theory experience lower levels of subjective well-being, because they make less progress towards their personal goals than people with a nonlimited theory.

Further, previous research shows that goal progress is related to the availability of goal-relevant resources (Diener & Fujita, 1995). Therefore, the studies tested whether willpower theories affected goal progress, because they shape the perceived availability of goal-relevant resources (e.g., self-discipline, stress resistance, social support). The perceived

availability of goal-relevant resources is therefore examined as mediator for the effect of willpower theories on goal progress. The hypotheses were tested in one cross-sectional and one longitudinal study, using a variety of measures for subjective well-being (i.e., affective well-being, life satisfaction, physical well-being).

Part IV: Improving self-control by changing implicit theories about willpower

The research conducted in Part IV builds on previous intervention studies documenting that changing implicit theories can promote adaptive behavior and reduce maladaptive behavior in real-world settings, such as improving student's learning strategies and achievement, or reducing aggression in adolescents (Aronson et al., 2002; Blackwell, Trzesniewski, & Dweck, 2007; Yeager, Trzesniewski, & Dweck, 2013). In two intervention studies, we examined whether people can learn to adopt a nonlimited theory about willpower and whether this promotes their self-control in everyday life (e.g., reduce students' procrastination during the final examination period). Based on the previous findings suggesting that willpower theories are relevant in the face of self-regulatory demands, it was hypothesized that the intervention is particularly effective for students who face high self-regulatory demands. Further, we assumed that simply telling people that willpower is not limited may not be sufficient to observe effects on self-control performance. Instead, we tested whether complementing the idea of nonlimited willpower with strategies helps people to implement this new mindset into situations that demand self-control in everyday life.

PART I

Beliefs About Willpower Predict Self-Regulation and Grades in Everyday Life

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Abstract

Laboratory research shows that when people believe that willpower is an abundant (rather than highly limited) resource they exhibit better self-control after demanding tasks. However, some have questioned whether this “nonlimited” theory leads to squandering of resources and worse outcomes in everyday life when demands on self-regulation are high. To examine this, we conducted a longitudinal study, assessing students’ theories about willpower and tracking their self-regulation and academic performance. As hypothesized, a nonlimited theory predicted better self-regulation (better time management and less procrastination, unhealthy eating, and impulsive spending) for students who faced high self-regulatory demands. Moreover, among students taking a heavy course load, those with a nonlimited theory earned higher grades, which was mediated by less procrastination. These findings contradict the idea that a limited theory helps people allocate their resources more effectively; instead, it is people with the nonlimited theory who self-regulate well in the face of high demands.

Introduction

Do people's beliefs about the nature of self-control affect their ability to exert self-control in everyday life settings? If so, what beliefs are most functional? One hypothesis is suggested by the strength model of self-control (Baumeister et al., 1998; Baumeister, Vohs, & Tice, 2007). This model proposes that self-control relies on a limited resource and that understanding this limit helps people use this resource judiciously, improving self-regulation especially when demands on self-control are high (Vohs et al., 2013). In the present research, however, we propose the opposite, namely, that this limited theory undermines people's self-regulatory efforts and, moreover, does so especially when demands on self-control are high. The belief that willpower relies on a limited resource, we suggest, leads people to act as though their self-regulatory resources are depleted long before they reach any actual limit in their self-regulatory capacity. As a consequence, we expect that people with a limited theory will reduce their effort and engage in various overindulgent behaviors when they face high demands on self-control. Instead, we propose that an alternative belief—the belief that willpower is not easily used up and can even be fueled by the exertion of self-control (a nonlimited theory)—promotes more successful self-regulation and performance when people encounter challenging self-regulatory demands.

The Strength Model of Self-Control

Much contemporary research on self-regulation draws on the strength model of self-control, which, as noted, posits that self-control relies on a limited energy resource (Baumeister et al., 1998; Baumeister, Vohs, & Tice, 2007). According to this model, every act of self-control depletes this resource, directly reducing the capacity to exert further self-control—a phenomenon termed ego depletion. Empirical support for this model comes from numerous laboratory experiments, which show that, after an initial task requiring self-control, people exhibit worse self-control on subsequent tasks than do people who engaged in an

initial undemanding task (for a meta-analysis, see Hagger et al., 2010). Recent field studies extend these findings to everyday self-regulation, and appear to suggest that the same principle applies. For instance, in an experience sampling study Hofmann, Vohs, and Baumeister (2012) found that the more participants controlled themselves by resisting desires the more likely they were to show self-control failures later in the day. Similarly, research on stress and self-regulation confirms that when people contend with stressful circumstances, such as daily hassles or academic examinations, they tend to engage in more problematic, potentially harmful behaviors like eating unhealthy food, consuming alcohol, smoking, and spending excessively (Connor, Jones, Conner, Mcmillan, & Ferguson, 2008; Ng & Jeffery, 2003; Oaten & Cheng, 2005; Steptoe, Lipsey, & Wardle, 1998). It is thus well documented that self-control often suffers when self-control demands are high, both in laboratory and in everyday life settings.

Given the importance of self-regulation for successful goal-striving, health, and overall functioning (e.g., Moffitt et al., 2011), identifying factors that predict better self-regulation, especially in the face of high demands, is critical. Recent research has identified several variables that moderate the ego depletion effect. For instance, motivational variables like incentives, expectations, and perceptions of a task can diminish or eliminate ego depletion in laboratory settings (Clarkson, Hirt, Jia, & Alexander, 2010; Martijn et al., 2002; Muraven & Slessareva, 2003). Most pertinent to the present research, Job, Dweck, and Walton (2010) found that people's lay beliefs about willpower, so called *implicit theories*¹, determined whether people showed ego depletion at all.

Implicit Theories About Willpower

Challenging the strength model of self-control, Job and colleagues (2010) demonstrated in a series of laboratory experiments that only people who believe that

¹ Here the term "implicit" means that theories about willpower are most often not articulated. However, we assume that people are able to recognize their beliefs when asked to respond to items that make them explicit.

willpower is limited and easily depleted (a *limited theory* of willpower, assessed with questions like “After a strenuous mental activity, your energy is depleted and you must rest to get it refueled again”) show ego depletion, that is, perform worse after an initial self-control task. People who reject the view that willpower is highly constrained and who believe, instead, that willpower can even be self-generating (e.g., “After a strenuous mental activity, you feel energized for further challenging activities”) showed no impairment over a series of demanding self-control tasks (see also Miller et al., 2012). We call the latter belief a *nonlimited theory* of willpower. We intentionally do not use the term “nonlimited.” People with a nonlimited theory may not believe that willpower is limitless or that they are immune to depletion from highly strenuous tasks of long duration. However, they reject the view that willpower is easily depleted by acts of self-control.

Job and colleagues found that implicit theories about willpower predict ego depletion both measuring theories about willpower as an individual-difference and manipulating them experimentally, suggesting their causal role. These findings imply that self-regulatory failure following the brief exertion of self-control results from people’s beliefs about their available resources rather than from a true lack of resources (see also Job, Walton, Bernecker, & Dweck, 2013).

How do implicit theories about willpower affect ego depletion? Research suggests that the belief that willpower is limited sensitizes people to cues that may signal the availability or unavailability of mental resources. For example, finding an initial self-control task exhausting predicted worse subsequent self-control performance for people with a limited theory but was not predictive for people with a nonlimited theory (Job et al., 2010, Study 3). In another series of studies, ingesting glucose restored self-control for those with a limited theory but had no effect on those with a nonlimited theory, who continued to perform well on self-control tasks whether they had ingested glucose or not (Job et al., 2013).

Previous research suggests that glucose signals the restoration of self-control resources (Chambers, Bridge, & Jones, 2009; Molden et al., 2012). Our results suggest that only people who believe that willpower is highly limited carefully monitor for cues to the availability of self-control resources.

Extending this research, Vohs and colleagues (2013) replicated the effects of implicit theories about willpower on ego depletion and raised an important question: Will the same effects hold when self-control demands are especially high? Vohs and colleagues hypothesized that implicit theories about willpower lead people to temporarily compensate for a lack of resources. They suggest that people can do so effectively in the face of mild or moderate self-control demands but not in the face of high demands, where “severe” depletion eventually takes its toll. In a laboratory experiment, they examined how a manipulation of theories about willpower interacted with three ego depletion conditions: a “no depletion” condition in which participants completed no initial self-control tasks; a “mild depletion” condition in which participants completed two initial self-control tasks; and a “severe depletion” condition in which participants completed four initial self-control tasks. Vohs and colleagues replicated the finding that a nonlimited theory of willpower improves self-control in the face of “mild depletion.” But in the “severe depletion” condition, there was no positive effect of a nonlimited theory and on one of two measures of self-control performance the effect even reversed: Participants led to adopt a limited theory performed better. Vohs and colleagues concluded that a nonlimited theory can be counterproductive. Thinking that willpower is nonlimited, they write, “might undermine the normal tendency to conserve resources (Muraven et al., 2006) so that people find themselves severely depleted after multiple tasks” (p.186).

Laboratory tasks, however, are not ideal for drawing conclusions about the limits of willpower. There are many reasons people might display less effort after a long series of

demanding but potentially unmeaningful tasks. The critical test of how beliefs about willpower affect self-regulation must be conducted in real-world settings in which people contend with accumulating demands on their self-control as they strive to accomplish personal goals. Indeed, in contrast to Vohs and colleagues' conclusion, an earlier longitudinal study found that college students who endorsed a nonlimited theory of willpower exhibited superior everyday self-regulation during the week before final exams, when demands on self-control were assumed to be high (Job et al., 2010, Study 4). They ate less unhealthy food, procrastinated less, and pursued personal achievement goals more effectively than students with a limited theory.

The present research extends this prior study to provide a more detailed examination of how implicit theories about willpower predict everyday self-regulation. The study does so in several ways. First, the prior study simply assumed that self-regulatory demands were high for all students at a particular time, that is, as final exams approached. In the present research, we assessed the level of self-regulatory demands for each student on a week-by-week basis across an academic term so we could identify the students who faced consistently high demands and those who faced lower demands. We hypothesized that a nonlimited theory of willpower would predict better self-regulatory outcomes among students who contended with high self-regulatory demands but not necessarily among students who faced low self-regulatory demands. Second, we assessed a broader range of self-regulatory outcomes than in past research, including not only procrastination and unhealthy eating but also ineffective time management, impulsive spending, and emotion-regulation failure. Finally, we examined a further important outcome that is determined in part by self-regulation, and that is not self-reported: participants' end-of-term grade-point-average (GPA) (see Duckworth & Seligman, 2005). We examined whether a nonlimited theory of willpower would predict a higher GPA that term (controlling for past GPA) especially among students who took a heavy course load.

We further expected that any improvement in GPA would be mediated by better self-regulation, especially lower levels of procrastination.

In summary, we tested the hypothesis that students holding a nonlimited theory of willpower facing consistently high demands would display better self-regulation and consequently would reach higher grades than would students holding a limited theory facing similar circumstances. If this is the case, it would suggest that thinking of willpower as a nonlimited resource, rather than harming people by leading them to waste their resources, helps people stay focused on their goals when a heavy workload and accumulating demands make self-regulation challenging.

Method

Participants and Procedure

Participants were 176 students at a selective university in the Western United States (101 women; $M_{age} = 21.21$, $SD = 2.62$). They were asked to complete an online questionnaire at five time points, once each week during the second half of a 10-week term (T1-T5). Students received \$3 for completing each questionnaire and a \$10 bonus for completing all five questionnaires. A total of 113 participants completed all five questionnaires; 26 completed four, 13 completed three, 10 completed two, and 14 completed one. Data from all participants who completed at least two consecutive questionnaires were included in hierarchical linear modeling (HLM) analyses of self-regulation ($N = 156$). [Participants completed the relevant measures versus those who did not did not differ in theories about willpower, $t(174) = -.84$, $p = .40$.] Each week on Monday morning participants received a link to the online questionnaire with a request to respond that day. On average, 65% of participants completed the questionnaire that day (ranging from 83% at T1 to 54% at T4). Non-responding participants were sent a reminder on Tuesday and could respond until Wednesday night.

At the beginning of the first questionnaire participants provided informed consent and were asked to authorize the release of their college academic records from the term of their participation and the prior term. One hundred fifty-three participants (87%) authorized the release. [Participants who authorized the release of their academic record did not differ in their theories about willpower from those who did not, $t(174) = 0.23, p = .82$]

Measure of Implicit Theories About Willpower

At Time 1 participants completed a 6-item measure assessing theories about willpower with respect to strenuous mental exertion (Job et al., 2010). Sample items include “After a strenuous mental activity your energy is depleted and you must rest to get it refueled again” (limited theory) and “Your mental stamina fuels itself; even after strenuous mental exertion you can continue doing more of it” (nonlimited theory) ($1 = strongly\ agree, 6 = strongly\ disagree; \alpha = .85$). Items referring to the limited resource-theory were reverse-scored so that higher values represent greater agreement with the limited theory ($M_{grand} = 3.88, SD = 0.88$).

Measures of Everyday Self-Regulation Failures and Self-Regulatory Demands

Our questionnaire allowed us to determine which students faced high demands over a several week period. Each questionnaire assessed, first, indices of everyday self-regulation failures during the previous week and, second, self-regulatory demands anticipated in the current week. This approach separates the assessment of the two critical variables for each week so as to prevent reports of one from biasing reports of the other. Since we had no measure of self-regulation failures during the last week of the study, we had complete information about anticipated self-regulatory demands and self-regulation failures for four weeks.

Everyday self-regulation. Each questionnaire (T1-T5) assessed self-regulatory failures during the prior week by asking participants to report the frequency of (1)

procrastination, defined as engaging in nonacademic activities rather than studying (e.g., “How often did you meet friends instead of studying?”), (2) consumption of unhealthy (high fat/high sugar) foods and drinks, like chocolate bars or salty snacks, (3) poor time management (e.g., “How often did you come late to an appointment?”), (4) excess spending (e.g., “How often did you buy something knowing that it’s actually too expensive for you?”), and (5) failure to control emotions, (e.g. “How often did you have trouble controlling your temper?”) during the prior week (*1 = never, 2 = 1 time per week, 3 = 2 times per week, 4 = 3-4 times per week, 5 = 5-6 times per week, 6 = 1 time per day, 7 = two or more times per day*). Descriptive statistics and reliability information are presented in Table 1.

To assess whether the five indicators of self-regulation failure converged as indicators of a single latent variable, we conducted a confirmatory factor analysis with full information maximum likelihood estimation on the five measures assessed at T1. A one-factor model fit the data: $\chi^2 (df = 5, N = 176) = 3.03, p = .70$, comparative fit index (CFI) = 1.00, root mean square error of approximation (RMSEA) = .00. All loadings were significant (standardized values: procrastination = .67, consumption of unhealthy foods = .22, poor time management = .59, excess spending = .46, emotion-regulation failure = .52). Therefore, in addition to examining each measure separately, we also created a composite index of self-regulation failure by averaging scores for the five variables at each time point.

Anticipated self-regulatory demands. We created a list of 13 demands undergraduate students commonly face over an academic term. These included academic tasks (e.g., “class presentations to deliver,” “tests to take”) and social stressors (e.g., “conflicts with one’s professor or TA,” “experience of social exclusion or rejection”). For each demand, participants were asked to “indicate how much you will have to deal with [this] task or experience during the next seven days” (*1 = not at all, 2 = a little, 3 = somewhat, 4 =*

very much). These ratings thus allowed us to summarize diverse anticipated self-regulatory demands to create a single index for each student.²

Academic performance and course load. Students' college academic records provided measures of (a) their GPA during the term the study was conducted and the previous term and (b) their course load, i.e., the number of units students enrolled in each term.

Trait Self-Control

If we find the hypothesized relationship between a nonlimited theory and fewer self-regulatory failures, a potential alternative explanation involves trait self-control: Perhaps people with a nonlimited theory about willpower show better self-regulatory outcomes simply because they have greater self-control to begin with. To examine this possibility, we administered the brief Trait Self-Control Scale (Tangney et al., 2004) at the end of the T2 questionnaire. Participants indicated on a 5-point scale (*1 = not at all, 5 = very much*) how well each of 13 statements about self-control described their typical behavior (e.g., "I'm good at resisting temptation," "I am lazy") ($\alpha = .88$).

Results

After reporting descriptive statistics and zero-order correlations, the results are divided into two main sections. First, we analyzed everyday self-regulation with a multilevel approach. Our primary focus was on between-participant differences in self-regulatory demands—whether students who faced high demands during the term self-regulated better or

² An important question concerns how self-regulatory demands change over the course of an academic term. In past research, we theorized that demands increase as finals week approaches (Job et al., 2010). The present data allow a test of this assumption. This was the case for academic demands. Specifically, participants' ratings of how much they would have to deal with tests increased over the four weeks as indicated by a significant linear within-participant contrast, $F(1, 128) = 59.20, p < .001$. There was no such increase for non-academic demands; indeed, social stressors (e.g., social obligations) declined as the end of the term approached, $F(1, 128) = 5.67, p = .04$. A strength of the present study is that, rather than assuming that all students are facing high or low demands at certain times, we assessed the level of demands each student anticipated week by week over the second half of the term.

more poorly as a function of their implicit theory of willpower. We focused on this question because we expected self-regulatory demands and behavior to vary more between- than within-participants over this relatively short time period (i.e., five consecutive weeks within a term). However, we also examined within-participant (i.e., week-to-week) changes in self-regulatory demands to determine whether students showed differences in self-regulation, as a function of their theories about willpower, on weeks they had previously predicted would pose high versus low demands.

Second, we examined students' end-of-term GPA. A series of regression analyses tested the hypothesis that theories about willpower would predict GPA, that this relationship would be moderated by academic work-load, and that it would be mediated by procrastination.

Descriptive Statistics

Means and standard deviations of self-regulatory behaviors and self-regulatory demands for each week are presented in Table 1. Over the course of the five measurement times, levels of procrastination and time-management failure dropped: linear within-participant contrasts $F(1, 93) = 16.19, p = .001$ and $F(1, 93) = 25.32, p < .001$, respectively. As the end of the term and final exams approached, students procrastinated less and managed their time better.

Table 1

Means and Standard Deviations of Self-Regulation Failure, Negative Affect, and Forecasted Self-Control Demands

Scale	Sample Item	α	Week 1	Week 2	Week 3	Week 4
<i>N</i>			158	149	143	119
Procrastination	“How often did you meet friends instead of studying?” (6 items)	.78-.87	3.37 (1.14)	3.30 (1.26)	3.29 (1.28)	2.92 (1.31)
Unhealthy Food	“How often did you eat chocolate or candy bars?” (6 items)	.67-.74	2.99 (1.00)	2.96 (0.95)	2.98 (1.00)	2.95 (1.03)
Poor Time Management	“How often did you come late to an appointment?” (4 items)	.62-.76	1.77 (0.73)	1.81 (0.81)	1.73 (0.91)	1.41 (0.62)
Excess Spending	“How often did you buy something knowing that it’s actually too expensive for you?” (6 items)	.80-.91	1.58 (0.68)	1.53 (0.65)	1.64 (0.88)	1.45 (0.66)
Emotion Reg. Failure	“How often did you have trouble controlling your temper?” (3 items)	.76-.87	2.06 (0.92)	2.03 (1.08)	2.00 (1.03)	2.00 (0.92)
Forecasted Self-Regulatory Demands	“How much will you have to deal with <i>papers/essays due?</i> ” (13 items)	.66-.72	25.74 (5.70)	24.99 (6.14)	25.13 (5.79)	24.32 (5.92)

Table 2 reports the means, standard deviations, and zero-order correlations of theories about willpower, course load in the current term, GPA in the current and previous term, as well as trait self-control. There were no significant zero-order correlations among willpower theories, course load, and GPA. As expected current- and prior-term GPA were highly correlated and there was no mean difference between the two, $t < 1$. There was also a significant correlation between theories about willpower and trait self-control. Participants

low in trait self-control agreed more with a limited theory. As will be seen, however, this difference did not account for the effect of theories about willpower on self-regulation and performance.

Table 2

Descriptive Statistics and Zero-Order Correlations for Participant-Level Variables

Variable	2	3	4	5	6	<i>M</i>	<i>SD</i>
1. Willpower Theory	-.07	-.13	-.01	-.17	.10	3.88	0.88
2. Course Load ^a		-.01	.02	-.16	-.39	14.60	3.64
3. Current Term GPA			.68	.23	.25	3.57	0.46
4. Previous Term GPA				.17	.28	3.60	0.42
5. Trait Self-Control					-.10	3.07	0.72
6. Age						20.58	1.74

Note. ^aUnits taken in the current term. Correlations $r > |.16|$ are significant at $p < .05$ (two-tailed).

Everyday Self-Regulation Failure and Self-Regulatory Demands

Our data on students' weekly self-regulation failure and self-regulatory demands conform to a two-level hierarchical structure (repeated measures nested within individuals). Therefore, we used hierarchical linear modeling (HLM 6.2 statistical software package, Raudenbush, Bryk, Cheong, Congdon, & du Toit, 2004) to analyze between- and within-person differences in self-regulation as our dependent variable. We first estimated an unconditional model with no predictors at either level of the hierarchy, to see how much variation in weekly self-regulation lay between- versus within-participants. This analysis revealed that, as might be expected, most of the variance in self-regulation was between-participants (81%) ($\tau_{00} = 0.35$); only 19% was within-participants ($\sigma^2 = 0.08$). Similarly, an unconditional model predicting forecasted demands showed that, more of the variance was between-participants (62%) than within-participants (38%) ($\sigma^2 = 0.12$, $\tau_{00} = 0.08$).

To estimate effects of self-regulatory demands at both the between-participants and within-participants levels of analysis we ran a compositional model including the aggregated score for mean demands across weeks as a participant-level predictor, as well as weekly scores of demands (group-centered) as the week-level predictor (Bryk & Raudenbush, 1992; Enders & Tofghi, 2007). This is the full model:

$$\text{Self-Regulation}_{ij} = B_{0j} + B_{1j}\text{Demands} + R_{ij}$$

$$B_{0j} = G_{00} + G_{01}\text{WillpowerTheory} + G_{02}\text{MeanDemands} + G_{03}\text{Theory} \times \text{Demands} + u_{0j}$$

$$B_{1j} = G_{10} + G_{11}\text{WillpowerTheory} + u_{1j}$$

G_{00} is the intercept. G_{01} and G_{02} represent the main effects of willpower theories and mean demands on participants' mean self-regulation failure reports. G_{03} represents the interaction between willpower theory and demands, which tests our hypothesis at the between-participant level. G_{10} represents the main within-participant effect of week-to-week changes in predicted self-regulatory demands on week-to-week self-regulation reports. Finally, G_{11} represents the cross-level interaction between willpower theory and self-regulatory demands, which tests effects at the within-participant level.

Table 3 contains the coefficients for this model predicting the composite self-regulation failure index as well as each measure of self-regulation failure. There was a highly significant main effect of mean demands (G_{02}): High demands were associated with more self-regulation failure. The main effect of willpower theories (G_{01}) (irrespective of self-regulatory demands) was significant for procrastination: The more students endorsed a limited theory the more they procrastinated. Most important, the interaction between willpower theories and mean demands (G_{03}) was significant for both the composite index and each measure of self-regulation failure except poor time management. These results support our hypothesis: A limited theory about willpower predicted more self-regulation failure among students who experienced greater self-regulatory demands than their peers.

Table 3

Unstandardized Coefficients From a Multilevel Linear Model Predicting Self-Regulation

Predictor	Composite Self-Reg. Failure	Procrastination	Unhealthy Food	Poor Time Management	Excess Spending	Emotion- Regulation Failure
G ₀₀ Intercept	2.31 (0.04)***	3.26 (0.08)***	3.00 (0.07)***	1.71 (0.05)***	1.56 (0.04)***	2.03 (0.06)***
G ₀₁ Willpower Theory (WT)	0.08 (0.04) ⁺	0.23 (0.09)*	0.04 (0.08)	0.11 (0.06) ⁺	0.02 (0.05)	-0.02 (0.06)
G ₀₂ Mean Demands	0.95 (0.10)***	1.18 (0.22)***	0.55 (0.19)**	0.92 (0.13)***	0.73 (0.12)***	1.27 (0.15)***
G ₀₃ WT × Mean Demands	0.17 (0.04)***	0.33 (0.09)**	0.18 (0.08)*	0.05 (0.05)	0.12 (0.06)*	0.13 (0.06)*
G ₁₀ Weekly Demands	0.05 (0.06)	0.28 (0.14)*	-0.03 (0.10)	0.32 (0.10)**	-0.04 (0.10)	-0.23 (0.14)
G ₁₁ WT × Weekly Demands	-0.07 (0.7)	-0.01 (0.18)	-0.17 (0.12)	0.09 (0.12)	-0.00 (0.12)	-0.25 (0.17)

Note. WT = Willpower Theory; Standard errors are given in parentheses. ⁺ $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Figure 1 depicts predicted values of the composite index for students with a limited (+1 SD) and a nonlimited theory (-1 SD) who had to deal with high (+1 SD) or low (-1 SD) mean self-regulatory demands. Among students who generally faced high demands, those with a limited resource reported significantly more self-regulatory failures than those with a nonlimited theory, $b = 0.27$, $se = 0.07$, $t(152) = 3.98$, $p < .001$.

Among students who faced lower demands, self-regulatory failures were far less frequent. Interestingly, however, among these students those with a nonlimited theory showed marginally worse self-regulation than those with a limited theory, $b = -0.12$, $se = 0.07$, $t(152) = -1.81$, $p = .07$. We return to this interesting point later.

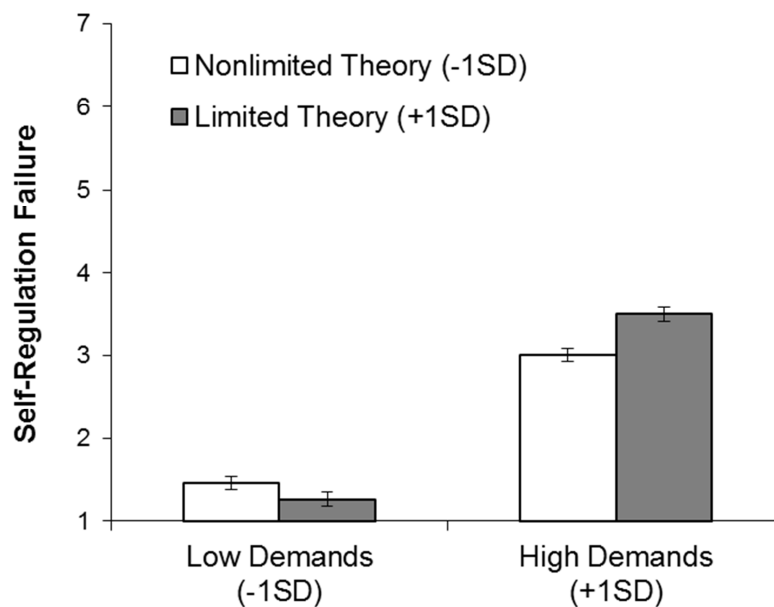


Figure 1. Mean self-regulation failure (composite index) as a function of forecasted self-regulatory demands and willpower theory.

Next, we tested the key contrast for each index of self-regulation failure. Among students who faced high demands, those with a limited theory, relative to those with a nonlimited theory, procrastinated more, $b = 0.61$, $se = 0.14$, $t(152) = 4.20$, $p < .001$, consumed more unhealthy foods, $b = 0.24$, $se = 0.12$, $t(152) = 1.99$, $p = .05$, managed their time

marginally more poorly, $b = 0.16$, $se = 0.09$, $t(152) = 1.91$, $p = .06$, and spent more excessively, $b = 0.16$, $se = 0.08$, $t(152) = 2.06$, $p = .04$. For emotion regulation there was a weak trend in the same direction, $b = 0.14$, $se = 0.10$, $t(152) = 1.39$, $p = .17$. To illustrate the interactions, Figure 2 depicts procrastination and unhealthy eating behavior for participants with a limited or nonlimited theory who faced high versus low demands.

For students who faced low demands, willpower theories were not significantly related to procrastination, $b = -0.15$, $se = 0.14$, $t(152) = -1.06$, $p = .29$, unhealthy eating, $b = -0.16$, $se = 0.12$, $t(152) = -1.35$, $p = .18$, bad time management, $b = 0.03$, $se = 0.08$, $t(152) = 0.38$, $p = .70$, or excess spending, $b = -0.11$, $se = 0.07$, $t(152) = -1.52$, $p = .13$. Students with a nonlimited theory, however, reported marginally worse emotion regulation when demands were low, $b = -0.18$, $se = 0.10$, $t(152) = -1.86$, $p = .06$.

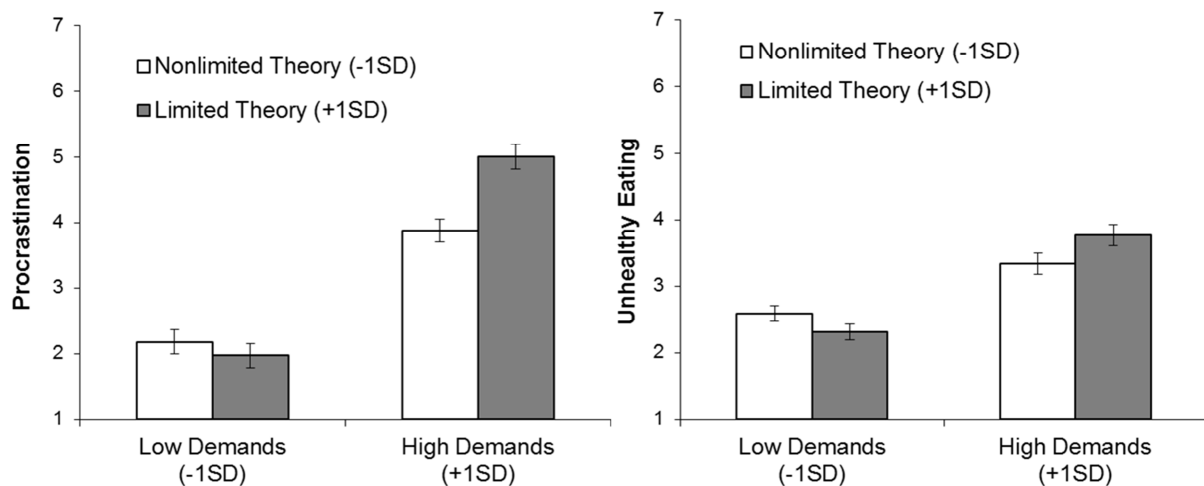


Figure 2. Mean procrastination and unhealthy eating as a function of self-regulatory demands and willpower theory.

We have suggested that a limited theory undermines self-regulation when self-regulatory demands are high. A potential alternative explanation is that students with a limited theory anticipate and have more self-regulatory demands than students with a nonlimited

theory. This was not the case. We ran an HLM analyses on students' anticipated self-regulatory demands with theories about willpower as a participant-level predictor. This analysis showed no relationship between implicit theories and anticipated demands, $b = -0.01$, $se = 0.02$, $t(552) = -0.40$, $p = .69$. Further, the correlation between theories about willpower and mean self-regulatory demands was not significant, $r = -.03$, $p = .75$. Students with a limited and a nonlimited theory anticipated similar self-regulatory demands. But only students with a limited theory responded to high demands with more self-regulation failures.

A second potential alternative explanation, as noted earlier, involves trait self-control: Perhaps students who endorse a limited willpower theory self-regulate less effectively in the face of self-regulatory challenges simply because they have less trait self-control. This was not the case. We ran an HLM-model predicting the composite index of self-regulation failure from theories about willpower, mean demands, and their interaction, as well as trait self-control and its interaction with mean demands as participant-level predictors. There was a significant main effect for trait self-control, $b = -0.39$, $se = 0.05$, $t(146) = -7.92$, $p < .001$: Students lower in trait self-control reported more self-regulatory failures. The interaction between trait self-control and demands was also significant, $b = -0.07$, $se = 0.03$, $t(146) = -2.20$, $p = .03$: When demands were high, students low in trait self-control reported the most self-regulatory failures. However, importantly, in this analysis the interaction between theories about willpower and mean demands remained significant, $b = 0.09$, $se = 0.04$, $t(146) = 2.43$, $p = .02$. The effect of theories of willpower is not accounted for by differences in trait self-control.

In contrast to these between-participant results, within-participant results were not significant (see Table 3). First, within-participant (week-to-week) changes in demands (G_{10}) predicted only procrastination and time management failure. They were not related to the composite index of self-regulation failure. Second, there was no cross-level interaction

between willpower theories and within-participant changes in demands (G_{11}). That is, there was no conjoint effect of participants' week-to-week changes in demands, corrected for their mean level of demands, and theories about willpower on weekly reports of self-regulation. We suspect that a longitudinal study with more intervals over a longer period of time might be able to better detect conjoint effects of willpower theories and within-person changes in demands on participants' self-regulation. Another reason for the lack of within-person effects could be that the cumulative estimate of mean demands provides a more reliable measure of the demands a student faces than week-by-week predictions. For example, on the Monday of one week a student might predict low demands for the upcoming week, but then might accomplish less over the next few days and end up having high demands the rest of the week. Or a student might predict that the week will be a high-demand week but then an instructor grants the class an extension on an assignment and the week becomes lower in demands. If so, the anticipation of demands on a week-by-week basis may be less accurate than cumulative estimates of demands over several weeks.

Academic Performance and Course Load

The self-report measures provide nuanced insight into how willpower theories predict everyday self-regulation in the face of self-regulatory demands. Next, we tested whether willpower theories also predict an objective (non-self-reported) and cumulative index of successful self-regulation over time: students' end-of-term GPA calculated from official school records. If this shows the same pattern, it would extend the self-reported indices of self-regulation and further illustrate the implications of theories about willpower for students' lives.

Willpower theories and academic performance. To test whether willpower theories predicted students' end-of-term GPA, we conducted a hierarchical regression analyses. First, we controlled for standardized GPA in the prior term, $R^2 = .47$, $F(1,146) = 128.01$, $p < .001$.

Second, we added standardized willpower theories, which was significant, $\beta = -.12$, $b = -.06$, $se = .03$, $\Delta R^2 = .02$, $F(1,145) = 4.18$, $p = .04$. Thus, even controlling for prior GPA, the more students endorsed a limited theory the lower was their end-of-term GPA.

Next, we tested whether this was especially the case among students taking a heavy course load. We added course load and the willpower theories by course load interaction (willpower theories and course load were independent, $r = -.06$, *ns*). In the final model ($\Delta R^2 = .04$, $F(1,143) = 10.74$, $p = .001$), the main effect of willpower theories was marginally significant, $\beta = -.11$, $b = -.05$, $se = .03$, $t(143) = -1.80$, $p = .08$. There was no main effect of course load, $\beta = -.04$, $b = -.02$, $se = .03$, $t < 1$. However, the willpower theories by course load interaction was significant, $\beta = -.19$, $b = -.09$, $se = .03$, $t(143) = -3.28$, $p = .001$. As shown in Figure 3, willpower theories did not predict GPA among students taking a light course load (1 SD below the mean, or 10.96 units out of a possible 20), $\beta = .12$, $b = .04$, $se = .12$, $t(144) = 1.01$, $p = .31$. But among students taking a heavy course load (1 SD above the mean, or 18.14 units), those with a limited theory earned lower GPAs ($M_{est} = 3.41$) than those with a nonlimited theory about willpower ($M_{est} = 3.69$), $\beta = -.41$, $b = -.14$, $se = .11$, $t(144) = -3.77$, $p < .001$. In addition, a heavy course load was associated with worse performance only for students with a limited theory, $\beta = -.32$, $b = -.11$, $se = .12$, $t(144) = -2.81$, $p = .01$. Students with a nonlimited theory actually performed slightly better when they had a heavy course load, $\beta = .21$, $b = .07$, $se = .11$, $t(144) = 1.81$, $p = .07$.

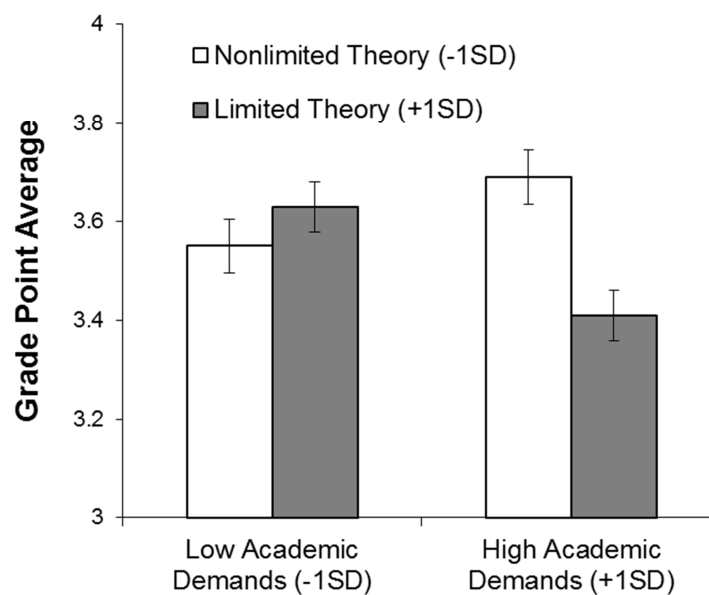


Figure 3. Mean grade point average (GPA) as a function of academic demands (units taken) and willpower theory. Means are adjusted for prior-term grade point average, age, and sex.

We also tested whether a limited theory predicted worse grades on a longitudinal basis—that is, when students’ course load increased from one term to the next. We examined students’ current-term GPA, with prior-term GPA controlled, and tested the effects of willpower theories, change in course load (difference between current term course load and previous term course load, $M_{change} = -0.76$, $SD = 3.26$) from the prior term to the current term, and the willpower theories by change-in-course-load interaction. The interaction was significant, $\beta = -.13$, $b = -.06$, $se = .03$, $t(143) = -2.17$, $p = .03$. Among students whose course load decreased ($M_{change} - 1 SD = -0.76 - 3.26 = \text{decrease of } 4.02 \text{ units}$), there was no effect of willpower theories on grades, $t < 1$. But among students whose course load increased ($M_{change} + 1 SD = -0.76 + 3.26 = \text{increase of } 2.5 \text{ units}$), those with a limited theory earned worse grades than those with a nonlimited theory, $\beta = -.35$, $b = -.12$, $se = .12$, $t(144) = -2.95$, $p = .004$. These findings confirm that GPA varies with students’ implicit theories about willpower and their changing course load.

As was the case for everyday self-regulation, the effect of willpower theories on GPA was not accounted for by trait self-control. We conducted a hierarchical regression predicting GPA from previous-term GPA (block 1), theories about willpower, course load, and trait self-control (block 2), as well as the interactions between course load and trait self-control and between course load and willpower theories (block 3). In the final model ($\Delta R^2 = .54$, $F(6,124) = 24.04$, $p < .01$) the main effects for trait self-control and willpower theories were both nonsignificant, $\beta = .10$, $b = .04$, $se = .03$, $t(124) = 1.49$, $p = .14$, and, $\beta = -.08$, $b = -.04$, $se = .03$, $t(124) = -1.31$, $p = .19$, respectively. The course load by trait self-control interaction was also not significant, $\beta = -.07$, $b = -.03$, $se = .03$, $t(124) = -1.08$, $p = .28$. However, the course load by willpower theory interaction remained significant, $\beta = -.23$, $b = -.10$, $se = .03$, $t(124) = -3.71$, $p < .01$. In the face of a heavy course load, willpower theories predict GPA above and beyond trait self-control.

Mediation. Finally, we tested whether greater procrastination explained the relationship between a limited willpower theory and GPA. Past research shows that procrastination leads to lower grades (Steel, 2007). Likewise, in the present research mean procrastination (averaged over five weeks) predicted GPA controlling for previous-term GPA (partial $r(145) = -.32$, $p < .001$). Since the previous analysis showed that theories about willpower affect students' procrastination, we tested whether students' mean procrastination mediated the effect of willpower theories on GPA (see Figure 4). We did so using the INDIRECT macro (Preacher & Hayes, 2008), which uses bootstrapping to estimate the indirect effect of an independent variable (i.e., willpower theories) on a dependent variable (i.e., GPA) through a mediator (i.e., procrastination). Because the macro provides only unstandardized path coefficients all variables were z-standardized prior to using the macro to generate standardized coefficients. The mediational model was significant, $R^2 = .53$, $F(3,144) = 52.71$, $p < .001$. As reported earlier, there was a main effect for willpower theories

predicting procrastination; a limited theory predicted greater procrastination, $\beta = .18$, $se = .07$, $t(144) = 2.60$, $p = .01$ (*a* path). The direct effect of procrastination on GPA was also significant, $\beta = -.11$, $se = .03$, $t(144) = -3.75$, $p < .001$ (*b* path). The more students procrastinated the lower was their end-of-term GPA. The bootstrapped indirect effect was different from zero, 95% CI $[-.005, -.047]$, and the direct effect of willpower theories on GPA was no longer significant, $\beta = -.03$, $se = .03$, $t(144) = -1.30$, $p = .20$ (*c'* path). The other indicators of self-regulatory failure did not show this mediational pattern. The results suggest that the more students endorsed a limited theory about willpower the more they procrastinated and the lower was the GPA they earned.

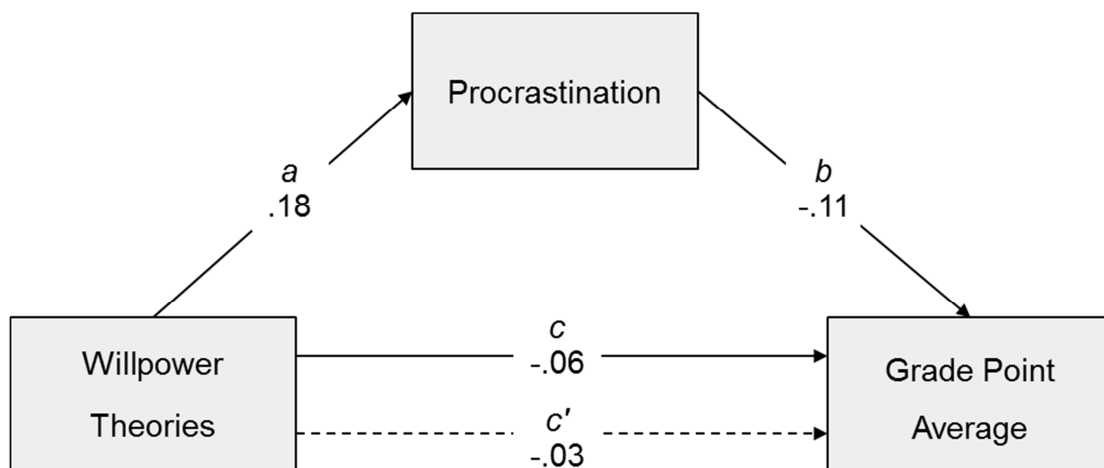


Figure 4. Mediation model testing the indirect effect of willpower theory on grade point average through procrastination. Dotted regression paths are not significant; bold regression paths are statistically significant at $p < .05$.

General Discussion

The present research shows that students who think that willpower is limited and easily depleted—the view of willpower suggested by the strength model of self-control—self-regulate less well in their everyday lives when they face high self-regulatory demands. Far

from conserving their resources and showing strong self-regulation when needed, students who endorsed the limited theory and who faced high demands over the term, procrastinated more (e.g., watching TV instead of studying), ate more junk food, and reported more excessive spending as compared to students with a nonlimited theory about willpower. This was the case even though students with a limited and a nonlimited theory faced similar self-regulatory demands. By measuring students' self-regulatory demands, the present study provides the first direct evidence that it is precisely in the face of consistently high demands that a nonlimited theory of willpower predicts better everyday self-regulation.

Importantly, we found the same pattern for students' term grades, an objective and inherently important variable resulting from successful self-regulation. Among students who took a heavy course load, students with a limited theory earned lower grades than students with a nonlimited theory. They did so, a mediation analysis suggests, because they were more likely to procrastinate in completing their work. By contrast, the nonlimited theory led people to deploy their resources more effectively when they were needed most. Notably, the effects of willpower theories on everyday self-regulation and on GPA did not arise because students with a limited theory had lower trait self-control. The patterns remained significant even controlling for trait self-control.

Our findings contradict the hypothesis that a nonlimited theory about willpower undermines self-regulation and does so especially when demands are high. Relying on a laboratory experiment, Vohs and colleagues (2013) suggested that the belief that willpower is nonlimited might counteract ego depletion only in cases of mild or moderate demands but not when self-control demands are "severe." They speculated that this belief could even amplify ego depletion and worsen self-regulation by undermining people's "normal tendency" to conserve their resources and then deploy them when they were needed. To the contrary, examining students' success and failure self-regulating in a highly demanding academic

environment, we found that the nonlimited theory was most predictive of better outcomes among students who faced the greatest demands on their self-regulation.

In fact, it was only among students who faced *low* demands—when self-regulation lapses may be less costly—that students with a nonlimited theory “wasted” their self-regulatory resources relative to those with a limited theory. Under these conditions, they reported giving in to impulses and pursuing non-academic activities at least as much as, if not more than, students with a limited theory. Thus, students with a nonlimited theory are not self-control super heroes who never give in to temptations; nor are they unwilling to admit self-regulatory failure. This view is further supported by the rather low correlation between theories about willpower and trait self-control, suggesting that those with a nonlimited theory are not simply natural self-regulators or people with outsized self-control abilities. Rather, those with a nonlimited theory are people who lean in when demands on self-regulation are high.

This pattern was replicated in the analysis of students’ academic performance, where a nonlimited versus limited willpower theory predicted higher GPA among students who took heavy course loads. It was also interesting to find that participants with a nonlimited theory tended to earn even higher grades when they were dealing with a heavy course load than when they were taking a light course load. These latter findings suggest that people with a nonlimited theory may even profit from challenging circumstances. Indeed, it is possible that in situations where they are not sufficiently challenged (e.g., in a boring job), people with a nonlimited theory might be the ones to show lower performance. For them, boredom or lack of challenge may be depleting! In short, people with a nonlimited theory about willpower look strong when high demands require effective self-regulation but do not perform better when demands are low.

Why did Vohs and colleagues (2013) find a different pattern in a laboratory study—that the benefits of a nonlimited theory for self-control performance disappeared as the number of self-control tasks increased? As a laboratory session wears on, many other factors beyond participants' self-control capacity may affect their willingness to exert further self-control on laboratory tasks. For instance, participants may simply decide that they have done enough and/or that the tasks are no longer interesting or consequential. A nonlimited theory about willpower would not be functional if it led people to engage on a high level with every task that came along regardless of its value or purpose. Future laboratory research may decompose the capacity to exert self-control from the value or meaning of a task to the self.

In Vohs' and colleagues (2013) research as well as in other recent theorizing on ego depletion (Inzlicht, Schmeichel, & Macrae, 2014; Inzlicht & Schmeichel, 2012) the effects of willpower theories are grouped together with those of other “motivational” factors such as monetary incentives. It is often assumed that both counteract ego depletion through enhanced motivation. Research on theories about willpower, however, proposes a different perspective. A nonlimited theory does not just motivate people to regulate themselves better; instead, it removes a process that undermines self-regulation. Our previous research suggests that a limited theory makes people more sensitive to or more vigilant for cues that signal the availability of mental resources, like perceived exhaustion or ingested glucose (Job et al., 2010, 2013). From this perspective people with a limited theory perform worse under high demands because as soon as they experience even low-level signs of strain or exhaustion (as soon as they perceive any “depletion”) they begin to reduce effort on the task at hand. Instead of staying focused on a demanding task they turn toward saving and/or replenishing their presumably limited resources. Thus, willpower theories are not simply another variable that changes the incentive value of a task. Rather, by affecting the fundamental assumptions

people make about the nature and workings of willpower, they can change how people approach and enact self-regulation itself.

The present results suggest that a nonlimited theory of willpower is functional in a student sample facing high demands and likely in other populations facing self-regulation challenges. But if so why do many people believe that willpower is limited? Vohs and colleagues (2013) argued that if a nonlimited theory were beneficial, these benefits would have led the theory to spread across individuals and cultures. But a belief need not be functional to spread. It just has to be simple and appealing (Bangerter & Heath, 2004; Dawkins, 2006; Wagner, Kronberger, & Seifert, 2002). A fixed mindset about intelligence (the belief that intelligence is fixed not malleable) is a simple and widespread idea that can have clear negative effects, for instance in undermining students' resilience and academic achievement (Blackwell et al., 2007; Dweck & Leggett, 1988; Hong et al., 1999). Further, both a fixed mindset about intelligence and a limited theory about willpower can have psychological benefits; for instance, as a justification for putting forth low effort in the face of challenging tasks or temptations (see, e.g., Job et al., 2010; Robins & Pals, 2002).

Although a limited theory might serve some psychological functions, the present research documents its costs. The ability to self-regulate successfully is one of the most robust predictors of major life outcomes, including health, wealth, and well-being (Moffitt et al., 2011). A critical question for future research involves better understanding the causal effects of willpower beliefs in everyday settings and, if causal, how to change these beliefs to increase self-regulatory success. Laboratory studies show that implicit theories about willpower can be manipulated and that their effects when manipulated parallel their effects when measured (Job et al., 2010, 2013; Miller et al., 2012). Thus it seems probable that willpower beliefs have causal effects in everyday life settings and, in these settings too, they may be changed. Nevertheless, randomized field experiments that manipulate willpower

beliefs and examine everyday self-regulatory outcomes are necessary to establish causality. Such field experiments would also test a novel means to improve people's self-regulatory outcomes, a pressing issue (Diamond, 2012; Duckworth, Grant, Loew, Oettingen, & Gollwitzer, 2011). Previous field experiments show that it is possible to change people's implicit theories about intelligence and personality in field settings, with beneficial consequences including for academic performance (Aronson et al., 2002; Blackwell et al., 2007) and social outcomes (Yeager et al., 2013). Such interventions give people information (e.g., scientific reports) about the nature of human qualities and help them internalize this information using powerful persuasive techniques (e.g., "saying-is-believing" exercises, Aronson, 1999; see also Yeager & Walton, 2011). Could this approach change people's beliefs about the nature of willpower in a relatively enduring way?

Importantly, it may be essential to pair such learning opportunities with information about effective strategies that can help people avoid self-regulatory failures. Although the present research did not examine self-regulation strategies, these strategies may be an important consideration in the development of interventions to promote a nonlimited theory about willpower. Ironically, simply learning that willpower is stronger than one might have supposed could backfire if this encourages people to put themselves in situations they are ill-equipped to deal with (e.g., keeping temptations close at hand in the belief that they will be able to resist them indefinitely). Effective self-regulation strategies may involve formulating plans to cope with temptations (e.g., implementation intentions) or structuring one's environment to avoid temptations (e.g., putting junk food in a high cabinet, blocking Facebook while trying to study) (Duckworth et al., 2011; Magen & Gross, 2007; Neal, Wood, & Drolet, 2013; Stadler, Oettingen, & Gollwitzer, 2010; Webb & Sheeran, 2003). Both for broad populations in demanding environments (e.g., students) and for clinical populations (e.g., diabetics), it would be exciting if exercises to teach people a nonlimited theory plus

effective self-regulatory strategies could increase their success as they face stressful demands and strive to accomplish their goals.

PART II

Beliefs About Willpower are Related to Diabetes Self- Management and Psychological Adjustment in Patients with Type 2 Diabetes

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Abstract

Research demonstrates that the belief that willpower is a limited resource that gets easily depleted (limited theory) undermines self-control performance, particularly when people face high self-regulatory demands (Job et al., 2010). We hypothesized that endorsing a limited theory about willpower is associated with worse self-management and psychological adjustment in patients with diabetes type 2. Seventy-nine patients with type 2 diabetes (35 female, age range: 28-87 years) reported their willpower theories, diabetes self-management (i.e., self-care, diet, exercise) and psychological adjustment (i.e., emotional distress, well-being, life quality). As predicted, endorsing a limited theory was associated with worse diabetes self-management and psychological adjustment. Further, the effects of willpower beliefs on self-care and emotional distress were moderated by diabetes duration. Patients with longer diabetes duration probably develop routines that substitute self-control and make willpower beliefs less influential. Results suggest that beliefs about willpower are important for the successful management of and adjustment to diabetes.

Introduction

Diabetes is one of the most common chronic diseases today with a global prevalence of more than 285 million patients (Shaw et al., 2010). The management of the disease demands patients to follow a complex self-care regimen, because they otherwise risk severe short-term complications (e.g., hyperglycemia) and long-term consequences (e.g., cardiovascular disease, mortality) (e.g., Andersson & Svärdsudd, 1995). Many aspects of a typical diabetes regimen, such as monitoring one's blood sugar levels, having to follow a strict diet, or engaging in physical activity, require self-control (Turner et al., 1999). Self-control is the capacity to alter one's thoughts, emotions, and behavior to support the pursuit of long-term goals (Baumeister, Vohs, & Tice, 2007).

The prominent strength model of self-control suggests that this important capacity relies on a limited resource that gets depleted with every act of self-control (Baumeister, Vohs, & Tice, 2007). According to this model previous exertion of self-control undermines future attempts to self-control due to resource depletion. For patients with diabetes, who have to deal with constant self-control demands, the model would predict that permanent compliance with the regimen is very unlikely, if not impossible.

Challenging the assumptions of the strength model, recent research demonstrates that how people respond to self-control demands depends on their beliefs—or implicit theories—about willpower (Job et al., 2010). Some people believe that their willpower is limited and gets depleted by exerting self-control (*limited theory*), while others believe that their willpower is not limited and can even get activated by self-control exertion (*nonlimited theory*). Implicit theories about willpower can be measured for different domains of self-control that are relevant for the context of diabetes, such as remaining in strenuous mental activities or resisting temptations. For instance, people indicate how much they agree with items such as “Resisting temptations makes you feel more vulnerable to the next temptations

that come along” (reflecting a limited theory) or “After you have resisted temptations your capacity to face upcoming temptations is still the same” (reflecting a nonlimited theory). The term “implicit theory” does not refer to the mode of measurement but to the fact that people are not aware of their beliefs about willpower and of the effects they have on their behavior.

Previous studies found that when people engaged in a self-control task (e.g., crossing out “e”s from a text according to a complicate rule), people with a limited theory performed worse in a subsequent self-control task (e.g., Stroop task) than people with a nonlimited theory (Job et al., 2010). Importantly, the effects replicated when theories about willpower were induced and not measured, suggesting their causal role (Job et al., 2010; see also Miller et al., 2012).

More pertinent to the present research, a field study suggests that willpower theories predicted self-control, particularly in times when self-control demands accumulate (Job et al., 2010, Study 4). The study found that during the commencement of their final exams, students with a limited theory reported worse self-control performance (e.g., a less healthy diet) than their nonlimited fellows. In the middle of the semester, when self-control demands were low, willpower theories did not predict self-control (Job et al., 2010, Study 4).

Building upon this previous findings the present study examined whether endorsing a limited theory about willpower undermines self-management and psychological adjustment in patients with type 2 diabetes. Because most diabetes regimen are complex and cover different domains of self-control, we measured willpower theories in the domain of strenuous mental activity, strenuous physical activity, and resisting temptations. Thereby, the latter two should be most predictive value for patients’ diet and level of physical activity. To rule out that willpower theories simply reflected individual differences in people’s general ability to self-control we also assessed and controlled for patients’ trait self-control (Tangney et al., 2004).

Further, we expected that willpower theories have a stronger influence on outcomes among newly diagnosed patients. According to dual process theories a behavior can generally be guided by reflection (i.e., self-control) or automatic processes (i.e., habits) (Rothman et al., 2009). Reflective processes are particularly important for the execution of new behavior. Over time when the same behavior is often repeated within the same context it gradually it becomes habitual, that means it becomes automatically enacted when cued by the environment (Aarts, Paulussen, & Schaalma, 1997). Thus, it was expected that the longer a patient's disease history the less influential are willpower theories, because less self-control is required for the diabetes management. To rule out that moderations with diabetes duration are confounded with the age of patients or the presence of comorbid conditions these factors were controlled in the moderation analyses.

Method

Participants

Seventy-nine diabetes type 2 patients (35 female, 44 male, $M = 63.8$ years, Range: 28-87 years) were recruited in information centers, support groups, doctors surgeries in Germany and Switzerland and in online forums. To treat their condition 28 indicated taking medication, 16 taking insulin, 31 taking both, and 3 were only monitoring their diet and exercise.

Procedure and Measures

Participants filled in a 15-minute online or paper-pencil survey. Table 1 summarizes the descriptive statistics and reliability of the measures.

Implicit theories about willpower. Implicit theories about willpower were measured for three different self-control domains, namely strenuous mental activity, resisting temptations, and strenuous physical activity. The scale for strenuous mental activity and

resisting temptations has previously been introduced by Job and colleagues (2010). For the purpose of this study we designed a new scale measuring willpower theories in the domain of strenuous physical activity (e.g., “After engaging in a strenuous physical task, your energy resources is usually depleted and you must rest to get it refueled again”, 1 = *Strongly disagree* to 6 = *Strongly agree*). Each subscale was assessed with four items. The 12 items built a homogenous scale (see Table 4 for reliability information) and were thus averaged to a summary index of willpower theories. But we also tested whether the single subscales would predict behavior referring to the respective self-control domain (e.g., willpower theory on strenuous physical task predicting physical activity; willpower theory on resisting temptations predicting diet). High scores on each scale reflected greater agreement with a limited theory.

Diabetes specific self-care. Participants answered seven items about their diabetes care within the past month (e.g., “Within the last month, how often did you control your blood sugar levels?”, 1 = *Less than once per day* to 6 = *Five or more times per day*; ., “Within the last month, how often did you keep record of your blood sugar levels?”, 1 = *Never* to 6 = *Every day*; “Within the last month, how often did you forget to take your diabetes medication/did you forget insulin injections?”, 1 = *Ca. once per day* to 5 = *Never*; “Within the last month, how often did you have light hyper-/hypoglycemia?” 1 = *Less than once per month* to 5 = *Multiple times per day*). Answers on each item were z-transformed and then averaged to one index of diabetes self-care with high values reflecting better self-care.

Diet and exercise. Four items taken from the Summary of Diabetes Self-Care Activities Measure (Toobert, Hampson, & Glasgow, 2000) measured eating behavior (e.g., “How many of the last seven days have you followed a healthful eating plan?”, 0 to 7) and two items measured frequency of physical exercise (e.g., “On how many of the last seven days did you participate in at least 30 minutes of physical activity? (Total minutes of continuous activity, including walking)”, 0 to 7). The items were averaged for each scale.

Diabetes specific emotional distress. Emotional distress from diabetes was assessed with the Problem Areas in Diabetes Scale (Welche et al., 1997), which measures negative feelings related to the disease and its treatment, including worry, depressed mood, and fear. Two subscales with 14 items were administered (e.g., “Feeling constantly burned out by the constant effort to manage diabetes”, 0 = *Minor problem* to 4 = *Serious problem*).

Subjective well-being. Five items of the German version of the WHO-5 scale (Brähler, Mühlhan, Albani, & Schmidt, 2007) assessed participants’ well-being (e.g. “Over the last two weeks...I have felt cheerful and in good spirits.”, 1 = *Never* to 6 = *All the time*).

Life quality. Participants rated their life quality on one item (i.e., “In general my current life quality (overall condition in current life situation) is...”, 1 = *Very poor* to 7 = *Excellent*).

Body mass index. The body mass index (BMI) was calculated from two items assessing height and weight (i.e., “Please indicate your height (in m)/ weight (in kg): [open response]”) by dividing the reported weight by the squared height.

Trait self-control. Participants filled in the German version of the Trait Self-Control Scale (Bertrams & Dickhäuser, 2009) consisting of 13 items (e.g., “I am good at resisting temptations.”, 1 = *Not at all like me* to 5 = *Very much like me*).

Diabetes duration. Participants indicated the month and year they were diagnosed, which was used to calculate the number of years since the diagnosis.

Comorbid conditions. Presence of seven common comorbid conditions of diabetes type 2 were assessed (i.e., “cardiovascular disease”; “eye diseases”, “kidney disease”; “gum diseases/tooth decay”, “skin diseases”, “nervous diseases”, “other diseases”). Participants indicated the presence of each condition on a dichotomous scale (0 = *No* to 1 = *Yes*).

Results

Table 4 shows the bivariate correlations among the main variables of the study. Willpower theories were significantly related to BMI and trait self-control. The more people endorsed a limited theory the higher was their BMI and the lower was their trait self-control. To rule out confounding effects of both factors on diabetes self-management and psychological adjustment, we controlled for BMI and trait self-control in the main analyses.

Table 4

Descriptive Statistics and Zero-Order Correlations of the Main Measures

Variable	α	M	SD	Min	Max	1	2	3	4	5	6	7	8	9	10
1. Willpower Theory	.80	3.45	0.77	1.40	6.00										
2. Diabetes Specific Self-Care ^a	-	0.16	0.54	-1.64	1.20	-.26									
3. Diet	.67	5.73	1.41	0.00	7.00	-.10	.10								
4. Exercise	.64	3.29	1.92	0.00	7.00	-.30	-.13	.11							
5. Diabetes Specific Emotional Distress ^b	.92	0.25	0.16	0.00	0.70	.48	-.16	-.08	-.07						
6. Subjective Well-Being	.92	4.12	1.23	1.40	6.00	-.53	.09	.00	.44	-.47					
7. Life Quality	-	4.97	1.04	3.00	7.00	-.47	.12	.02	.34	-.56	.76				
8. BMI	-	29.26	6.06	21.23	49.94	.25	.09	-.27	-.41	.33	-.18	-.27			
9. Trait Self-Control	.83	3.63	0.71	1.89	5.00	-.40	.20	.25	.05	-.35	.22	.21	-.32		
10. Diabetes Duration	-	15.53	12.06	0.17	44.74	-.12	.19	.15	.05	-.14	.24	.21	-.04	-.03	
11. Comorbid Conditions	-	0.96	1.20	1.00	5.00	-.02	.16	-.01	-.11	.13	-.23	-.18	.06	-.04	.05

Note. Higher scores reflected greater agreement with a limited theory, higher trait self-control, better self-care, healthier diet, more exercise, higher subjective well-being, higher life quality, more diabetes specific distress. Correlations above $r = |.19|$ are significant at $p < .05$. BMI = body mass index. ^aScale from different z-transformed indicators. ^bScale was log-transformed to correct for skewness.

Table 5

Hierarchical Regression Analyses Predicting Diabetes Self-Management and Psychological Adjustment

Predictor	Measures of Diabetes Management									Measures of Psychological Adjustment								
	Self-Care			Diet ^a			Exercise ^b			Emotional Distress			Subjective Well-Being			Life Quality		
	ΔR^2	β	<i>p</i>	ΔR^2	β	<i>p</i>	ΔR^2	β	<i>p</i>	ΔR^2	β	<i>p</i>	ΔR^2	β	<i>p</i>	ΔR^2	β	<i>p</i>
Step 1	.08		.052	.10		.019	.17		.001	.17		<.001	.06		.092	.09		.038
BMI		.18	.127		-.21	.086		-.46	<.001		.23	.036		-.12	.366		-.22	.073
Trait Self-Control		.28	.022		.19	.107		-.05	.725		-.30	.019		.19	.111		.14	.245
Step 2	.06		.027	.03		.089	.05		.037	.12		.001	.19		<.001	.15		<.001
BMI		-.21	.068		-.19	.110		-.43	<.001		.18	.070		-.06	.625		-.17	.130
Trait Self-Control		.16	.196		.10	.390		-.14	.508		-.13	.316		-.01	.936		-.04	.721
Willpower Theory		-.28	.027		-.21	.089		-.21	.037		.40	.001		-.50	<.001		-.44	<.001
$f^2_{\text{Willpower Theory}}$.07			.03			.06			.17			.25			.20		

Note. Higher scores reflected higher BMI, higher trait self-control, greater agreement with a limited theory, better self-care, healthier diet, more frequent exercise, higher emotional distress, better subjective well-being, and better life quality. BMI=Body Mass Index. ^aSubscale of willpower theory for resisting temptations used for the analysis. ^bSubscale of willpower theory for strenuous physical activity used in the analysis.

We conducted hierarchical regression analyses predicting the outcome measures for self-management and lower psychological adjustment by (z-standardized) BMI and trait self-control in the first block of the model and (z-standardized) willpower theory in the second block. The results are summarized in Table 5. As expected, endorsing a limited theory was significantly correlated with worse diabetes self-management (i.e., lower diabetes self-care, unhealthy diet [marginal significant], less frequent physical exercise) and lower psychological adjustment (i.e., higher diabetes specific emotional distress, lower subjective well-being, and lower life quality). According to Cohen (1988) the effect sizes of the variance explained by willpower theory ($f^2_{\text{Willpower Theory}}$) were small for the indicators of diabetes management and large for indicators of psychological adjustment.

Further, there was evidence for the expected domain-specificity of willpower theories. The effect on diet was marginal significant only for willpower theories in the domain of resisting temptations. Similarly, the effect on frequency of physical exercise was only significant for willpower theories in the domain of physical strenuous activity. Neither outcome was significantly predicted by the domain-unrelated subscales or by the averaged scale.

Finally, we tested whether the effects of willpower theories were moderated by diabetes duration. Regression analyses were conducted to predict all six indicators of diabetes self-management (i.e., self-care, diet, and exercise) and psychological adjustment (i.e., emotional distress, subjective well-being, life quality) by willpower theories, diabetes duration and their interaction term. Additionally, age and the number of comorbid conditions were controlled in the regression model to rule out confounding effects. The interaction between willpower theory and diabetes duration was significant for diabetes specific self-care, $\beta = .30$, $t(72) = 2.65$, $p = .010$, and diabetes related emotional distress, $\beta = -.23$, $t(72) = -2.33$, $p = .023$. The interactions are depicted in Figure 5. Simple slopes analyses revealed that the effect of willpower theories on self-care was significant among newly diagnosed patients (-

1SD), $b = -.32$, $se_b = .10$, $t(77) = -3.38$, $p < .001$, but not significant for longer diagnosed patients (+1SD), $t < 1$. Similarly, for emotional distress the effect of willpower theories was larger for newly diagnosed patients (-1SD), $b = .12$, $se_b = .02$, $t(77) = 4.87$, $p < .001$, than for those longer diagnosed (+1SD), $b = .04$, $se_b = .02$, $t(77) = 2.09$, $p = .004$. For the other four outcomes (i.e., diet, exercise, subjective well-being, and life quality) the interaction effects were not significant, $ts < 1$. Here, a nonlimited theory was related to better outcomes, even in patients with longer diabetes duration.

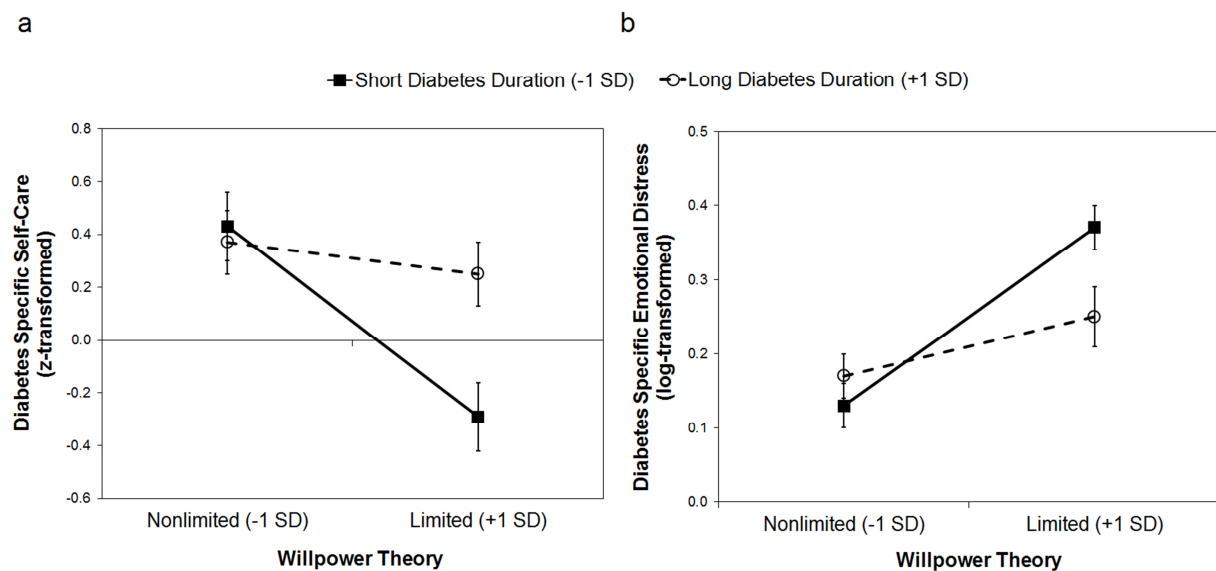


Figure 5. Effects of implicit theories about willpower on diabetes specific self-care and emotional distress moderated by diabetes duration. Error bars indicate +/-1SE.

General Discussion

The present findings suggest that endorsing a limited theory about willpower is associated with worse self-management and psychological adjustment in patients with type 2 diabetes. Patients with a limited theory reported less self-care, a less healthy diet, and lower levels of physical activity. They also reported higher emotional distress from the disease, experienced lower subjective well-being, and higher life quality. The effect of willpower theories on self-care was moderated by diabetes duration. The findings suggest that the longer

the disease history of the patient the lower is the impact of willpower theories. We suspect that over time self-care behaviors, such as regular blood sugar monitoring, become habitual, which means that they are automatically enacted and less dependent on self-control (Rothman et al., 2009). The effects of willpower theories on diet and exercise were not moderated by diabetes duration, indicating that diet and exercise remain an issue of self-control even when people are diagnosed for a longer time. These findings are in line with previous intervention studies suggesting that people have a harder time to change their lifestyle with respect to their diet and exercise than to develop self-care routines (Rubin, Peyrot, & Saudek, 1991).

With regard to psychological adjustment the effects of willpower theories on subjective well-being and life quality were independent from diabetes duration, while the effect on diabetes specific emotional distress was dependent on the specific burden of the disease. Newly diagnosed patients reported higher distress the more they believed that their willpower is limited. Among patients with longer disease history the effect of a limited theory was still significant but less pronounced. This result parallels the findings for diabetes self-management. Self-care habits might ease the handling of the disease and thereby lower the levels of distress associated with it. However, to test these predictions, further studies are needed. Future studies should investigate the development of self-care habits in type 2 diabetes patients using longitudinal designs and examine whether the formation of habits explains the weaker influence of willpower theories over time.

To conclude, it is well established in the literature that how well patients comply with their diabetes regimen has a great impact on patients' general health and longevity (Andersson & Svärdsudd, 1995; Klein et al., 1996). The present study is the first to show that beliefs about willpower, a socially shaped, psychological variable might also be of considerable importance for effective self-management in type 2 diabetes.

PART III

Implicit Theories About Willpower Predict Well-Being

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Abstract

Field research shows that people's lay theories about willpower—whether they believe it is a limited or nonlimited resource—predict self-control and successful goal striving in everyday life (Job et al., 2010). Three studies examine whether the negative effect of a limited theory about willpower on goal striving radiates to peoples' subjective well-being. Study 1 ($n = 258$) finds that a limited theory is related to lower subjective and physical well-being. In Study 2 ($n = 196$), a limited theory predicts negative change in subjective well-being over a period of six months, independent of participants' trait self-control. Study 3 ($n = 167$) finds that the effect of willpower theories on well-being is mediated by perceived availability of resources and personal goal progress. People with a limited theory seem to make less progress on their personal goals, because they perceive a lack of important goal-relevant resources, leading to lower well-being.

Introduction

Self-control is essential for the pursuit of long-term goals, because it enables people to forego immediate needs and direct their behavior toward long-term objectives (Baumeister, 2002; Carver & Scheier, 1982; Duckworth, 2011). For instance, people need self-control to stay concentrated on a strenuous mental task, to resist temptations, and to control unwanted emotions (Baumeister, Vohs, & Tice, 2007).

Recent research suggests that self-control depends on people's beliefs—or implicit theories—about willpower (Job et al., 2010). Some people believe that their willpower resembles a limited resource that gets easily depleted (*limited theory*), whereas others believe that willpower is not limited and can get activated by exerting self-control (*nonlimited theory*). Endorsing a nonlimited theory has been found to be beneficial for self-control in everyday life, sustained learning, and even for students' academic performance (Job et al., 2010; Job, Walton, Bernecker, & Dweck, 2015; Miller et al., 2012). However, the gains of holding a nonlimited theory about willpower for self-control and achievement outcomes might come at costs to individuals' subjective well-being. Lately, it has been argued that a nonlimited theory might undermine people's natural tendency to conserve mental resources and put them at risk to suffer from "severe depletion" (Vohs et al., 2013). In contrast to this assumption, a recent field study demonstrates that under high real-world demands students with a nonlimited theory do not show signs of depletion but, on the contrary, reach their best performance (Job, Walton, et al., 2015). Still, it seems plausible that advantages caused by simply believing in nonlimited willpower might backfire in some way or the other. For instance, if people with a nonlimited theory frequently neglect their immediate needs and abstain from pleasures in life, this might have negative consequences for their subjective well-being (Hofmann et al., 2013). Thus, the question is: Are people with a nonlimited theory less happy than their fellows who think that willpower is limited? We argue against this idea and

hypothesize that endorsing a nonlimited theory is related to higher subjective well-being because it promotes progress toward personal goals (Brunstein, 1993; Emmons, 1986).

Implicit Theories About Willpower and Self-Control

Implicit theories about willpower can be assessed by asking people how much they agree with items, such as “After a strenuous mental activity, your energy is depleted and you must rest to get it refueled again” (reflecting a limited theory) or “After a strenuous mental activity, you feel energized for further challenging activities” (reflecting a nonlimited theory). The term “implicit theory” does not refer to the method of measurement, which is clearly explicit, but to the fact that people are usually not aware about their lay beliefs and the effects these beliefs may have on their behavior.

Experimental studies suggest that implicit theories about willpower moderate the so called *ego depletion effect*, which describes the finding that self-control usually relapses on the second of two subsequent self-control tasks (Hagger, Wood, Stiff, & Chatzisarantis, 2010; Muraven & Baumeister, 2000; but see Carter & McCullough, 1998). However, Job and colleagues (2010) found that only among people, who endorsed a limited theory—those who believed that their willpower is limited and gets easily depleted—self-control performance declined in response to previous self-control efforts. Individuals, who endorsed a nonlimited theory, maintained their self-control performance on a high level despite of previous self-control exertion. Importantly, this pattern of results was replicated when willpower theories were manipulated, suggesting their causal role (Job et al., 2010; Miller et al., 2012; for similar findings see Hamburg & Pronk, 2015; Salmon, Adriaanse, De Vet, Fennis, & De Ridder, 2014).

Further, field studies showed that a limited theory predicts self-control performance in everyday life (Job et al., 2010; Job, Walton, et al., 2015). In one study, students were surveyed three times over the course of one academic quarter, once at the beginning, the

middle, and the end (Job et al., 2010, Study 4). Students, who held more of a limited theory at the beginning, reported more self-control failure at the end; they procrastinated more and consumed more high-fat or high-sugar foods as compared to students with a nonlimited theory. Most pertinent to the present research, students with a limited theory reported lower self-regulation with respect to a challenging personal goal that they had named at the beginning of the study. For example, they reported that they were often not in the mood to pursue the goal or that they got easily distracted from doing something for their goal (Job et al., 2010, Study 4). Taken together, these results suggest that a limited theory undermines self-regulation in everyday life and impedes successful goal pursuit. Building on these findings, we propose that a limited theory about willpower harms subjective well-being, because it impedes progress on personal goals.

Goal Progress and Subjective Well-Being

Within the past 30 years, research on subjective well-being has shown that having goals and making progress toward them contributes to high subjective well-being (Diener et al., 1999). Personal goals embrace individual meaning and describe what a person is striving for in the current life situation and what he or she wants to attain or avoid in the future (Brunstein & Maier, 2002). Past findings suggest that goal progress predicts higher levels of cognitive (i.e., life satisfaction) and affective well-being (Brunstein, 1993; Emmons, 1986; Sheldon & Elliot, 1999). For instance, one longitudinal study found that students' progress toward personal goals within one semester predicted higher life satisfaction and affective well-being at the end of the semester (Brunstein, 1993). Similarly, findings from a diary study suggest that progress on work-related goals increases positive affect over the course of a workday (Harris, Daniels, & Briner, 2003). A recent meta-analysis summarized the findings of 85 studies and found a significant association between successful goal striving and subjective well-being ($\rho = .43$, 95% CI [.39, .47]; Klug & Maier, 2014).

In the present research, we link research on personal goals and subjective well-being with previously reported findings that suggest beneficial effects of a nonlimited theory about willpower on personal goal-striving. We hypothesize that implicit theories about willpower are related to affective and cognitive well-being and that this link is mediated by personal goal progress. Further, we investigate whether willpower theories also affect people's physical well-being. Past research found that health status is positively related to life satisfaction and affective well-being (Diener et al., 1999; Okun & George, 1984; Okun, Stock, Haring, & Witter, 1984). Therefore, willpower theories might be related to physical well-being through its relationship with life satisfaction and affective well-being.

Perceived Availability of Resources: An Additional Mediator

The model tested in the present research connects implicit theories about willpower with well-being via personal goal progress, connecting previous findings on the single paths between (a) willpower theories and goal-striving, on the one hand, and (b) goal-striving and well-being, on the other hand. However, the present research takes a further step, going beyond the previously established paths. We aim to provide deeper insights into the mechanism accounting for the positive effect of believing in nonlimited willpower on personal goal progress and, in turn, on high subjective well-being. We hypothesize that implicit theories about willpower affect goal progress by shaping people's perceptions about the availability of goal-relevant resources.

In line with the previous literature, we define resources as “material, social, or personal characteristics that a person possesses that he or she can use to make progress toward her or his personal goals” (Diener & Fujita, 1995, S. 926; see also Halbesleben, Neveu, Paustian-Underdahl, & Westman, 2014). Diener and Fujita (1995) created a list of material resources (e.g., money), social resources (e.g., social support, influential connections), and personal resources (e.g., self-discipline, stress resistance) and found that the availability of

these resources was positively correlated with subjective well-being. They argued that resources are related to well-being, because they support progress on personal goals. As indirect support for their hypothesis, they found that the relationship between resources and subjective well-being was moderated by the degree to which these resources were relevant for participants' personal goals. Availability of goal-relevant resources was more strongly related to subjective well-being resources than availability of goal-irrelevant resources (Diener & Fujita, 1995). Taken together, these findings suggest that the availability of (goal-relevant) resources predicts well-being due to their positive effect on goal progress.

In the present research, we adopt this reasoning and add the assumption that theories about willpower shape people's perception of the availability of resources. People who endorse a limited theory believe that their willpower is limited and that every act of self-control consumes willpower resources. We assume that this theory directly affects the perception of the availability of personal resources, such as self-discipline or stress resistance. People with a limited theory should naturally think that they have less of these personal resources available, because they believe these resources vanish with every use. However, the effect might also carry over to the perception of material and social resources, such as time and social support. If a person believes that he or she has limited self-discipline, he or she might also expect to need more time to reach his or her goals. Time for rest and recovery has to be included in the budget. Therefore, the perception of available time for a personal goal might be affected by one's implicit theory about willpower. Further, maintaining one's social network requires time and personal resources. If willpower theories affect these two categories then they might also affect the perceived availability of social support. People with a limited theory might not ask for social support, because they think they will not have enough strength and time to reciprocate the support. Therefore, implicit theories about willpower might affect the perceived availability of personal (e.g., self-discipline), material

(e.g., time), and social resources (e.g., social support). Taken together, we expect that implicit theories about willpower affect well-being, because they have an effect on the progress people make on their personal goals via shaping people's perception about the availability of resources.

Overview

Three studies investigate whether implicit theories about willpower affect well-being and test the proposed mediating processes. Study 1 establishes the relationship between implicit theories about willpower and subjective as well as physical well-being using a cross-sectional correlational design. Longitudinal Study 2 examines whether implicit theories about willpower predict a change in subjective well-being and whether the effect is independent of trait self-control. Last, Study 3 tests whether the effect on change in well-being is mediated by perceived availability of resources and goal progress. In sum, the studies test the following hypotheses:

Hypothesis 1. Implicit theories about willpower are correlated with subjective and physical well-being. The more people endorse a limited versus nonlimited theory, the lower is their level of well-being (Study 1).

Hypothesis 2. Implicit theories about willpower predict longitudinal change in subjective well-being. The more people endorse a limited versus nonlimited theory, the lower is their later level of subjective well-being, when controlling for previous levels of well-being and trait self-control (Study 2).

Hypothesis 3. The relationship between implicit theories about willpower and change in subjective well-being is mediated by the perceived availability of resources and goal progress (Study 3).

Study 1

The purpose of this study was to provide preliminary evidence for our hypothesis that a nonlimited theory is associated with higher levels of well-being, indicated by life satisfaction, affective well-being, and physical well-being in a diverse adult sample.

Method

Participants. We recruited a sample of 258 Swiss and German working adults (163 women, 95 men, $M_{\text{age}} = 39.2$ years, age range: 18-65 years) on different internet forums on stress and burnout.³ Participants filled in a 60-minute online questionnaire in return for monetary compensation. The sample was diverse regarding employment and family status (148 worked fulltime, 56 worked part time, 36 were self-employed, six students, four retired workers, and eight indicated a different employment, 110 indicated having at least one child).

Measures and Procedure

Implicit theories about willpower. Implicit theories about willpower were assessed with a 6-item scale (Job et al., 2010). Three items reflected a limited theory (e.g., “After a strenuous mental activity your energy is depleted and you must rest to get it refueled again”), and three items a nonlimited theory (e.g. “Your mental stamina fuels itself; even after strenuous mental exertion you can continue doing more of it”). Participants indicated how much they agreed with these items on a 6-point scale (1 = *Strongly disagree*; 6 = *Strongly agree*). Items reflecting a nonlimited theory were recoded before all items were averaged to one measure of implicit theory about willpower ($\alpha = .83$). Higher scores on the scale reflect higher agreement with a limited theory.

Life satisfaction. The German version of the satisfaction with life scale was administered to assess life satisfaction (Glaesmer, Grande, Braehler, & Roth, 2011).

³ The study was part of a larger research project on implicit motives and burnout and included other variables not of interest for the present research question.

Participants were asked to judge their current satisfaction with life on five items (e.g., “In most ways my life is close to my ideal”). The statements were rated on a 7-point scale (1 = *Do not agree at all*; 7 = *Perfectly agree*). The items were averaged to one index of life satisfaction with high scores representing high life satisfaction ($\alpha = .91$).

Affective well-being. The multidimensional mood questionnaire assessed participants’ affective well-being (Steyer, Schwenkmezger, Notz, & Eid, 1997). It measures mood on three dimensions, namely pleasantness (pleasant to unpleasant), alertness (awake to tired), and serenity (serene to restless) with 16 mood items, eight for the dimension pleasantness (e.g., “happy”, “dissatisfied” [recoded], $\alpha = .96$), four for the dimensions alertness (e.g., “awake”, “tired” [recoded], $\alpha = .88$), and four for the dimension serenity (e.g., “serene”, “restless [recoded], $\alpha = .86$). Participants indicated how they recently felt on a 5-point scale (1 = *Not at all*; 5 = *Very much*). The items of each dimension were averaged with higher scores reflecting more positive mood.

Physical well-being. Physical well-being was assessed with a physical symptom checklist adopted from Emmons (1991). Participants indicated how frequently they experience the following symptoms in their everyday life: headaches, stomachache/pain, chest/heart pain, stiff/sore muscles, runny or congested nose, coughing/ sore throat, faintness/dizziness/shortness of breath. Participants indicated the frequency of each category of symptoms on a 5-point scale (1 = *Multiple times per week*; 5 = *Never*). Items were recoded and averaged for each participant. Participants further indicated how often they were taking four groups of medication in their everyday life (i.e., “painkillers”; “stimulating drugs”; “calming drugs”; “other drugs”, 1 = *Multiple times per week*; 5 = *Never*). Items were recoded and averaged for each participant. Participants further answered one item assessing sleep problems (i.e., “How often do you have problems falling asleep?”, 1 = *Multiple times per week*; 5 = *Never* [recoded]), and one item asking about the number of visits to the doctor

within the past six months (i.e., “How often did you visit a doctor within the past 6 months?”; open response).

Results and Brief Discussion

To test the relationship between implicit theories about willpower and well-being, we first calculated zero-order correlations (see Table 6). There was a significant correlation between implicit theories about willpower and life satisfaction. The more participants endorsed a limited theory the lower was their life satisfaction. Further, implicit theories about willpower were significantly correlated with all three mood dimensions. The more participants endorsed a limited theory, the more frequently they experienced unpleasant mood states and feelings of fatigue and agitation. According to convention, the effects were of moderate size (Cohen, 1988). Further, a limited theory about willpower was associated with lower physical well-being, namely more physical symptoms, more frequent intake of medication, more frequent sleep problems, and more doctor’s visits within the past six months. The effects were small to moderate in size (Cohen, 1988).

Next, we calculated partial correlations to test whether the effect of willpower theories on life satisfaction was still significant when controlling for affective or physical well-being. The partial correlation between implicit theories about willpower and life satisfaction was significant when affective well-being (all three indicators) was controlled, $r(253) = -.21, p < .001$, and when indicators of physical well-being were controlled, $r(247) = -.24, p < .001$. These findings suggest willpower theories have an effect on life satisfaction independent of their effect on affective and physical well-being.

Further, we tested whether the effects of willpower theories on physical well-being can be explained by differences in affective well-being and life satisfaction. When controlling for affective well-being and life satisfaction willpower theories were no longer significantly related to frequency of physical symptoms, $r(252) = .05, p = .428$, visits to the doctor, $r(252)$

= .08, $p = .210$, medication intake, $r(252) = .08$, $p = .222$, and sleep problems, $r(252) = -.05$, $p = .375$. The correlation of willpower theories on physical well-being seems to be due to their effect on affective well-being and life satisfaction. Additionally, we ran a mediation analysis using the indirect macro for SPSS (Preacher & Hayes, 2004). Before we ran the model we calculated one indicator of physical well-being by averaging all (z-transformed) measures of physical well-being and one indicator of subjective well-being by averaging the (z-transformed) measures of affective well-being and life satisfaction. The direct effect of willpower theories on physical well-being (c path) was significant, $b = .30$, $se = 0.05$, $t(250) = 5.69$, $p < .001$, but was not significant when subjective well-being was controlled (c' path) in the model, $b = .03$, $se = 0.04$, $t(250) < 1$, ns . The indirect effect ($a*b$ path) was significantly different from zero, $b = .27$, 95% CI [0.19, 0.38], as indicated by the bias-corrected bootstrapped confidence interval.

In sum, the findings support Hypothesis 1. They suggest that a limited theory is related to lower cognitive, affective, and physical well-being. As indicated by partial correlations the effects of willpower theories on affective and cognitive well-being seem to be independent, while the effect of willpower theories on physical well-being is explained by their effect on life satisfaction and affective well-being. Therefore, the upcoming studies will focus on life satisfaction and affective well-being as measures for subjective well-being. As the findings are based on a cross-sectional dataset, it is not possible to draw any conclusions about causality. Therefore, we conducted a longitudinal study to test whether implicit theories about willpower predict changes in subjective well-being over time.

Table 6

Descriptive Statistics and Zero-Order Correlations for the Main Constructs of Study 1

Variable	<i>M (SD)</i>	<i>Range</i>	1	2	3	4	5	6	7	8
1. Willpower Theories	3.77 (0.86)	1.00-6.00								
2. Life Satisfaction	4.65 (1.36)	1.00-7.00	-0.36							
3. Mood Pleasant-Unpleasant	3.43 (1.19)	1.00-5.00	-0.34	0.55						
4. Mood Awake-Sleepy	2.98 (1.19)	1.00-5.00	-0.32	0.45	0.79					
5. Mood Calm-Stressed	3.15 (1.12)	1.00-5.00	-0.33	0.46	0.77	0.76				
6. Physical Symptoms	2.28 (1.16)	1.00-4.83	0.33	-0.44	-0.72	-0.77	-0.72			
7. Medication Intake	1.64 (0.96)	1.00-5.00	0.28	-0.38	-0.46	-0.48	-0.52	0.57		
8. Sleep Problems	2.46 (1.45)	1.00-5.00	0.20	-0.37	-0.57	-0.55	-0.63	0.59	0.39	
9. Doctor's Visits	2.20 (3.65)	0-25	0.24	-0.32	-0.42	-0.39	-0.38	0.42	0.43	0.30

Note. High scores represent a limited theory, high life satisfaction, higher frequency of positive mood states, frequent physical symptoms, frequent medication intake, frequent sleep problems, and frequent doctor's visits. Correlations above $r > |.11|$ are significant at $p < .05$.

Study 2

This longitudinal study was conducted to test whether implicit theories about willpower predict change in subjective well-being or vice versa. We measured willpower theories and subjective well-being twice over the course of six months. Additionally, this study aims to rule out that effects of implicit theories can be explained by trait self-control, which refers to stable individual differences in self-control behavior (Tangney et al., 2004). Recent research suggests that trait self-control is related to subjective well-being (Hofmann et al., 2013), and that implicit theories about willpower are related to trait self-control (Job, Walton, et al., 2015). Because the trait self-control measure assesses self-control in different domains (e.g., ability to resist temptations, ability to control emotions), we used a broader measure of implicit theories about willpower than in Study 1. Particularly, we assessed beliefs about willpower in three different domains of self-control (i.e., strenuous mental activities, resisting temptations, and emotion control). Therefore, a lack of overlap between the two measures cannot be attributed to a domain-specific assessment of willpower theories.

Method

The present study was part of a larger research project. The measures of interest for this research question were administered at the third and fourth measurement point, which was an online questionnaire (T_1), and in a laboratory session six months later (T_2).⁴ For each measurement point (60 minutes) participants received 20 Swiss Francs or course credit.

Participants

Undergraduate students were recruited with posters and flyers on campus and through announcements in lectures. At T_1 , $n = 196$ students (147 female, 47 male, 2 no indication, $M_{age} = 21.5$, age range: 18-51 years) participated in the study. Six month later, at T_2 , we were able to collect data from $n = 166$ students.

⁴ The study included an ineffective manipulation administered at the second measurement point. The manipulation did not affect any of the measures of interest for the present research question, $F_s < 1$, and controlling for the manipulation in the main analyses did not change the pattern of results.

Measures and Procedure

Implicit theories about willpower. Implicit theories about willpower were assessed with a more comprehensive measure compared to Study 1. We used the same six items as described in Study 1 to assess implicit theories about willpower in the domain of strenuous mental activities. Additionally, two sets of four items assessed willpower theories in the domain of resisting temptations (e.g., “It is particularly difficult to resist a temptation when you had to resist another temptation right before”, “It doesn’t matter how many temptations you are faced with consecutively, your willpower to resist them is still the same“ [recoded], Job et al., 2010), and in the domain of emotion control (e.g., “Having to control a strong emotion makes you exhausted and you are less able to manage your feelings right afterwards”, “Even if you had to keep cool and control your emotions in several different situations in a day, it does not affect your ability to control your emotions in a new situation” [recoded]). Participants indicated how much they agreed with each item on a 6-point scale (1 = *Strongly disagree*; 6 = *Strongly agree*). Again, high values on the averaged measure represent higher agreement with a limited theory about willpower ($\alpha_{T1} = .72$; $\alpha_{T2} = .80$).

Subjective well-being. Subjective well-being was measured with one measure for cognitive and one measure for affective well-being. Cognitive well-being was assessed with the German version of the WHO-5 well-being index (Brähler et al., 2007). The scale consists of five items (e.g., “My life was full of things that interest me”), which participants rated with reference to the previous week on a 6-point scale (1 = *All the time*; 6 = *At no time*). High scores on the averaged index represent higher cognitive well-being ($\alpha_{T1} = .81$; $\alpha_{T2} = .83$). Affective well-being was measured with the same scale as used in Study 1 (Steyer et al., 1997). Participants indicated on 16 items how they recently felt on a 5-point scale (1 = *Not at all*; 5 = *Very much*), which measured positive and negative mood states in three dimensions ($\alpha_{S1} > .78$; $\alpha_{S2} > .80$).

At both measurement points the measures for cognitive and affective well-being were substantially correlated ($.59 < |rs| < .78$, $ps < .001$). An exploratory factor analysis on all 21 items showed a one factor solution for both time points. This factor accounted for 47.29% (all loadings $> .59$, eigenvalues = 8.04) at T_1 and 50.06% (all loadings $> .60$, eigenvalues = 8.51) at T_2 . We calculated an aggregated well-being index for both time points by taking the average of the (z-standardized) cognitive well-being measure and the (z-standardized) affective well-being measure (all items averaged to one indicator of mood, $\alpha s > .90$). For the purpose of brevity we will only report the results of the aggregated index. However, when we tested the model separately for each measure the results were similar for cognitive and affective well-being.

Trait self-control. Trait self-control was assessed with the German version of the trait self-control scale (Bertrams & Dickhäuser, 2009). The scale consists of 13 items (e.g. “I am good at resisting temptation”, “I do certain things that are bad for me, if they are fun” [recoded]). Participants were asked to rate each item with respect to how much it reflected their typical behavior on a 5-point scale (1 = *Not at all like me*; 5 = *Very much like me*). On the averaged scale high values represented higher trait self-control ($\alpha_{T1} = .77$; $\alpha_{T2} = .82$).

Results

Correlational analyses. Descriptive statistics and bivariate correlations for the main variables are summarized in Table 7. First, implicit theories about willpower at T_1 and T_2 were highly correlated, suggesting that implicit theories about willpower were stable over a period of 6 months, which is a precondition for the hypothesized long-term effect on subjective well-being. Second, replicating the findings of Study 1, implicit theories about willpower at T_1 were significantly correlated with subjective well-being at T_1 . Again, the more participants endorsed a limited theory the lower was their subjective well-being. Third, there was a significant negative correlation between implicit theories about willpower and

trait self-control, both at T₁ and T₂. People who agreed more with a limited theory had lower trait self-control. However, the correlation was only of moderate size suggesting that willpower theories and trait self-control represent separate constructs.

Table 7

Descriptive Statistics and Zero-Order Correlations for the Main Constructs of Study 2

Variable	<i>M (SD)</i>	<i>Range</i>	1	2	3	4	5
1. Willpower Theories (T ₁)	3.46 (0.51)	2.07-4.79					
2. Willpower Theories (T ₂)	3.38 (0.60)	1.57-5.00	.61				
3. Trait Self-Control (T ₁)	3.21 (0.57)	1.77-4.77	-.40	-.34			
4. Trait Self-Control (T ₂)	3.25 (0.60)	1.77-4.70	-.34	-.40	.72		
5. Subjective Well-Being (T ₁)	0.00 (0.95)	-2.67-1.90	-.26	-.22	.24	.20	
6. Subjective Well-Being (T ₂)	0.00 (0.95)	-2.00-1.99	-.24	-.33	.07	.23	.46

Note. High values in willpower theories reflect higher agreement with a limited theory, higher trait self-control and subjective well-being. Correlations above $r = |.13|$ are significant at $p < .05$.

Longitudinal analyses. The hypothesis that implicit theories about willpower predict change in subjective well-being was tested with a *cross-lagged change regression model* (McArdle, 2009) estimated in AMOS (version 20). A change-regression model provides a *base-free* estimation of the change between two measurement points, that is, a latent difference controlled for the baseline (McArdle, 2009). In the present analyses, we modeled the latent change for subjective well-being and implicit theories about willpower between T₁ and T₂ (see Figure 6). Both latent change parameters were predicted by implicit theories about willpower and subjective well-being measured at T₁. Further, trait self-control measured at T₁ was added to control for its effects on change in subjective well-being. Two correlational paths accounted for the correlations between implicit theories about willpower and trait self-control at T₁ and trait self-control and subjective well-being at T₁.

As expected, the effect of implicit theories about willpower on change in subjective well-being was significant, $\beta = -.19$, $SE = .14$, $C.R. = -2.64$, $p = .008$ (see Figure 6, path from

“Willpower Theories T_1 ” to “LC Well-Being”). Subjective well-being at T_1 on did not predict change in willpower theories, $\beta = -.10$, $SE = .04$, $C.R. = -1.25$, $p = .210$ (see Figure 6, path from “Well-Being T_1 ” to “LC Willpower”). The effect of trait self-control on change in well-being was also not significant, $\beta = -.12$, $SE = .13$, $C.R. = -1.62$, $p = .105$. The finding suggests that implicit theories about willpower had an incremental effect on change in subjective well-being that was independent of trait self-control.

Additionally, subjective well-being at T_1 significantly predicted the change in subjective well-being, $\beta = -.52$, $SE = .07$, $C.R. = -7.53$, $p < .001$ (see Figure 6, path from “Well-being T_1 ” to “LC Well-Being”), and willpower theories at T_1 significantly predicted change in willpower theories, $\beta = -.37$, $SE = .08$, $C.R. = -4.57$, $p < .001$ (see Figure 6, path from “Willpower Theories T_1 ” to “LC Willpower Theories”). The negative change parameters simply reflect regression to the mean effects also known as law of initial values (e.g., Wilder, 1957). With regard to our hypothesis it is important to note that this part of the individual change that was related to the baseline level was partialled out from the latent change parameter. Therefore, the effect of implicit theories about willpower at T_1 on change in subjective well-being was controlled for its baseline at T_1 .

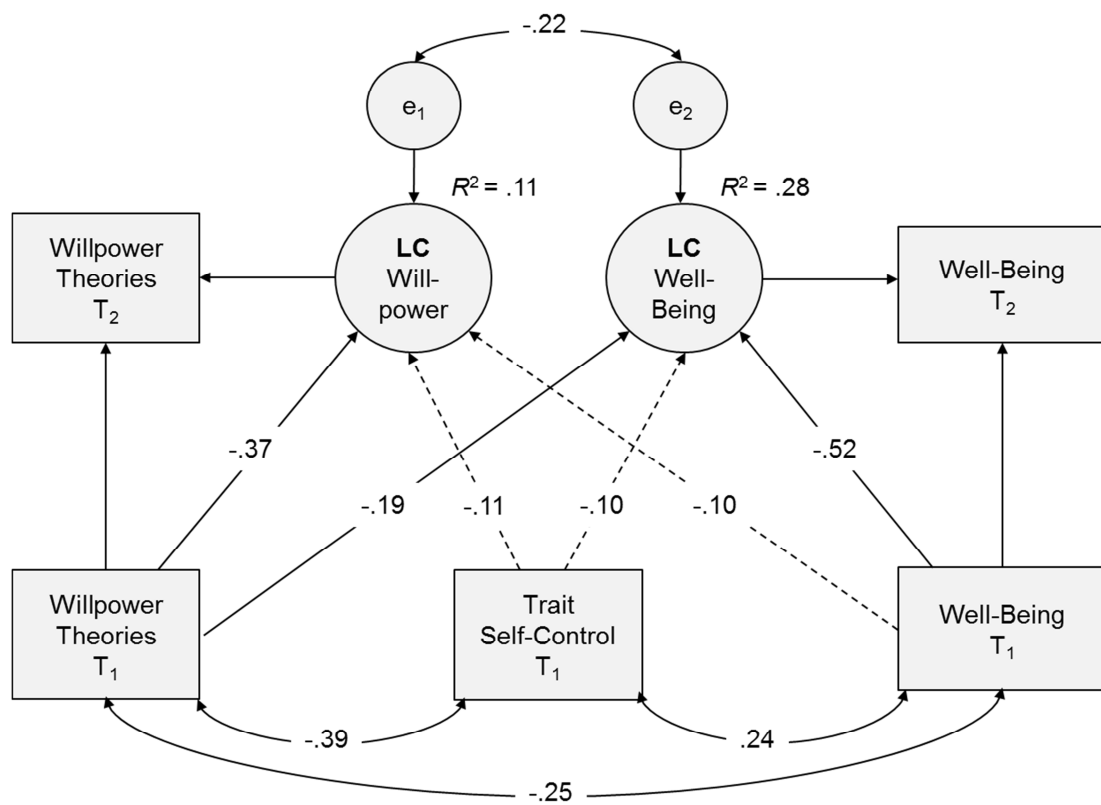


Figure 6. Cross-lagged change regression model predicting change in well-being over six months from implicit theories about willpower. The regression weight of the four paths to well-being at T₂ and willpower theory at T₂ were fixed. Thus, the latent variables (LC = latent change) represent the base free change in well-being and willpower theories from T₁ to T₂. Single-headed errors represent regression paths and double-headed paths covariances. Standardized maximum-likelihood parameters are used. A circle (e = residual error) indicates a residual error in the prediction of an observed variable. Because the model was saturated no model fit indices could be estimated. Above endogenous observed variables, R² indicates the total explained variance. Dotted regression paths are not significant. Bold regression paths are statistically significant at $p < .05$.

Brief Discussion

In support for Hypothesis 2, implicit theories about willpower predicted change in subjective well-being over time. The more participants agreed with a limited theory, the lower was their subjective well-being six months later. However, subjective well-being did not predict change in implicit theories. Further, the effect of implicit theories about willpower on subjective well-being was independent of trait self-control.

Study 3

The purpose of this study was twofold. First, we aimed to replicate the finding of Study 2 that implicit theories about willpower predict change in subjective well-being (Hypothesis 2). Second, we aimed to test whether perceived availability of resources and change in goal progress would mediate this relationship (Hypothesis 3).

Method

Participants

Data was collected as part of a larger research project on personal goal striving in students consisting of a longitudinal study over one and a half years, four semesters, and 12 measurement points. For the study, freshmen of a public Swiss university were recruited via announcements during lectures, flyers, and advertising on billboards. For each measurement point, participants were emailed a link to an online survey that included among others the measures of interest for this research question. For each measurement point, participants received a coupon (10 Swiss Francs) of a popular mail-order company as compensation.

The baseline of the present study was the seventh follow-up (referred to as T_1), which was located within the semester break before participants entered their third semester. By the seventh follow-up, 167 students (115 women, 53 men, $M_{\text{age}} = 20.7$ years, age range: 18-39 years, 55 psychology students) were still participating in the study. At this point in the study,

implicit theories about willpower were measured and then used to predict subjective well-being over the course of the following semester. Measures of well-being, resource availability, and goal progress were collected throughout the semester at four measurement points (T₂ to T₅), which were equally spaced across five months. T₂ was located at the beginning of the semester, T₃ and T₄ within the semester, and T₅ at the end of the semester.

Measures

Implicit theories about willpower. At T₁, implicit theories about willpower were assessed with the same 6-item measure used in Study 1 ($\alpha = .87$).

Perceived availability of resources. To assess the perceived availability of resources, we created a list of seven resources (i.e., time, self-discipline, stress resistance, self-confidence, ability to concentrate, physical energy, and social support) adapted from Diener and Fujita (1995). Participants were asked to indicate on a 7-point scale how much of each resource they had available in comparison to an average student (1 = *Much below average*; 7 = *Much above average*).

To test whether the list was a consistent measure, we ran an exploratory factor analysis for each measurement point. The analyses showed a one-factor solution, with one factor accounting for 40.9% to 43.1% of the variance (eigenvalues = 2.86 to 3.02). Except for time, all resources loaded on this first factor (loadings: .54 - .81). Because time did not load on one factor with the other resources, we decided to exclude it from the analysis. The remaining scale with six resources was consistent within each measurement point (α s = .71 - .79). To get a measure of resources participants perceived to have available over the course of the semester, we averaged the scores from T₂ to T₅. We did not include resources at T₁ to avoid overlap with implicit theories about willpower, the independent measure.

Goal progress. At the beginning of the study, participants named two personal goals following the procedure from Brunstein (1993). Further, all participants answered questions

regarding the goal to successfully graduate from university as a third personal goal, which was the same for all participants. The goals were presented at each measurement point and participants evaluated their progress on each goal answering one question (i.e., “I am satisfied with the progress on that goal”) on a 5-point scale (1 = *Not at all true*; 5 = *Very true*). We summed goal progress for all three goals at T₂ and T₅. This index reflected the overall goal progress made on three personal goals with higher values representing more goal progress.

Subjective well-being. Subjective well-being was again assessed with two measures. Cognitive well-being was assessed with the satisfaction with life scale described in Study 1 (Glaesmer et al., 2011). The scale was highly reliable (α s = .88 - .91). Affective well-being was measured with the same positive and negative affective states as described in Brunstein (1993). Participants indicated how they felt within the last week rated on a 7-point scale (1 = *never*; 7 = *often*). Four items assessed positive affect (i.e., “happy”, “joyful”, “pleased”, and “confident”) and four items negative affect (i.e., “frustrated”, “sad”, “anxious”, and “depressed”), presented in random order. The subscales for positive (α s = .87 - .90) and negative affect (α s = .84 - .89) were both reliable.

Life satisfaction, positive affect and negative affect were substantially correlated across all time points ($.51 < |rs| < .65$, $ps < .001$), and an exploratory factor analysis on the 13 items showed one factor that accounted for 53.6% (Time 1, all loadings > .62), 52.6% (Time 2, loadings > .65), 52.4% (Time 3, loadings > .55), 53.3% (Time 4, loadings > .62), and 52.6% (Time 5, loadings > .64) of the variance (eigenvalues = 6.96, 6.83, 6.81, 6.93, and 6.81, respectively). Therefore, we decided to calculate an aggregated well-being index for each time point separately by taking the average of the z-standardized scores for positive and negative affect (recoded) and life satisfaction, reporting the results of the aggregated index for the purpose of brevity. However, we also tested and examined whether results generalized

across all measures of subjective well-being and tested the final model for each measure separately. The effects were similar for each separate measure.

Results

Correlational analyses. Means, standard deviations, and zero-order correlations between the main constructs of the study are reported in Table 8. Implicit theories about willpower were negatively related to subjective well-being at the beginning (T_2) and the end of the semester (T_5). The effect was significant at the end of the semester but not significant at the beginning of the semester. Further, implicit theories about willpower were negatively related to perceived availability of resources. As expected, students with a limited theory reported lower availability of resources than students with a nonlimited theory. Additionally, we examined how willpower theories were related to the perceived availability of each single resource. We averaged the values for each category across all five measurement points and found that willpower theories were related to the availability of self-discipline, $r(154) = -.25$, $p = .002$, stress resistance, $r(154) = -.30$, $p < .001$, self-confidence, $r(154) = -.16$, $p = .049$, ability to concentrate, $r(154) = -.35$, $p < .001$, physical energy, $r(154) = -.36$, $p < .001$, and social support, $r(154) = -.18$, $p = .027$. The more participants endorsed a limited theory the less goal-relevant resources they perceived to have available.

Table 8

Descriptive Statistics and Zero-Order Correlations for the Main Constructs of Study 3

Variable	<i>M (SD)</i>	<i>Range</i>	1	2	3	4	5
1. Willpower Theories (T ₁)	3.81 (0.83)	1.66-6.00					
2. Perceived Resources (T ₂ -T ₅)	4.44 (0.84)	2.32-6.00	-0.38				
3. Goal Progress (T ₂)	10.07 (2.06)	5.00-15.00	-0.08	0.31			
4. Goal Progress (T ₅)	9.78 (2.05)	5.00-15.00	-0.12	0.43	0.56		
5. Well-Being Index (T ₂)	0.00 (2.57)	-8.14-3.96	-0.12	0.55	0.47	0.46	
6. Well-Being Index (T ₅)	0.00 (2.56)	-8.08-4.71	-0.20	0.46	0.29	0.54	0.57

Note. High values in willpower theories reflect higher agreement with a limited theory, more perceived resources, more goal progress, and higher subjective well-being. Correlations above $r = .13$ are significant at $p < .05$. T₁ = semester break, T₂ = beginning of semester, T₅ = end of semester. Other measurement points are omitted.

Longitudinal analyses. First, we tested our second hypothesis that implicit theories about willpower (T₁) would predict change in subjective well-being (T₅, controlled for well-being at T₂) and specified a regression model using AMOS for SPSS (Version 20). The model was analyzed for the total sample (*direct effect model*, $n = 167$, $df = 0$) using maximum likelihood estimation. Previous well-being had a significant effect on later well-being, $\beta = .55$, $SE = 0.07$, $C.R. = 7.90$, $p < .001$. Controlling for well-being at the beginning of the semester, implicit theories about willpower had a significant effect on well-being at the end of the semester, $\beta = -.14$, $SE = 0.22$, $C.R. = -2.03$, $p = .042$: A limited theory predicted a negative trend in well-being over the course of the semester. Overall, the model explained 33% of the variance in well-being at T₅.⁵

Mediation analyses. We evaluated a *serial multiple mediator model* (Hayes, 2013, p. 143) to test the third hypothesis that perceived resources and goal progress mediated the

⁵ Earlier in the study generalized self-efficacy was assessed with the I-SEE scales (Greve, Anderson, & Krampen, 2001). Self-efficacy was correlated with willpower theories, $r(164) = -.29$, $p < .001$. When self-efficacy was controlled in the direct effect model it did not predict change in well-being, $\beta = .04$, $SE = 0.16$, $C.R. < 1$, *ns*. The direct effect of willpower theories only slightly reduced and was still marginal significant, $\beta = -.13$, $SE = 0.22$, $C.R. = -1.79$, $p = .073$. When the effect of self-efficacy on change in well-being was controlled in the multiple mediator model the indirect effects remained highly significant.

relationship between willpower theories (T_1) and change in well-being (T_5 , controlled for well-being at T_2). The model is depicted in Figure 7. Indirect effects were assessed with the bootstrap resampling method (Shrout & Bolger, 2002). As the performance of bootstrap analyses to assess indirect effects with the AMOS software package requires complete data, the final model was first evaluated with complete data ($n = 128$, 89 women, 39 men, $M_{\text{age}} = 20.6$ years, age range: 18-39, 49 psychology students) and then tested for selectivity in comparison to the total sample ($n = 167$; Byrne, 2004). A non-significant chi-square difference ($\Delta\chi^2_{(14)} = 1.94, p = .999$) between the *full sample model* ($n = 167, df = 1$) and the *subsample model* ($n = 128, df = 1$) indicated that parameter estimates did not significantly differ between the subsample and the full sample model. Due to the absence of evidence of selectivity, statistical analyses are subsequently reported exclusively for the subsample model, the results of which may be generalized to the full sample.

Results of the *serial multiple mediator model* are illustrated in Figure 7 and summarized in Table 9. Bias-corrected bootstrapped 95% confidence intervals were estimated for the indirect effects, which were interpreted as significant when the interval did not include zero. There was a significant indirect effect of willpower theories (T_1) on change in well-being over the course of the semester (T_5 , controlled for well-being at T_2), mediated by perceived resources ($T_2 - T_5$) and change in goal progress (T_5 , controlled for goal progress at T_2) [total indirect effect: $a_1a_3b_2 + a_1b_1 + a_2b_2$]. Further, willpower theories had a significant indirect effect on change in goal progress through perceived availability of resources [indirect effect: a_1a_3]. The perceived availability of resources had a significant indirect effect on well-being through goal progress [indirect effect: a_3b_2]. Results indicate that willpower theories affect subjective well-being indirectly by shaping perceived availability of resources and goal progress. The differentiation between complete/full and partial mediation is not addressed in

the present article as these concepts have “no substantive or theoretical meaning or value of any consequences . . . [and therefore] should be abandoned” (Hayes, 2013, p. 172).⁶

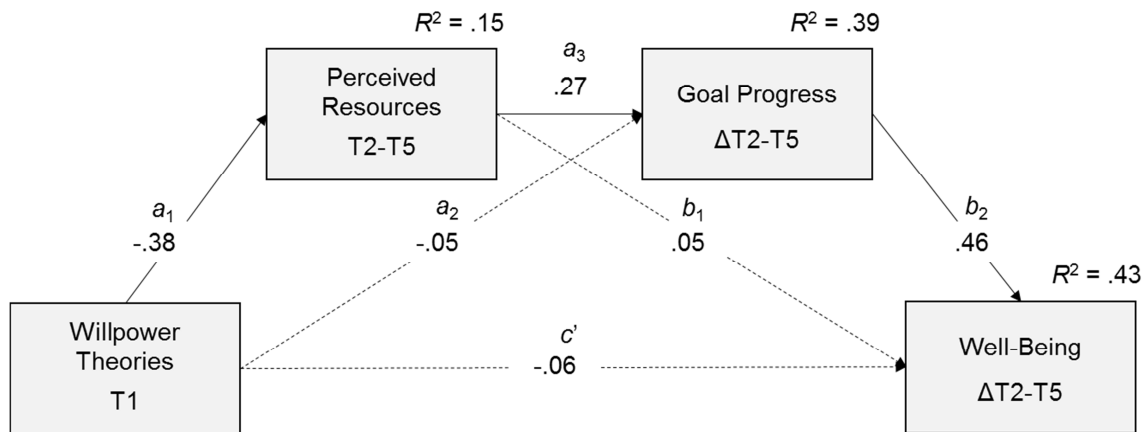


Figure 7. A multiple-step multiple mediator model of willpower theories (IV), perceived resources (mediator 1), goal progress (mediator 2), and well-being (DV). The relationship between willpower theories before the beginning of the semester (T_1) and change in well-being over the course of the semester (T_5 , controlled for well-being at T_2) was mediated by perceived resources and goal progress over the semester (T_5 , controlled for goal progress at T_2) [$X^2(1) = 1.241, p = .265, NNFI = .984, CFI = .999, RMSEA = .044$ (90% CI [.000, .246]; PCLOSE = .337)]. Squares indicate observed variables. Residual errors, correlations with residual errors, and covariates are not depicted in the model. Single-headed arrows represent regression paths. Above endogenous observed variables, R^2 indicates the total explained variance. Dotted regression paths are not significant. Bold regression paths are statistically significant at $p < .05$. Standardized maximum-likelihood parameters are used.

⁶ Willpower theories were also assessed at the first measurement point of the study. When we used this measure to predict well-being over the course of participants' first year in college, all indirect effects were significant. However, the direct effect did not reach significance, which may be due to the fact that shortly after participants' transition to university well-being was affected by other variables, for instance whether they made new friends or whether they were satisfied with their studies.

Table 9

Standardized Coefficients of a Multiple-Step Multiple Mediator Model

Effect	β	<i>C.R.</i>	<i>SE</i>	95%CI	<i>p</i>
<i>c</i> path (total effect, controlled for well-being T ₂)	-.14	-2.03			= .042
<i>a</i> ₁ path	-.38	-4.66			< .001
<i>a</i> ₂ path	-.05	-0.61			= .542
<i>a</i> ₃ path	.27	3.36			< .001
<i>b</i> ₁ path	.05	0.55			= .580
<i>b</i> ₂ path	.46	5.51			< .001
<i>a</i> ₁ x <i>a</i> ₃ (indirect effect)	-.10		.04	[-.18, -.05]	
<i>a</i> ₃ x <i>b</i> ₂ (indirect effect)	.12		.04	[.07, .21]	
<i>a</i> ₁ x <i>a</i> ₃ x <i>b</i> ₂ (indirect effect)	-.09		.05	[-.19, -.01]	
<i>c'</i> path (direct effect)	-.06	-0.84			= .400
<i>Covariate</i> (well-being T ₂ on well-being T ₅)	.33	4.01			< .001
<i>Covariate</i> (goal progress T ₂ on goal progress T ₅)	.48	6.63			< .001

Note. Maximum likelihood estimates are provided for the *c* path, *a* paths, *b* paths, the *c'* path, and the covariates. For standardized indirect effects bootstrap estimates with confidence intervals are provided. C.R. = critical ratio.

Brief Discussion

The findings supported Hypothesis 2 and replicated Study 2. A limited theory was associated with a negative change in well-being. In line with Hypothesis 3, the effect was mediated by participants' perceptions about the availability of resources and progress they made toward personal goals. The more students agreed with a limited theory at the beginning of the semester, the fewer resources they perceived to have available and the lower was their progress toward personal goals. Low goal progress was in turn related to lower subjective well-being, which replicates previous findings (Brunstein, 1993). The results support previous theorizing about goal progress mediating the relationship between resource availability and subjective well-being (Diener & Fujita, 1995). In sum, the findings suggest that implicit theories about willpower affect change in subjective well-being by shaping people's

perception about the availability of resources, which in turn affects the progress they make on their personal goals.

General Discussion

The present research examines how individual differences in implicit theories about willpower affect subjective well-being. In Study 1 endorsing a limited theory about willpower was associated with lower levels of life satisfaction, affective well-being, and physical well-being in a sample of working adults. Longitudinal Study 2 showed that implicit theories about willpower predicted change in subjective well-being, independent of trait self-control. A limited theory predicted a negative trend in well-being over six months. Finally, longitudinal Study 3 replicated the long-term effect over a period of five months and additionally found that the effect was mediated by students' perceived availability of resources and their progress in personal goals. Students with a limited theory about willpower reported having fewer resources available and made less progress on their personal goals, which predicted a decrease in subjective well-being. Due to the relatively large sample sizes, the three studies were sufficiently powered providing confidence that the effects would replicate in future studies.

The present findings document the far-reaching consequences of holding a limited theory about willpower. Previous research showed that believing that willpower is a limited resource has detrimental effects on self-control performance and achievement outcomes (Job, Walton, et al., 2015). Here, we document that these effects radiate onto people's subjective and physical well-being. When people believe that their willpower is limited, they make less progress toward personally meaningful goals, because they perceive a lack of essential goal-relevant resources, such as self-discipline, physical energy, and social support. In turn, this drags their well-being down; they are less satisfied with their life and feel less positive and more negative affect. Thereby, the present findings contradict the concern that the positive effects of endorsing a nonlimited theory on self-control might backfire in terms of lower well-

being. Instead, across three studies, a nonlimited theory was consistently related to better subjective well-being.

Based on previous findings that linked a nonlimited theory to successful goal striving (Job et al., 2010), we proposed that goal progress might mediate the link between willpower theories and well-being. The link between goal progress and well-being is already well-established in the literature (Brunstein, 1993; Klug & Maier, 2015). Continuing this previous work, we examined implicit theories about willpower as a precursor of goal progress and subjective well-being.

Finally, this research provides first direct evidence for the mediational function of goal progress in the relationship between availability of resources and subjective well-being. This mechanism was first postulated by Diener and Fujita (1995). They argued that resources may relate to subjective well-being because they help people achieve their personal goals. However, in this seminal paper, the role of goal progress as mediating mechanism was only tested indirectly, by showing that the availability of goal-relevant resources was more strongly related to well-being than the availability of goal-irrelevant resources. In the present research, we tested their assumption directly using mediation analyses and found that goal progress indeed mediates the effect of resource availability on well-being.

Willpower Theories and Personal Resources

Study 3 demonstrates that beliefs about willpower match people's perception of the availability of resources—people with a nonlimited theory about willpower perceived to have more resources available than people with a limited theory. For some resources, this relationship is not surprising as they are conceptually close to willpower, such as self-discipline or stress resistance. Other resources, however, seem not related to willpower on the first glance, such as physical energy or social support. The present findings suggest that people's willpower theories radiate on to goal-relevant resources in general and not just the

ones that are conceptually close to willpower. But there was one exception. The perceived availability of time did not converge with the perception of the other personal resources and it was not related to implicit theories about willpower. This suggests that time is with some regard different from the other resources. Perhaps, the availability of time is more affected by situational factors, such as amount and magnitude of competing projects or goals, reducing the effect of beliefs about willpower. Or it might be that people with a nonlimited theory, due to their perception that they have enough resources, take on more projects and goals and therefore perceive that time is the only resource that is not available. In the current study, we did not assess the number of personal goals people simultaneously pursued. Therefore, more research is needed to clarify the special role of time as a distinct goal-relevant resource.

Open Questions and Future Directions

One important question that is pertinent to the present research is whether people are stuck with their beliefs about willpower or whether willpower theories can be changed. Although we found that willpower theories were stable over a period of six months within a natural setting, it is possible that a targeted intervention might be able to change the way people think about their willpower. Previous lab studies already documented that willpower theories can be manipulated with a simple method (Job et al., 2010; Miller et al., 2012). As a next step, field studies should investigate whether long-term change in willpower theories is possible and people can learn to adopt a nonlimited theory. Such an intervention should affect the perceived availability of resources, personal goal progress, and subjective well-being. In the past, interventions targeting people's implicit theories about intelligence or personality have been effective in improving important outcomes, such as academic achievement (Aronson et al., 2002; Blackwell et al., 2007; Good, Aronson, & Inzlicht, 2003; Yeager et al., 2013). The methods that have been used in these studies might inform future willpower-theory interventions.

Conclusion

Three empirical studies suggest that implicit theories about willpower affect individuals' well-being. Endorsing the belief that willpower is limited was related to lower levels of subjective and even predicted a downwards trend in well-being over several months. These findings suggest that the previously documented functionality of the nonlimited theory for self-control performance and academic achievement can be extended to emotional outcomes. Instead of persuading people to overexert themselves and to overly abstain from the pleasurable things in life, a nonlimited theory about willpower encourages them to invest their resources in order to achieve personally meaningful goals. This investment pays off in terms of higher subjective well-being.

PART IV

Can Changing Implicit Theories About Willpower Influence Real-World Self-Regulation?

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Abstract

Recent laboratory and longitudinal field research suggest that the belief that willpower depends on a limited resource (limited theory) versus not (nonlimited theory) is dysfunctional for self-control and undermines academic performance (Job, Walton, et al., 2015). Can learning a nonlimited theory about willpower improve students' self-control in real-world settings? In two studies, a nonlimited theory intervention increased endorsement of this theory four to seven weeks later. In Experiment 1, where the treatment message and strategies were processed but not trained in the real world, no effect on self-control was observed. In contrast, in Experiment 2, where participants were guided to incorporate this theory into their everyday lives, the intervention improved students' self-regulation, for instance, they worked harder for a demanding class and (compared to one of two control groups) the treatment reduced procrastination among students taking a heavy course load.

Introduction

Despite its importance for long-term goal pursuit research suggests that people's capacity to self-control is vulnerable and prone to failure when self-control demands accumulate (Baumeister & Heatherton, 1996). The strength model of self-control argues that the ability to inhibit and change attentional, emotional, and behavioral impulses is based on a limited resource that gets easily depleted (Baumeister et al., 1998; Baumeister, Vohs, & Tice, 2007). In line with this assumption a number of studies show that self-control performance is impaired by previous self-control acts and by high self-control demands (Hagger et al., 2010; Oaten & Cheng, 2005).

However, recent research suggests that self-control or willpower need not be such a limited resource (Job et al., 2010). Instead, people's beliefs—or implicit theories—about willpower determine whether self-control performance suffers from previous self-control acts or when self-control demands accumulate (Job et al., 2010; Job, Walton, et al., 2015). In laboratory experiments and field studies we find that only people who believe that their willpower depends on a limited resource that is easily depleted (*limited theory*) show self-regulatory failure as demands accumulate. People who believe that willpower is not so limited (*nonlimited theory*) show no evidence of self-regulatory depletion (Job et al., 2010; Job, Walton, et al., 2015).

Our research has involved both, laboratory experiments in which willpower theories have been measured or manipulated, and field studies in which willpower theories have been measured and used to predict self-control in real-world settings. What has been lacking is field experimental research, which (1) demonstrates causal effects on self-control outcomes in the real world and (2) demonstrates a novel, theory-based application to important and difficult problems of self-control. Therefore, the aim of the present research was to examine whether willpower theories could be changed in the field and whether such a willpower theory intervention would improve self-control in everyday life.

Implicit Theories About Willpower and Self-control

Implicit theories about willpower are beliefs people hold about the nature of their willpower (Job et al., 2010). These beliefs are often not explicitly represented in people's minds, but can be made explicit with targeted questions. For instance, one can ask people how much they agree with items, such as "After a strenuous mental activity, your energy is depleted and you must rest to get it refueled again" (reflecting a limited theory) or "After a strenuous mental activity, you feel energized for further challenging activities" (reflecting a nonlimited theory). Studies have also used a biased version of these items to manipulate willpower theories (Job et al., 2010; Miller et al., 2012).

Laboratory studies using the so called dual-task paradigm (Baumeister et al., 1998) found that only people who endorse a limited theory about willpower show impaired self-control after a previous self-control task (Job et al., 2010). Participants holding a nonlimited theory performed well on the second task even when they previously exerted self-control. Other experiments demonstrated that manipulating willpower theories had the same effect on self-control performance, suggesting their causal influence (Job et al., 2010; see also Miller et al., 2012).

Experiments investigating the mechanism behind willpower theories suggest that a limited theory makes people sensitive to cues signaling loss of self-control resources, such as feelings of exhaustion, and cues signaling incoming resources, such as glucose (Job et al., 2010, 2013). Only among participants who were led to endorse a limited theory, self-control performance reflected levels of exhaustion and the amount of incoming glucose (Job et al., 2010, 2013). Thus, a nonlimited theory does not improve self-control instead it removes a process that undermines self-regulation in people with a limited theory.

Field studies suggest that this mechanism is particularly defeating for self-control performance when people face high self-control demands. In one study (Job et al., 2010, Study 4), students were surveyed three times within an academic term, at the beginning,

middle, and end. At the end of the term, when students took final exams and self-regulatory demands were presumably greatest, students who endorsed more of a limited theory showed worse overall self-control (e.g., they procrastinated more and ate more junk food) than students with a nonlimited theory. Importantly, willpower theories did not predict differences in self-control in the middle of the term when self-control demands were presumably less severe. These findings suggest that a limited theory is most problematic when self-regulatory demands accumulate.

Corroborating this conclusion, a second longitudinal study assessed the level of daily self-regulatory demands individual students experienced during an academic term—such as the number of tests, amount of coursework, and degree of conflicts with others they faced (Job, Walton, et al., 2015). Among students facing generally low self-regulatory demands, those who endorsed a limited theory of willpower showed no worse self-regulatory outcomes. But among students facing relatively high demands, those who endorsed a limited theory reported procrastinating more, eating more junk food, spending more excessively, and experiencing greater emotion-regulation failures. Moreover, among students taking a heavy academic load (more course units), those with a limited theory earned lower term grades (controlling for previous grades); this effect was mediated by higher levels of procrastination. Taken together, a limited theory seems especially disruptive when people face high self-regulatory demands. It is then that limited theorists are most likely to infer that they lack the resources to continue (Job et al., 2010; Job, Walton, et al., 2015).

Based on these previous findings, we expected that learning a nonlimited theory about willpower might decrease students' level of procrastination during final examinations—especially for students who face the greatest self-regulatory demands during this period.

Malleability of Implicit Theories About Willpower

How malleable are implicit theories about willpower? Our prior longitudinal field studies suggest that, absent specific intervention, implicit theories about willpower are stable over time. Among college students, implicit theories about willpower correlated significantly over a period of three months ($r = .77$; Job et al., 2010, Study 4). However, laboratory research suggests that implicit theories about willpower can be manipulated using techniques as simple as a biased questionnaire (Job et al., 2010, 2013; Miller et al., 2012). In these studies, people are given items from our scale that are altered to elicit high degrees of agreement, such as adding “can” before “activate” in the following sentence: “Working on a strenuous mental task can activate your mental resources and you can become even better at accomplishing subsequent demanding tasks” (nonlimited theory induction; Job et al., 2010). Studies suggest that this simple manipulation affects self-control performance in a laboratory setting (Job et al., 2010; Miller et al., 2012).

Further, past intervention studies suggests that other implicit theories, for instance, about intelligence or personality, can be changed to improve real-world outcomes. For instance, a growth-mindset of intelligence intervention (teaching that intelligence is malleable) improved student’s attitudes towards learning and their academic achievement over the course of 9 weeks (Aronson, Fried, & Good, 2002). In other interventions, a growth-mindset training improved students’ academic achievement (Blackwell et al., 2007; Good et al., 2003).

Given the significance of self-control for diverse outcomes (Duckworth, 2011), an important question is whether it is possible to modify implicit theories about willpower in field settings and if doing so would promote self-control.

The Present Research

We conducted two interventions with a randomized control group design to test whether teaching students a nonlimited theory about willpower can improve self-control performance in everyday life, namely reduce levels of procrastination among students. In both studies the core of the treatment message was that willpower can strengthen as people take on strenuous tasks. In Experiment 1, this message was accompanied by three strategies explaining how to use a “nonlimited mindset” in everyday life. However, the findings of Experiment 1 suggest that reading about these strategies was insufficient in helping participants to implement the idea of nonlimited willpower into their everyday life routines. Therefore, in Experiment 2, the treatment message was combined with a practice phase to train a specific strategy (i.e., thinking of nonlimited willpower when working on a demanding task). We expected that this treatment would reduce levels of procrastination and improved study habits. In light of the previous findings, we figured that a nonlimited-willpower intervention would be most effective in times when they face high self-control demands (e.g., final examination period). Further, individual differences in self-control demands (e.g., course load) might moderate the effect of the nonlimited-willpower intervention on self-control.

Experiment 1

Experiment 1 aimed to test whether students can be guided to adopt a nonlimited theory about willpower and whether this would decrease their levels of procrastination at the end of the semester when self-control demands accumulate. The treatment and control messages were conveyed in a scientific article, a procedure that has been used in previous studies to change implicit theories about intelligence (e.g., Blackwell et al., 2007; Bergen, 1991; Dinger & Dickhäuser, 2013). These past studies have used different control treatments, such as teaching participants learning strategies (Blackwell et al., 2007). Here, we designed

three control treatments that were either related to willpower and studying, only related to studying, or unrelated to willpower and studying.

Further, the treatment (and control) message was combined with three strategies that were to help people to use the idea of nonlimited willpower in their everyday life. To remember these strategies we let participants draw illustrations of these strategies and keep these pictures for the time of the study. This method was inspired by research suggesting that learner-generated drawings improve memory performance (e.g., Van Meter & Garner, 2005).

Method

Overview

Overall, the study consisted of three online surveys. One week before the treatment participants filled in a 5-minute pre-treatment survey with the baseline measures. One week later participants were randomly assigned to the treatment group or one out of three control groups and filled in a 30-minute survey, which included the entire treatment. Seven weeks later participants filled in a post-treatment survey with the dependent measures. The post-treatment survey was intentionally placed into the pre-examination phase of the semester, because willpower theories have been found to be most important for self-control performance in times of high self-regulatory demands (Job et al., 2010; Job, Walton, et al., 2015).

Participants

Participants were 246 first year psychology students at a public Swiss University (200 female, 46 male, $M = 22.13$ years, Range: 18-59) who participated in exchange for course credit. Participants were recruited in lectures and through flyers on campus for a study on “First Year Students’ Experiences,” and received course credit as compensation.

Procedure

Pre-treatment survey. One week before the treatment we assessed demographics (e.g., gender, age), implicit theories about willpower, and participants' baseline level of procrastination.

Treatment and control session. One week later participants filled a second online survey that included the treatment. At the beginning of the survey, all participants were told that the purpose of the study was to examine the effect of drawing pictures on memory. This deception was needed to cover the real purpose of the study and avoid demand effects. Participants were then asked to get three sheets of paper and a pen and place them on their desk. It was explained that these materials were needed to draw three pictures later on in the survey. Then the program randomly presented one out of the four ostensible web articles that conveyed either the treatment or a control message.

In the treatment group, which we will refer to as the *nonlimited willpower group* ($n = 58$), the article explained that “willpower is our mental strength, which helps us to shield us from distraction, postpone gratification, to stay focused during strenuous mental tasks and to go about strenuous tasks instead of procrastinating on them.”. Further, participants were told that “there are simple strategies to avoid unproductive working hours”. The first was to “question feelings of exhaustion, especially if they appear only after a short time, [because] the body has mechanisms to supply the brain with sufficient energy.” The second strategy was to seek difficulties instead of avoiding them, because research on learned industriousness shows that people perform better after engaging in a difficult rather than a simple task (Eisenberger, 1992). Third, they were told that “often after finishing one task, one feels the need to take a break – but why stop yourself from being productive? Rather one should start with the next task to stay in a productive mode.” The article finished with the notion that “being productive does not mean to avoid taking breaks at all, but rather you should try to

resist the need for a break, if it appears after a short time.” This sentence was included, because we did not aim to prevent students from taking breaks at all. Instead, we wanted them to avoid getting distracted from studying by taking breaks that they actually not needed.

The first control group, the *resource conservation group* ($n = 55$), read an article related to willpower and studying, namely about strategies how to conserve willpower resources, for instance, taking breaks when feeling exhausted, avoiding difficult tasks when feeling exhausted, or rewarding oneself for working hard. Research suggests that break can improve self-control performance and that people have natural tendency to conserve resources and reward themselves for effort (Muraven et al., 2006; Tyler & Burns, 2008; Witt Huberts, Evers, & De Ridder, 2011). Therefore, this group represents a very strict test for the effectiveness of the nonlimited-willpower treatment.

The second control group, the *strategy group* ($n = 58$), read about three different strategies to improve studying (i.e., planning studying ahead, maintaining to-do lists, chunking big tasks into smaller subtasks). We predicted that this treatment would not help students to reduce procrastination, because the strategies were not embedded in a larger idea such as in the nonlimited willpower group.⁷

Participants of the third control group, the *no-message group* ($n = 57$), read about a topic that was completely unrelated to willpower and studying, namely three possible strategies to stop climate change.

Participants had five minutes time to read through the article before they were automatically forwarded to the next page, where the first strategy was presented again. Participants were instructed to imagine a picture that would illustrate the respective strategy. On the following pages they first described the picture in a text box and were then instructed to draw the picture on a sheet of paper. Participants went through this procedure three times,

⁷ We pretested whether the article of the nonlimited willpower group and strategy group differed in how they were perceived. Participants ($N = 33$) rated both articles on 8 items such as “How well written was the article?” or “Do you think you can apply some of the content to your own studying?” ($1 = Not at all$; $5 = Very much$). T-tests showed that the ratings for the articles did not differ, $t_s < 1.39$.

once for every strategy. At the end of the session participants were reminded to store the pictures properly and to bring them to the laboratory when they picked up their course credit confirmation.

Post-treatment survey. Seven weeks after the treatment the dependent measures were assessed in another online survey. The survey assessed implicit theories about willpower, levels of procrastination, self-regulatory demands, and participants' memory of the treatment or control message. Finally, they were thanked, debriefed, and informed about where and when to collect their course credit confirmation.

Measures

Implicit theories about willpower. Implicit theories about willpower were assessed with six items focusing on strenuous mental activities (e.g., "Strenuous mental activity exhausts your resources, which you need to refuel afterwards (e.g., through breaks, doing nothing, watching television, eating...)" [reverse scored]; "Your mental stamina fuels itself. Even after strenuous mental exertion you can continue doing more of it," $1 = \textit{Strongly agree}$, $6 = \textit{Strongly disagree}$). The items were averaged such that high values represented stronger agreement with a limited theory ($\alpha_{\text{Pre}} = .76$, $\alpha_{\text{Post}} = .82$).

Procrastination. Procrastination was assessed with six items (e.g., "How often did you delay doing something for your studies, even when it was important?", $1 = \textit{Never}$ to $7 = \textit{Two times per day}$), which has been used in previous research (Job, Walton, et al., 2015). The items were averaged to form one indicator of procrastination with high values indicating higher levels of procrastination ($\alpha_{\text{Pre}} = .63$, $\alpha_{\text{Post}} = .70$).

Self-control demands. As a possible moderator of the treatment effect, we assessed participants' self-regulatory demands post-treatment. They were provided with a diverse list of 12 demanding tasks or experiences students typically experience in their life (e.g., "tests to take", "class presentation to deliver", "conflict with friends or partner" or "health problems");

(Job, Walton, et al., 2015). They were asked to “indicate how often you had to deal with each [task or experience] during the past seven days” ($1 = \text{Never}$ to $4 = \text{Very often}$). These ratings were summarized to one index of self-control demands.

Memory of treatment message. One plausible reason why we might find that the treatment causes changes in willpower theories might be that participants simply remember the treatment message and fill in the willpower theory measure accordingly. Thus, we assessed participants’ memory of the treatment message post-treatment in three open-ended questions. All participants were asked 1) to note all things they remembered from the article, 2) to summarize its main message, and 3) to name the three strategies. Based on the content of the treatment article participants’ responses were later coded for correctness by one coder, who was blind to hypotheses. Correct responses were coded as 1 and incorrect responses as 0. Because the articles remarkably differed in their content we were not interested in group differences. Rather, we tested within the treatment group whether change in implicit theories about willpower was related to participants’ memory of the treatment message.

Overview of Analyses

To test for treatment effects we used multiple linear regression models and dummy coding with the nonlimited willpower group being the omitted group (Cohen, Cohen, Aiken, & West, 2003). Dummy 1 tested the nonlimited willpower group against the resource conservation group (resource conservation group = 1, all other groups = 0), dummy 2 tested the nonlimited willpower group against the strategy group (strategy group = 1, all other groups = 0), and dummy 3 tested the nonlimited willpower group against the no-message group (no-message group = 1, all other groups = 0). To test our hypotheses all dummy variables were entered simultaneously into the regression models. Further, we controlled for the baseline measures in order to predict residual change in willpower theories and procrastination. The analyses were conducted in R version 3.0.1 (R Core Team, 2013) using

the base package for all linear regression models and the pequod package for simple slope analysis of two-way interactions (Mirisola & Seta, 2013).

Results

Preliminary analyses. Overall, 42 (17.1%) participants who had completed the pre-treatment survey dropped out over the course of the study. Dropout analyses confirmed that those who dropped out did not differ from the remaining participants on any measure assessed prior to the treatment, $t_s < 1.56$, *ns*. As a next step, we tested whether there were any group differences at baseline using X^2 -Tests for dichotomous outcomes and multiple linear regressions with dummy coding for continuous outcomes. The groups differed in neither their gender composition, $X^2(3) < 1$, *ns*, nor drop out over the course of the study, $X^2(3) = 4.08$, $p = .253$. Further, we did not find a group difference in implicit theories about willpower or procrastination at baseline, $t_s < 1.20$, *ns*. These findings suggest that randomization was successful.

Implicit theories about willpower. We examine whether the treatment group endorsed less of a limited theory compared to the three control groups seven weeks after the treatment. The group means for willpower theories post-treatment are summarized in Table 10. Descriptively there is a tendency for the nonlimited group to endorse less of a limited theory. But, is this tendency significant even when controlling for pre-treatment willpower theories? To test this, we conducted hierarchical linear regression analysis and predicted willpower theories with (standardized) willpower theories (block 1) and the dummy-coded group variables (block 2). Previous willpower theories were a significant predictor for post-treatment willpower theories, $b = .45$, $se = .04$, $t(200) = 10.18$, $p < .001$, 95% CI [0.36; 0.54]; Adjusted $R^2 = .36$, $F(4, 200) = 29.22$, $p < .001$. Further, there was a significant difference in willpower theories between the nonlimited willpower group and the resource conservation group, $b = .28$, $se = .13$, $t(200) = 2.21$, $p = .028$, 95% CI [0.03; 0.52], and the strategy group,

$b = .32, se = .13, t(200) = 2.52, p = .013, 95\% CI [0.07; 0.56]$. The difference between the nonlimited willpower group and the no-message group was marginally significant, $b = .24, se = .12, t(200) = 1.92, p = .056, 95\% CI [-0.01; 0.48]$. Participants in the control groups agreed significantly more with a limited theory than participants in the control groups. In a second analysis, we compared the treatment group against all three control groups simultaneously (1 = control group; 0 = treatment group). The effect of group membership on willpower theories was highly significant, $b = .28, se = .10, t(202) = 2.70, p = .008, 95\% CI [0.07; 0.48]$.

In sum, the findings suggest that the treatment was effective in changing participants' willpower theories. Seven weeks after the intervention, participants in the nonlimited willpower group agreed less with a limited theory about willpower compared to participants in the control groups.

Table 10

Descriptive Statistics, Group Mean Differences, and Effect Sizes for Willpower Theories in Experiment 1 and Experiment 2

Group	Implicit Theories About Willpower		
	<i>M</i> (<i>SD</i>)	<i>M</i> _{diff} [95% CI]	<i>d</i> [95% CI]
Experiment 1			
Nonlimited Willpower Group	3.77 (.77)		
Resource Conservation Group	4.15 (.79)	0.38 [0.07; 0.69]	0.49 [0.09; 0.89]
Strategy Group	4.15 (.68)	0.38 [0.09; 0.69]	0.53 [0.12; 0.92]
No-message Group	4.12 (.82)	0.35 [0.04; 0.66]	0.44 [0.05; 0.84]
Experiment 2			
Nonlimited Willpower Group	3.63 (.73)		
Strategy Group	3.92 (.70)	0.29 [-0.12; 0.72]	0.33 [-0.16; 0.99]
No-message Group	3.99 (.84)	0.36 [-0.06; 0.80]	0.39 [-0.07; 1.00]

Note. M_{diff} =mean difference between nonlimited willpower group and respective control group; d =effect size measure Cohen's d .

Memory of the treatment message. Next, we examined whether within the treatment group change in willpower theories was correlated with participants' memory of the treatment message. Thus, we examined the partial correlation between willpower theories post-

treatment and memory of the treatment message controlling for pre-treatment willpower theories. However, the correlation was close to zero and not significant, $r(46) = .01, p = .951$, suggesting that change in willpower theory was not related to memory of the treatment message. Thus, it seems unlikely that participants simply filled in the willpower theory items in accordance with their memory of the treatment message. The mechanisms underlying willpower theory change must involve other more implicit routes.

Procrastination. Finally, we tested whether the treatment affected students' level of procrastination and whether the treatment was particularly effective for students reporting high self-regulatory demands. Again, we conducted a hierarchical linear regression analysis to test the main effect of the treatment in the first block and the interaction effect with self-regulatory demands in the second block. In the first block we entered the (standardized) baseline measure of procrastination and three group dummies testing the simple group differences. In the second block, we added the standardized measure of self-regulatory demands and its interaction term with each of the three dummy variables (Aiken & West, 1991). In the first block, procrastination at baseline significantly predicted post-treatment procrastination, $b = .45, se = .05, t(200) = 8.49, p < .001$, Adjusted $R^2 = .25, F(4, 200) = 18.22, p < .001$. However, there was no significant difference between the nonlimited willpower group and the resource conservation group, $b = -.13, se = .15, t(200) = -0.89, p = .375$, 95% CI [-0.43; 0.17], the strategy group, $b = -.20, se = .15, t(200) = -1.30, p = .194$, 95% CI [-0.50; 0.10], or the no-message group, $b = -.05, se = .15, t(200) = -0.34, p = .731$, 95% CI [-0.35; 0.24]. In the second block, the effect of self-control demands on procrastination was not significant, $b = -.03, se = .10, t(196) = -0.31, p = .756$, 95% CI [-0.22; 0.16], which was surprising given that previous studies documented a negative effect of high self-control demands on procrastination (Job, Walton, et al., 2015; Oaten & Cheng, 2005). The interaction effects between the group dummies and self-control demands were also not

significant, $t_s < 1.33$. The findings suggest that the treatment did not affect procrastination and that the effect of the treatment was also not moderated by self-regulatory demands.

Discussion

The results suggest that the intervention was effective in changing implicit theories about willpower but failed to reduce levels procrastination. There was also no interaction effect of the treatment and individuals' self-control demands. One possible explanation might be that reading about the strategies was not sufficient to transfer the treatment message into everyday life. Another possibility is that there was overall a low level of self-control demands. The study was conducted with first year students only, who faced a small number of exams at the end of their first semester, when the dependent measures were assessed. Therefore, self-control demands were perhaps too low and all participants managed to study efficiently. Therefore, we conducted a second study to test whether we find effects on self-control, when a) including a practice phase that enables students to transfer the treatment message into their everyday life, b) conducting the study at a highly selective university, where all students face final exams at the end of each semester and c) collecting a more objective measure for self-regulatory demands.

Experiment 2

The aim of Experiment 2 was to address the weaknesses of Experiment 1, and test the hypotheses in an environment that placed relatively high self-regulatory demands on students, namely in the final examination period of the semester at a highly selective university. Besides testing the hypothesis in a more challenging environment, we modified the treatment in three important ways. First, the treatment group filled in a biased version of the willpower theory measure, which has been used to induce a nonlimited theory in previous laboratory research (Job et al., 2010), before they were confronted with the treatment message. We hoped that this manipulation would make them more receptive for the treatment

message. Second, instead of drawing illustrations about the treatment message, participants advocated the treatment message to a younger student in a personal letter. Research on attitude change has shown that when people publicly commit to an attitude position, their own acceptance of the advocated position is increased (e.g., Pallak, Cook, & Sullivan, 1980), also known as “saying-is-believing effect” (Higgins & Rholes, 1978; Higgins, 1999). Third, the treatment message was combined with a practice phase to help students to use the “nonlimited mindset” in their everyday life. To do that participants formed an implementation intention (Gollwitzer, 1993). This method has been used in previous interventions to help people to translate their intentions into behavior (for a review, see Gollwitzer & Sheeran, 2006). In the present study we used implementation intentions to assure that people remembered to practice a “nonlimited willpower mindset” in situations that required self-control in their everyday life.

Finally, we examined two different kinds of self-regulatory demands. First, we assessed students’ course load, as a more objective measure of demands, which should moderate the effect of the treatment on students’ procrastination. Second, we assessed students study habits in their least favorite class. Independent of students’ course load, studying for a disliked class should be particularly taxing and require a lot of self-control. Thus, the treatment should predict better study habits for this class.

Method

Overview

We conducted an online study with a randomized control group design with one treatment group and two control groups. Similar to Experiment 1, one control group received a control message and underwent the same procedure as the treatment group. Another control group received no treatment and only filled in the baseline and dependent measures. The procedure consisted of four 30-minute online sessions spaced over a period of six weeks.

Participants

The sample consisted of 129 students (49 female, $M_{\text{age}} = 21.9$ years, Range: 18-35 years) from a highly selective university in the western U.S. and was diverse in terms of academic year (44 freshmen, 22 sophomore, 18 junior, 30 senior, 9 post senior masters students, 6 no indication) and ethnic background (65 European American, 12 African American, 7 American Indian, 42 Asian, 5 Native Hawaiian, 12 Spanish). Participants were recruited from the participant pool for a “Study about College Students’ Experiences.” Participants were informed that the study has multiple sessions spaced over one and a half month and that they were contacted multiple times via email to complete different online sessions of 15 to 45 minutes length. Participants received \$16 per hour involvement in the study worth in gift cards for a popular online store.

Because the study was conducted online we included different measures of treatment adherence throughout. For instance, we measured how long participants spent on reformulating the treatment message in form of a personal letter and asked control question about the practice phase. Eight participants did not write anything or spend less than 30 seconds writing their personal letter, and one participant reported not having engaged in the assigned practice task at all. These participants were excluded from the main analysis.

Procedure

Pre-treatment survey. Participants filled in a 20-minute online survey including demographic questions and baseline measures of procrastination and study habits for a disliked class. At the end of the survey participants were randomly assigned to the *nonlimited willpower group* ($n = 43$), the *strategy group* ($n = 43$), or the *no-treatment group* ($n = 43$). Only participants in the nonlimited willpower group filled in a biased version of the willpower theory scale (Job et al., 2010). Because this biased version of the willpower theory measure was part of the manipulation, we did not assess implicit theories about willpower at baseline.

Treatment and control session. One week later, only participants in the nonlimited willpower group and the strategy group were invited to fill in another 30-minute online survey. The no-treatment group was not contacted. At the beginning of the session, they were told that one aim of the study was to help younger students who were struggling with their studies (Aronson et al., 2002). For that reason they would be asked to write a personal letter to a younger student in which they shared their knowledge and experience on study-related topics. After this introduction the program randomly assigned participants to the treatment or control group.

Participants in the nonlimited willpower group read an article describing how thinking about willpower as limited can undermine performance on difficult tasks and how thinking of willpower as nonlimited can help people persist in demanding tasks. Next, participants were asked to think of a situation from their past when they worked hard on a task and their willpower helped them to keep going and work through this challenge. They then described this situation in a text box. On the next page there asked to type a personal letter to a younger students into a text box presented in the middle of the page. They were instructed, “In your letter speak directly to the student and explain 1) why it is mistaken to think of willpower as something that is limited, and 2) why adopting a view of willpower as nonlimited can help them do better in school. Be sure to illustrate your letter with examples from your own experiences at school, in which you learned to view willpower as nonlimited, and how this has helped you work hard and persevere in the face of difficulties and challenge. You may use the example you just described.” Participants wrote for up to 20 minutes. Because there was no minimum time set, we measured how long participants spent writing their letter to be able to control for it in the analysis.

Finally, participants were guided to form an implementation intention to practice a “nonlimited willpower mindset” within the upcoming week. To continue the cover story, participants were told that they were about to pretest a new teaching method that was

designed for high school students. They were told, “Within the next 5 minutes we want you to make a concrete plan when you are going to test the “nonlimited willpower mindset” within the next 5 days. We will ask you to set this plan into action within the next 5 days. After that we will contact you to get your thoughts about this method. Please take this seriously because your data will be used to tailor future interventions for high school students.” Then they were asked to “...think of something tedious you have to work on during the next 5 days (e.g., paper, problem-set, learning for exams) and briefly describe it in the field below.” Then they were told that their plan for the next 5 days was “Every time I start to work on [name of demanding task] I will remind myself that my willpower is nonlimited and that I can keep working for a long time without getting distracted.” Last, they were told to set the plan into action within the upcoming 5 days and to write their plan down on a sheet of paper and to keep it until they were contacted again.

The strategy group followed the same procedure but received a control version of the article, which argued that some people mistakenly think that time management is complicated while in fact everybody can learn strategies for better time management. Then participants were asked to describe an experience when they worked on a tedious task and a time management strategy helped them to meet a deadline. Last, they wrote a personal letter to a younger student about 1) why it is mistaken to think of time management as something complicated and 2) why using simple strategies can help students to do better in school. After that the strategy group was also instructed to form an implementation intention to pretest an ostensible teaching method designed for younger students. They were told, “Within the next 5 minutes we want you to make a concrete plan when you are going to test the “chunking technique” within the next 5 days.” Similar to the willpower group they thought of and described a tedious task they had to work on during the next 5 days and were then told that their plan for the next 5 days was “Every time I start to work on [name of demanding task] I will chunk the task into smaller subtasks.” Last, they were also told to set the plan into action

within the upcoming 5 days and to note their plan on a sheet of paper and to keep it until they were contacted again.

Follow-up survey. After 5 days, participants in the willpower and the strategy group were invited to a 5-minute questionnaire including control questions about the practice phase. They were asked “How often have you worked on the task since the previous session?” ($I = \text{Never}$ to $5 = \text{More often}$), and “How often did you remind yourself that willpower is not limited before or while working on the task? / How often did you split the task into smaller chunks before working on the task?” ($I = \text{Never}$ to $7 = \text{Always}$). The no-treatment group was again not contacted.

Post-treatment survey. Four weeks after the practice phase all groups, including the no-treatment group, filled in the dependent measures for implicit theories about willpower, procrastination, study habits in a demanding class, and a measure for self-control demands. Last, participants were debriefed and thanked for participation.

Measures

Implicit theories about willpower. Willpower theories were assessed after the intervention using the same items as described in Experiment 1 ($\alpha = .80$). All items were answered on a 6-point scale ($I = \text{Strongly agree}$ to $7 = \text{Strongly disagree}$).

Study habits in a demanding class. At baseline participants were asked: “Please think of the class that you like least in this quarter (maybe because the topic doesn't interest you very much or because it is hard to follow). Write down the title of the class in the box below.” Then we asked them to rate eight items with regard to this class. Five items assessed their study habit (e.g., “I often feel so lazy or bored when I studied for this class that I quit before I finish what I planned to do”, “I work hard to do well in this class even if I don't like what we are doing” [reverse scored], $\alpha = .72/ .76$). Further, three items assessed their level of motivation to do well in this class (e.g., “Getting a good grade in this class is the most

satisfying thing for me right now”, $\alpha = .71/.72$), which was used as control variable. All items were answered on a 6-point scale ($1 = Strongly agree$ to $6 = Strongly disagree$). In the post-treatment survey the name of the class was presented again and participants rated the same eight items.

Procrastination. At baseline and after the intervention procrastination was assessed using identical items to those used in Experiment 1 ($\alpha = .72/.87$). All items were answered on a 7-point scale ($1 = Never$ to $7 = Two times per day$).

Self-control demands. As an objective measure of self-control demands participants indicated how many classes they were taking in the current quarter. Participants responded by typing a number into an open response field ($M = 4.16$; $SD = 1.62$). One outlier with 12 classes ($> 3 SD$ above mean), who probably reported the number of credit points, was excluded from the main analyses on procrastination.

Results

Preliminary analysis

Pre-treatment differences. Overall, 40 (31.0%) participants who had completed the baseline survey did not complete the post-treatment survey, leaving a sample of 87. The dropout rate was similar for all groups, $X^2(2) = 0.72$, ns . Dropout analyses confirmed that those who dropped out did not differ from participants remaining in the study on any measure assessed at baseline, $ts < 1.22$, ns . Next, we analyzed whether the groups differed before treatment using X^2 -test for gender composition and multiple linear regression for baseline measures of procrastination and study habits. Groups did neither differ in their gender composition, $X^2(2) = 3.54$, $p = .173$, nor in class-specific self-regulation or procrastination, $ts < 1.64$, ns . The results suggest that randomization was successful.

Treatment Effects

Implicit theories about willpower. As summarized in Table 10, the nonlimited willpower group reported lower agreement with a limited theory four weeks after the treatment. Because, we did not have a baseline measure of willpower theories we compared the agreement with a limited theory in a simple *t*-test collapsing the two control groups the difference was marginally significant, $t(74) = -1.84, p = .064, 95\% \text{ CI } [-0.71; 0.02]$. Participants in the nonlimited willpower group agreed less with a limited theory than participants in the control groups.

Procrastination. Next, we tested whether the treatment was effective in reducing students' level of procrastination and whether the treatment was particularly effective for students with a high course load. We conducted a hierarchical linear regression analysis and predicted levels of procrastination post-treatment. In the first block, we entered the (standardized) measure of pre-treatment procrastination and three dummy variables to test the group differences. In the second block, we entered (standardized) course load and the three interaction terms with the dummy variables.

In the first block, procrastination at baseline had a significant effect on procrastination after the treatment, $b = .81, se = .14, t(73) = 5.63, p < .001, 95\% \text{ CI } [0.53; 1.08], \text{ Adjusted } R^2 = .28, F(3, 73) = 10.62, p < .001$. However, there was no main effect of the treatment on procrastination, $t < 1, ns$. In the second block, there was no main effect of course load, $b = -.29, se = .25, t(70) = -1.18, p = .242, 95\% \text{ CI } [-0.78; 0.20], \text{ Adjusted } R^2 = .32, F(6, 70) = 7.03, p < .001$. However, the interaction between course load and the dummy comparing the nonlimited willpower group against the strategy group was significant, $b = .97, se = .36, t(70) = 2.68, p = .009, 95\% \text{ CI } [0.26; 1.67]$. The pattern of the interaction is depicted in Figure 8. Simple slope analysis showed that among students with a high course load those in the nonlimited willpower group procrastinated less than those in the strategy group, $b = 1.07, se = .47, t(70) = 2.29, p = .025$. When course load was low there was no difference between

groups, $b = -.63$, $se = .46$, $t(70) = -1.37$, $p = .175$. In the strategy group students with high course load procrastinated significantly more than students with low course load, $b = .68$, $se = .27$, $t(70) = 2.51$, $p = .014$. Within the nonlimited willpower group there was no difference in procrastination for students with high and low course load, $b = -.29$, $se = .25$, $t(70) = -1.18$, $p = .242$. However, course load did not moderate the difference in procrastination between the nonlimited willpower and the no-treatment group, $ts < 1$.

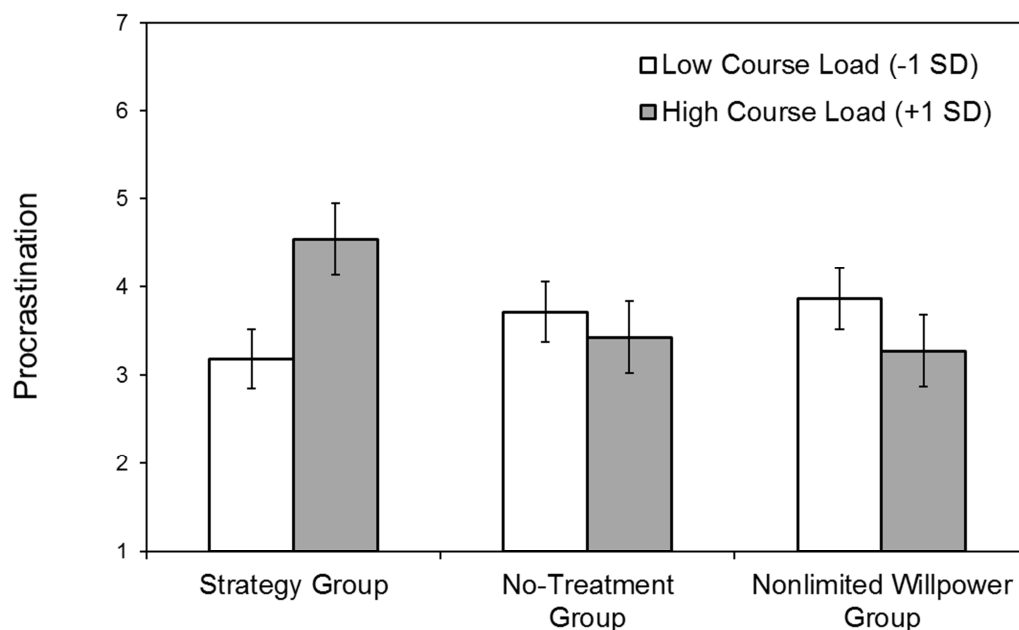


Figure 8. Procrastination predicted by group membership and course load in Experiment 2. Error bars show $\pm 1 SE$.

Study habits in a demanding class. Finally, we tested whether the nonlimited theory treatment affected students' study habits in their least favorite class. Again, we conducted hierarchical linear regression analysis. The first block included all (standardized) control variables, namely self-control at baseline, $b = .56$, $se = .10$, $t(71) = 5.82$, $p < .001$, 95% CI [0.37; 0.75], the motivation to do well in the class at baseline, $b = .50$, $se = .13$, $t(71) = 3.71$, $p < .001$, 95% CI [0.23; 0.77], and after the intervention, $b = -.68$, $se = .13$, $t(71) = -5.11$, $p <$

.001, 95% CI [-0.94; -0.41], Adjusted $R^2 = .45$, $F(5, 71) = 13.50$, $p < .001$. The second block included the dummy variables coding group membership. As expected, students in the nonlimited willpower group reported better self-regulation than students in the strategy group, $b = .51$, $se = .23$, $t(71) = 2.25$, $p = .027$, 95% CI [0.06; 0.97], and students in the no-treatment group $b = .53$, $se = .24$, $t(71) = 2.23$, $p = .029$, 95% CI [0.06; 1.01]. When comparing the nonlimited willpower group against both control groups simultaneously the effect was marginal significant, $b = .48$, $se = .24$, $t(72) = 1.95$, $p = .055$, 95% CI [-0.01; 0.96]. As expected, the treatment seemed to have improved study habits for a demanding class.⁸

Discussion

Replicating the results of Experiment 1 the intervention was effective in changing willpower theories. Participants who received the nonlimited willpower treatment agreed more with a nonlimited theory than participants who received a control treatment or no treatment. Compared to Experiment 1, the treatment included additional methods to buttress the transfer of the treatment message to everyday life. For instance, participants advocated the message that willpower is not limited in a personal letter to a younger student and connected it to their own experiences in school (e.g., Aronson, 1999; Aronson et al., 2002; Walton & Cohen, 2007, 2011). Further, participants built an implementation intention and practiced to think of their willpower as not limited whenever they worked on a demanding task for a period of 5 days. In contrast to Experiment 1, the treatment also showed effects on students' self-regulation, particularly under high self-regulatory demands. Participants in the treatment group reported better self-regulation for their least favorite class than participants in both control groups. The nonlimited treatment helped students to study uninteresting course material, independent of how important it was for them to perform well in that class. Second,

⁸ We conducted mediation analysis to test whether post-treatment willpower theories mediated the effect of the treatment on procrastination and study habits. However, the indirect effects were not significant, $ts < 1$, nor was there a significant reduction in the direct effects, $ts < 1$.

students in the nonlimited willpower group procrastinated less under high course load than students receiving the control treatment.

General Discussion

Research suggests that endorsing a nonlimited theory about willpower is functional for self-control performance, particularly when self-regulatory demands accumulate (Job et al., 2010; Job, Walton, et al., 2015). In two experiments we tested whether nonlimited theory treatment can cause long-lasting changes in willpower theories and promote self-control in everyday life. In both studies, we found that several weeks after the treatment participants agreed less with a limited theory compared to students who received a control treatment or participants without treatment. In Experiment 1, where participants processed the nonlimited willpower message and strategies by reading and drawing illustrations, the treatment did not affect students' procrastination. Experiment 2 involved four important modifications: a) the sample was drawn from a population of students, who face high self-control demands at the end of the semester, b) participants filled in the nonlimited theory questionnaire before receiving the treatment message, c) participants processes the message using the "saying is believing" effect, and d) participants formed an implementation intention to apply the treatment message to critical situations in their everyday life within a 5-day practice phase. Using this modified treatment, Experiment 2 found that among students with high course load procrastination decreased compared to an active control group. There was no improvement in procrastination compared to the no-treatment control group. However, the treatment improved students' study habits in a disliked class compared to both control groups.

We did not find that group differences in willpower theories measured after the treatment mediated the effect on procrastination or study habits. The finding that willpower theories did not function as mediator of the treatment effects was previously reported in other willpower-theory interventions (Aronson et al., 2002; Blackwell et al., 2007). There might be

several reasons for this. One might be a restricted range problem on the willpower theory scale, such that the manipulation might have created a ceiling effect in the experimental condition (Aronson et al., 2002). Further, in Experiment 2, we did not have a baseline measure for willpower theories and thus were not able to test whether *change* in willpower theories might drive the effects on *change* in procrastination and study habits. Another possibility is that we did not have sufficient power to reliably detect indirect effects due to the relatively small sample size.

Theoretical Implications

Previous studies suggest that the majority of people tend to agree more with a limited theory about willpower and that this belief is associated with a number of negative consequences, such as poor self-control in everyday life or poor academic performance (Job, Walton, et al., 2015). The present findings suggest that people are not stuck with their belief about willpower. Instead, it seems that these beliefs are malleable and people can learn to adopt a nonlimited theory about willpower. However, the findings also suggest that simply making people adopt a nonlimited willpower theory is not sufficient to observe self-control improvements. Instead, the new belief must be reinforced through everyday life experiences to translate into self-control behavior. The combined treatment that included a 5-day practice period was effective in improving students study habits for a demanding class. Previous longitudinal studies have already documented that endorsing a nonlimited theory is particularly functional, particularly when people face high self-regulatory demands (Job et al., 2010; Job, Walton, et al., 2015). The present research provides the first experimental evidence for the functionality of a nonlimited theory for self-control in everyday life.

Within the past decade researchers examined a number of different ways and strategies to improve self-control. For instance, many interventions were inspired by the strength model of self-control, which postulates that willpower is a limited resource that can

be enlarged by regular self-control training. Following this idea participants were led to engage in small self-control exercises (e.g., monitoring their posture, squeezing a handgrip as long as possible) for a period of two weeks up to two months (Baumeister, Gailliot, DeWall, & Oaten, 2006; Muraven et al., 1999; Muraven, 2010; Oaten & Cheng, 2006a, 2006b, 2007). Other interventions found that children's executive functions can be improved by building up self-regulatory skills, for instance, with computer-based training or traditional martial arts (Diamond, 2012). Other interventions found that motivational techniques, such as bridging the gap between intention and behavior improves self-control (Duckworth et al., 2011; Sherman, Mann, & Updegraff, 2006). The idea that people hold different beliefs about willpower opens a completely new perspective on the mechanisms by which these may interventions work. The experience of being able to successfully exert self-control should also affect people's beliefs about their willpower. In turn, people's beliefs may shape expectations, goals, and behavior in subsequent situations. Hence, beliefs about willpower might be one important ingredient that contributes to long-term effectiveness of different self-control interventions.

From a broader perspective, there are lots of places people get their beliefs about willpower from, including from scientific articles like our intervention, but also perhaps from daily experiences. In daily efforts at self-control, people may simultaneously build their self-control resources or skills, but also come to hold beliefs that are congruent with greater self-control. It may be this confluence between beliefs, skills, and resources that are important for promoting self-control in everyday life (Vohs et al., 2013). Correspondingly, a central question for future self-control interventions may be how to implement practices that promote positive willpower beliefs in people's daily activities.

Implications for Future Interventions

The present interventions were both administered on the internet only. Internet-based interventions became more popular within the past decade not at least because of their numerous advantages over the typical laboratory setting (Barrera, Glasgow, McKay, Boles, & Feil, 2002; Heron & Smyth, 2010; Wangberg, 2008; Ybarra & Bull, 2007). For instance, they do not involve any face-to-face interaction between participant and experimenter preventing any sort of experimenter bias. Further, online studies are cost effective and save resources on the side of experimenter and participant. Additionally, internet-based interventions can potentially reach out to a large number of people, in diverse locations, as well as to specific groups of people that are difficult to recruit for laboratory studies, such as working adults, parents, or the elderly. However, the use of the internet also comes with some disadvantages. For instance, in Experiment 2, we had a number of participants who dropped out and others that did not comply with the instructions. Due to the low experimental control noncompliance and drop out is still a huge problem for online studies and can cause selective samples (Reips, 2002). However, drop out analyses suggest that selection was not a problem in the present studies. However, future studies that use relatively complex treatments that require a lot of involvement from participants might choose a more controlled setting, at least for the main parts of the manipulation. Another possibility is that studies use experience-sampling methods to support the compliance with the treatment (e.g., Heron & Smyth, 2010). For instance, participants might receive reminders during the practice phase. In the present research we used implementation intentions to assure that people gained experience with the nonlimited theory, but found that participants practiced only a moderate amount. Short reminders sent via smartphone or email might increase the effectiveness of the treatment.

Conclusion

Previous studies suggest that endorsing a limited theory about willpower is dysfunctional for self-control performance in everyday life (Job, Walton, et al., 2015). The present research suggests that implicit theories about willpower are malleable and people can learn to adopt a nonlimited theory about willpower. However, simply teaching a nonlimited theory might not be sufficient to promote self-control performance. Instead, people need to be guided to discover the true capacity of their willpower and grow a nonlimited theory through these experiences. More research is needed to investigate how we can implement such practices that promote a nonlimited willpower belief into people's everyday life.

General Discussion

The present research aimed to examine the consequences of people's beliefs about willpower—whether they believe it is a limited or nonlimited resource—for self-control in everyday life and three important outcomes related to self-control, namely achievement, health, and well-being. Previous laboratory studies have already documented the effects of willpower theories on self-control performance (Job et al., 2010; Miller et al., 2012). They consistently found that the belief that willpower is a limited resource that gets easily depleted (*limited theory*) versus not limited and self-sustaining (*nonlimited theory*) undermines self-control performance (Job et al., 2010; Miller et al., 2012). The two main questions that guided the present research were whether a) people's beliefs about their willpower matter for self-control in the real world and b) whether changing beliefs about willpower can lastingly improve self-control performance.

Summary of the present findings

Based on the present findings the preliminary answer to both questions is: yes. Across studies we find that endorsing a limited theory about willpower is associated with lower self-control performance in everyday life, lower academic achievement (Part I), less health-promoting behavior and psychological adjustment (Part II), and lower subjective well-being (Part III). Further, the present findings suggest that teaching people a nonlimited theory results in better self-control, if combined with methods that help people transfer the nonlimited theory into their everyday life (Part IV). In general, the results suggest that endorsing a limited theory is maladaptive for self-control in everyday life and can thus have negative consequences with regard to achievement, health, and subjective well-being.

However, the findings also suggest that the more correct answer to both questions is: It depends. Across studies a recurring pattern is that willpower theories are particularly important when people temporarily or chronically face high self-regulatory demands. This

interactive pattern reflects the core of willpower theories as expectation about the capacity to continuously exert self-control. In other words, beliefs about willpower do not refer to people's general capacity to self-control, but instead reflect their expectations about fluctuations in self-control due to previous or ongoing self-control demands. Corroborating this theoretical assumption, the present research found not only main effects of willpower theories but also interaction effects with self-regulatory demands. For instance, self-control in everyday life (e.g., procrastination) was particularly impaired by a limited theory among students with high self-regulatory demands (Part I). Further, endorsing a limited theory was related to a lower grade point average, particularly among students with a high versus low course load (Part I). In a similar vein, the effects of willpower theories on diabetes patients' self-care and diabetes-related distress were significantly larger for patients who were shortly diagnosed with diabetes (Part II). Perhaps, after years of being diagnosed with diabetes patients develop self-care habits that substitute self-control and thereby reduce the self-regulatory demands implied by the disease. Finally, the nonlimited-theory intervention was only effective in reducing procrastination among students with high course load and improved study habits for a particularly demanding class (Part IV).

The only outcome for which we did not find an interactive pattern with self-regulatory demands was subjective well-being (see Part III). Perhaps, willpower theories have a main effect on subjective well-being, because the proposed mechanism, personal goal progress, already "includes" the interaction of willpower theories and self-regulatory demands. During the pursuit of a long-term personal goal people will very likely experience times of high self-regulatory demands. Probably it is within these periods when people with a limited theory make less progress on their goals than people with a nonlimited theory. In line with this assumption, a previous study found that a limited theory was related to self-regulation for a challenging personal goal during the demanding exam period but not during the less demanding mid-phase of the term (Job et al., 2010, Study 4). In the present study, we assessed

goal progress over the course of a term and found an indirect effect of willpower theories on goal progress (mediated by the perceived availability of resources). Goal progress in turn was directly linked to subjective well-being, replicating previous research (Brunstein, 1993). In sum, the present research findings suggest that willpower theories predict self-control performance, particularly when people are confronted with high self-control demands, instead of predicting individual's general capacity to self-control (e.g., their self-control in non-demanding phases).

As additional support for this assumption, we consistently find that trait self-control, which reflects individual's general capacity to self-control (Tangney et al., 2004), does not account for the proposed relationships between willpower theories and the respective outcomes. Willpower theories predict students' self-control in everyday life as well as their academic performance above and beyond effects of trait self-control (Part I). The same is true for the relationship of willpower theories and treatment adherence or psychological adjustment in diabetes patients (Part II), as well as the effect of willpower theories on change in subjective well-being (Part III, Study 2). Further, the effects of the manipulation of willpower theories on self-control speak against the role of third variables, like trait self-control (Part IV). To sum, the present research suggests that the effects of beliefs about willpower are independent of people's general capacity to self-control. Beliefs about willpower and trait self-control seem to resemble largely independent constructs that affect outcomes via different routes.

Limitations of the Present Research

One limitation of the present research is the use of mainly correlational designs. One problem of correlational designs is that there is an infinite number of possible confounds that could possibly account for the proposed relationships. Another problem is the inability to

draw conclusions about the direction of causality (e.g., do willpower theories affect treatment adherence or vice versa?).

To address the first problem in some studies trait self-control, as the theoretically closest and therefore most plausible confounding variable, was assessed and statistically controlled. However, the present studies failed to rule out other possible third variables, such as general beliefs (e.g., optimism, self-efficacy), cognitive complexity (e.g., intelligence) or motivational variables (e.g., regulatory focus). Although it is possible that these variables show overlap with willpower theories and the respective outcomes, it is very unlikely that they can account for the interactive effects with self-control demands that repeatedly emerged in our data. For general beliefs, intelligence, or regulatory focus, there is no reason to assume that they interact with self-control demands to predict self-control performance. Nevertheless, future studies should assess and control for these and other possible third variables to further test the incremental value of willpower theories for predicting important outcomes.

To address the second problem, direction of causality, the use of more longitudinal and experimental designs would have been preferable. However, most of the outcomes and processes under study in the present thesis (e.g., life satisfaction, self-care behavior, personal goal progress) are impossible to observe in the limited time frame of a laboratory experiment. Thus, experimental evidence has to come from intervention studies that manipulate willpower theories and assess the effects of this manipulation in the long-run. In this regard, the studies reported in Part IV are promising and provide a starting point for future research.

Unfortunately, the effect sizes observed for the willpower theory intervention on self-control performance were quite small (Part IV). One possible explanation for this is that the interventions were conducted online, where experimental control is naturally low. Although the Internet has generated a great interest in online interventions in the past decade, the present studies suggest that it may not provide an ideal setting for manipulations that require a lot of involvement from participants (e.g., writing a personal letter). The dilemma of

online studies is that researchers sit between chairs regarding experimental control and drop-out. Stepping up the experimental control (e.g., forcing people to write a certain amount) is very likely to increase the number of drop-outs and might result in a selective sample (Reips, 2002). On the other hand, lowering experimental control might lead to greater noncompliance. Within the present studies, we decided to keep levels of experimental control low and rather include measures for participant compliance to be able to exclude noncompliant participants. Of course, this procedure is not ideal, because data from noncompliant participants has to be excluded from the analyses. However, if future studies would aim for larger sample sizes, noncompliant participants might even be useful to test whether different “doses” of the manipulation produce different effect sizes and to identify essential parts of the manipulation. Unfortunately, within the present studies such analyses were not possible due to the small sample size. However, since the effectiveness of the willpower theory intervention is not well established yet, a first step for future studies might be to administer important parts of the intervention in the laboratory and not online (e.g., Aronson et al., 2002; Blackwell, Trzesniewski, & Dweck, 2007; Walton & Cohen, 2007). Therefore, the present studies can only be regarded as starting point for future interventions, which may be able to collect experimental evidence for the effects of willpower theories on real-world outcomes (e.g., health behavior, subjective well-being), complementing our correlational findings.

Another limitation of the present research is the overly use of self-report measures to assess the outcome variables (except for the official grades collected in Part I). First, because willpower theories are also measured via self-report common-method variance may have inflated the overlap between willpower theories and the respective outcome variables. Second, self-report measures are more likely biased by conscious (e.g., social desirability) or unconscious processes (e.g., memory biases) than more objective behavioral measures (Fredrickson & Kahneman, 1993; Kahneman & Krueger, 2006). Therefore, behavioral

measures are often regarded as the “to-be-preferred” measure in social psychology (Baumeister, Vohs, & Funder, 2007).

Within recent years the vast technological progress (e.g., computers, smartphones) has increased the opportunities for researchers to objectively measure people’s behavior and physiological states, such as tracking their mobility, their social interactions, their eye movements, or their heart rate (Mehl & Conner, 2012). In upcoming years this development will probably go on and lastingly change the field of social psychology, where the collection of behavioral data becomes easy and inexpensive. However, one has to be aware that behavioral and physiological measures come with their own challenges. The most obvious is that they are difficult to interpret. The question will always be: what is it that we measure? A good example for this problem is heart-rate-variability, which has been interpreted as indicator for self-control, fatigue, effort, and regulated emotional responding (e.g., Appelhans & Luecken, 2006; Segerstrom & Nes, 2007). Measuring psychological constructs with objective measures will always have the problem of subjective interpretation.

Interestingly, in economics, a field that has traditionally been reluctant to the use of subjective measures, there currently seems to be an opposing trend (e.g., Oswald & Wu, 2009). The Commission on the Measurement of Social and Economic Progress argued in their last report: “Another key message, and unifying theme of the report, is that the time is ripe for our measurement system to *shift emphasis from measuring economic production to measuring people’s well-being.*” (Stiglitz, Sen, & Fitoussi, 2009, p. 12). Further it is argued that, “Measures of both objective and subjective well-being provide key information about people’s quality of life. Statistical offices [worldwide] should incorporate questions to capture people’s life evaluations, hedonic experiences and priorities in their own survey” (Stiglitz et al., 2009, p. 16). To conclude, both types of measures, subjective and objective, have their pitfalls and researchers should try to pursue a multi-method approach to avoid common-method bias and to be able to cross-check the validity of their behavioral measures.

Open Questions and Future Directions

Although research on self-control has prospered within the past two decades there are many open questions that future research should address. With regard to willpower theories one question is how many different self-control domains are there that people hold implicit theories about. Many different behaviors have recently been proposed as being related to self-control, such as making choices (Baumeister, 2002), forgiving (Balliet, Li, & Joireman, 2011), or withstanding pain (Silvestrini & Rainville, 2013). Future research should investigate whether there is the need to measure willpower theories for each domain of self-control or whether there is one underlying factor, which predicts behavior across self-control domains. In the present research, we find that items measuring willpower theories for different domains of self-control (e.g., remaining in strenuous mental tasks, resisting temptations, or remaining in strenuous physical activities) build one homogenous scale, suggesting one underlying factor. On the other hand, the findings of Part II suggest that the separate subscales might have higher predictive power for domain-specific self-control behavior. In this study, willpower theories about resisting temptations were associated with a healthy diet and willpower theories about strenuous physical activities were associated with physical exertion. None of these outcomes was significantly related to the combined scale.

The question of domain-specificity of willpower beliefs is strongly intertwined with the domains that are studied within the self-control literature. Critical voices argue that self-control plays a role in so many diverse aspects of human behavior that the topic is in danger of losing its boundaries (Mischel, Cantor, & Feldman, 1996). Thus, the goal of future research on both self-control and willpower theories should be to determine a reasonable number of subscales that adequately cover the most important domains of self-control. Developing a single scale that covers several self-control domains, based on the model of the trait self-control scale (Tangney et al., 2004), might be an important project for future research on willpower theories.

Another important question for future research is how the idea of willpower theories can be integrated with other theoretical approaches to self-control. For instance, Mischel and colleagues (2011) argue that self-control is determined by the use of functional strategies that people can use when confronted with a temptation (e.g., not attending to the tempting stimulus; thinking about its non-consummatory features). The use of effective self-control strategies might be a possible way to buffer the negative influence of a limited theory on self-control performance. Thus, the spontaneous use of self-control strategies might be a moderator for the effects of willpower theories on self-control performance. Indeed, previous studies found that there is greater variance in self-control performance among people with a limited theory than among people with a nonlimited theory (Job, Bernecker, Miketta, & Friese, 2015). This pattern suggests the presence of moderators, such as the use of self-control strategies. In the future, intervention studies should test whether people with a limited theory can profit from the use of self-control strategies. For instance, when confronted with a temptation they might profit from strategies like self-distraction or cognitive reappraisal of the stimulus (Mischel et al., 2011). Or when working on a strenuous mental task people with a limited theory might profit from task switching or the strategy to delay the break on a later but undefined time point. Thus, future interventions could use a strategy approach to buffer the effects of a limited theory instead of changing willpower theories. It is further possible that the use of effective self-control strategies would lead to a change in beliefs about willpower. As mentioned earlier in Part IV, it might be the confluence between beliefs and experiences that contributes to successful self-control.

Another interesting combination between the willpower theory and the strategy approach would be to look at strategies that people prospectively use to avoid self-control situations in the first place – also known as *prospective self-control* (Fujita & Roberts, 2010). It has been shown that people spontaneously use different strategies to support their self-control, such as committing to self-imposed deadlines (Ariely & Wertenbroch, 2002), making

rewards contingent on self-control success (Trope & Fishbach, 2000), or regulating the availability of temptations (Wertebroch, 1998). Willpower theories might be related to the use of prospective self-control strategies as well. Previous research suggests that people with high trait self-control are better able to avoid temptations (Hofmann, Baumeister, Förster, & Vohs, 2012; Imhoff, Schmidt, & Gerstenberg, 2013). Ironically, this might be the reason why people with high versus low trait self-control perform worse when confronted with temptations (Imhoff et al., 2013). Their ability to successfully avoid temptations may result in a lack of experience in resisting acute temptations (Imhoff et al., 2013). In the case of willpower theories it seems plausible that people with a nonlimited theory use prospective self-control strategies less often, because they feel well-equipped to deal with challenges of their willpower. In contrast, people with a limited theory might have better prospective self-control and are more active in trying to avoid situations that require self-control, because they fear that they will not have sufficient willpower to withstand a temptation. Thus, studies may investigate whether in real-world settings willpower theories are related to the spontaneous use of prospective self-control strategies. It would be interesting to see whether people with a limited theory use prospective strategies to make up for their belief of insufficient willpower.

Finally, I want to outline some ideas for future research on the strength model. In recent years researchers became increasingly doubtful about the model's basic tenet of a limited resource and many alternative explanations for the phenomenon of ego depletion have been proposed (e.g., Inzlicht et al., 2014; Inzlicht & Schmeichel, 2012; Job et al., 2010; Kool & Botvinick, 2014; Kurzban, Duckworth, Kable, & Myers, 2013). However, some of the model's central assumptions have only received little attention. Examining these assumptions could possibly falsify the model and shed light on the processes that underlie continuous self-control.

For instance, the strength model assumes that self-control performance (i.e., the ego depletion effect) should be proportional to the amount of self-control previously exerted

(Hagger et al., 2010). This “consumption hypothesis” has been tested in few studies and one meta-analysis so far. Ironically, these studies find smaller depletion effects when participants engage in multiple instead of one initial depletion task (Converse & DeShon, 2009; Xiao, Dang, Mao, & Liljedahl, 2014). Converse and DeShon (2009) argue that over the course of the initial tasks people adjust their expectation of the upcoming task and refer to the phenomenon of learned industriousness (Eisenberger, 1992). Learned industriousness describes the finding that performance in cognitive and physical tasks *increases* as a function of previous demands, if contingently rewarded (Eisenberger, 1992). Inconsistent with these results, Hagger and colleagues (2010) find supporting evidence for the consumption hypothesis in their meta-analysis. They found that studies with longer depletion tasks reported a slightly greater ego depletion effects (Hagger et al., 2010). Thus, there is inconsistent evidence for the “consumption hypothesis”. Part of this inconsistency might be explained by the differences in the administration—whether self-control is previously exerted in multiple tasks or in one lengthy task. Importantly, the strength model does not make different predictions for these two cases. According to the strength model the ego depletion effect should be invariant to these differences in administration. Future studies are necessary to systematically vary the amount of self-control exerted in the depletion phase by manipulating the task duration, the number of self-control tasks, or the self-control demands of the task itself (e.g., single-interference task versus multiple-interference task). An inconsistency in the depletion effect with these variations of the dual-task paradigm would call at least for a refinement of the model or suggest some important boundary conditions to the phenomenon of ego-depletion.

Further, from the nature of the relationship between amount of self-control exerted and the ego depletion effect one might be able to distinguish between different suggested mechanisms, namely resource depletion (Baumeister et al., 1998), motivated resource conservation (Muraven et al., 2006), or psychophysiological processes (e.g., Marcora et al.,

2009). Resource depletion should result in a linear relationship, because consumption of the resource should remain stable over time—just as a muscle uses the same energy to lift a weight there should be no change in the energy expended on the same task. But, there is empirical evidence suggesting that people have the natural tendency to conserve resources (Muraven et al., 2006). If the motivation to conserve resources underlies the ego depletion effect one should observe an accelerating power trend, because resources become (subjectively) more valuable over time (Muraven et al., 2006). Finally, if physiological processes underlie ego depletion, one might observe a decelerating power trend, because many psychophysiological processes follow a logarithmic function (e.g., Fechner, 1860; Weber, 1834). The systematic investigation of the relationship between amount of self-control exerted and the depletion effect might enable researchers to discriminate between the different mechanisms that have been suggested.

Another central assumption of the strength model is that self-control resources recover in times when no self-control is exerted. Accordingly, introducing an interim period between the depletion task and the dependent self-control task should result in a smaller depletion effect. So far, only two studies and a meta-analysis have investigated the effect of an interim period on the ego depletion effect (Hagger et al., 2010; Tyler & Burns, 2008). Consistent with the recovery hypothesis, findings indicated that depleted but rested individuals exhibited superior performance on the second task relative to depleted controls, who were not given the opportunity to rest or relax. Further, the studies find evidence for a “dose effect,” such that the restoration of self-control capacity is proportional to the duration of the recovery period (Tyler & Burns, 2008). In their meta-analysis, Hagger and colleagues (2010) also tested the effect of an interim period across multiple studies. They compared the size of the ego depletion effect between three types of studies: a) those reporting no interim period, b) those administering manipulation check questions, and c) those reporting a filler task or rest period between tasks. Ironically, the depletion effect for studies reporting no interim period is

significantly *smaller* than for studies reporting filler questionnaires or a filler task or rest period. Again, the findings regarding the recovery hypothesis are inconsistent and warrant further investigation.

In sum, some of the central assumptions of the strength model have not been systematically tested yet. This is very surprising given the large amount of research that the model inspired over the past two decades (Hagger et al., 2010). Testing the assumptions of the strength model is an important step for future research to investigate the processes that underlie fluctuations of self-control performance over time.

Conclusion

Self-control is a fundamental ability that allows people to direct their behavior, emotions, and thoughts away from immediate needs, and towards long-term objectives. Social psychological research on self-control has prospered within the past two decades. This spike in interest was not at least sparked by the introduction of the strength model and its provocative assumption that self-control is based on a limited resource (e.g., Baumeister et al., 1998). In recent years, this assumption was severely challenged by findings suggesting that self-control is not shaped by an actual resources, but people's beliefs about the limits of their willpower (Job et al., 2010, 2013). The present field studies corroborate this idea and demonstrate the broader relevance of people's beliefs about willpower for self-control in everyday life and a number of important outcomes related to it. The way people think about willpower seems to not only affect people's self-control performance in the laboratory, but shape real-world outcomes, such as students' academic achievement, patients' adjustment to a chronic disease, and people's subjective well-being. Further, the present research provides initial evidence that beliefs about willpower can be changed with targeted interventions, opening a promising avenue for future interventions that aim to promote self-control in everyday life. Given their relevance for a variety of life domains and their potential for self-

control interventions, future studies should continue investigating the underlying mechanisms of beliefs about willpower and regard them as more than just an alternative explanation for the ego depletion effect.

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POSITIONS AND STUDY VISITS

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RESEARCH GRANTS AND SCHOLARSHIPS

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JOURNAL ARTICLES (PEER-REVIEWED) RELATED TO THIS THESIS

Bernecker, K., Herrmann, M., Brandstätter, V., & Job, V. (in press). Implicit theories about willpower predict subjective well-being. *Journal of Personality*.

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CONFERENCE PRESENTATIONS – TALKS (*PRESENTING AUTHOR)

Job, V., Bernecker, K.*, Herrmann, M., & Brandstätter, V. (2015, September). Implicit theories about willpower predict subjective well-being. SSP/SGP Conference, Geneva, Switzerland

Ghassemi, M.*, Herrmann, M., Bernecker, K., & Brandstätter, V. (2015, September). Should I stop or should I go? Recent findings on the action crisis as a motivational conflict between goal pursuit and goal disengagement. Paper presented at the 14th Biannual Congress of the Swiss Psychological Society (SSP/SGP), Geneva, Switzerland.

Bernecker, K.*, Job, V., Dweck, C.S. & Walton, G.M. (2013, September). Veränderung von Impliziten Theorien über Willenskraft verbessert Selbstkontrolle unter Stress [Changing lay theories about willpower improves self-regulation under stress]. Fachgruppentagung Sozialpsychologie, Hagen, Germany.

Job, V.*, Bernecker, K., & Friese, M. (2013, September). “That was exhausting, I need a break!”: A limited theory of willpower predicts rest-goal-activation following self-control exertion. 13th Congress of the Swiss Psychological Society, Basel, Switzerland.

Bernecker, K.* & Job, V. (2013, August). Implicit theories about willpower predict preference for sugar after self-control exertion. Meeting of the European Social Cognition Network (ESCON), Vilnius, Lithuania.

Job, V.*, Walton, G. M., Bernecker, K., & Dweck, C. S. (2013, August). Beliefs about willpower determine the impact of glucose on self-control. European Social Cognition Network Meeting (ESCON), Vilnius, Lithuania.

Job, V.*, Bernecker, K., & Dweck, C. S. (2013, May). Are implicit motives the need to feel certain affect? Motive-affect congruence predicts relationship satisfaction. 6th Annual Meeting of the Society for the Study of Motivation (SSM), Washington, DC.

Job, V.*, Bernecker, K. & Friese, M. (2013, May). “That was exhausting, I need a break!”: A limited theory of willpower predicts rest-goal-activation following self-control exertion. 25th Annual convention of the Association for Psychological Science (APS), Washington, US.

Job, V.*, Walton, G. M., Bernecker K., & Dweck, C. S. (2012, October). Does glucose really boost willpower? Implicit theories vs. glucose as determinants of self-control. Annual Meeting of the Society of Experimental Social Psychology (SESP), Austin, US.

Bernecker, K.* & Job, V. (2012, September). Exploring the mechanism of implicit theories of willpower. Meeting of the European Social Cognition Network (ESCON), Estoril, Portugal.

Bernecker, K.*, Job, V., Dweck, C.S., & Walton, G.M. (2012, September). Veränderung von Impliziten Theorien der Willenskraft verbessert Selbstregulation unter Stress. [Change in willpower theories predicts better self-regulation under stress.] 48th Annual meeting of the Deutsche Gesellschaft für Psychologie, e.V. (DGPs), Bielefeld, Germany.

Job, V.*, Walton, G. M., Bernecker K., & Dweck, C. S. (2012, September). Implizite Theorien vs. Glucose als Determinanten von Selbstkontrolle [Implicit theories vs. glucose as determinants of self-control]. 48th Annual meeting of the Deutsche Gesellschaft für Psychologie, e.V. (DGPs), Bielefeld, Germany.

Bernecker, K.*, Job, V., Walton, G.M., & Dweck, C.S. (2012, January). Changing lay theories about willpower improves self-regulation under stress. 13th Annual Meeting of the Society for Personality and Social Psychology (SPSP), San Diego, US.

CONFERENCE PRESENTATIONS – POSTERS (*PRESENTING AUTHOR)

Bernecker, K.* & Job, V. (2013, September). When Do People Want Sugar? 13th Congress of the Swiss Psychological Society, Basel, Switzerland.

Bernecker, K.* & Job, V. (2012, May). Implizite Theorien der Willenskraft verändern [Change implicit theories about willpower]. LiMaDoKo, Zurich, Switzerland.

Bernecker, K.*, Job, V., & Dweck, C.S. (2011, January). Explicit motives buffer ego-depletion. 12th Annual Meeting of the Society for Personality and Social Psychology (SPSP), San Antonio, US.

Bernecker, K.*, Schmidt, A.*, Wagner, S.*, & Rummer, R. (2011, March). Gibt es einen Testing-Effekt für handlungsbezogenes Wissen? [Is there a testing-effect in action-related knowledge?]. 53. Tagung experimentell arbeitender Psychologen (TeaP), Halle, Germany.

Bernecker, K.*, Job, V., & Dweck, C.S. (2010, January). Which emotions create relationship satisfaction? 11th Annual Meeting of the Society for Personality and Social Psychology (SPSP), Las Vegas, US.

Bernecker, K.*, Dressler, A.*, Feistel, P.*, & Kaufmann, M. (2008). Unterscheiden sich implizite und explizite Stereotype? [Do implicit and explicit stereotypes differ?]. 53. Tagung experimentell arbeitender Psychologen (TeaP), Marburg, Germany