

Boosting Scholastic Test Scores by Willpower: The Role of Implementation Intentions

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As both high self-efficacy beliefs (Bandura, 1997) and forming implementation intentions (Gollwitzer & Sheeran, 2006) are known to improve goal attainment, it is suggested that implementation intentions geared at strengthening self-efficacy should be a very helpful self-regulation strategy to achieve high scholastic test scores. In Study 1, female participants had to perform a math test either with the goal intention of solving as many problems as possible or with an additional self-efficacy strengthening implementation intention. In Study 2, male participants worked on an analytic reasoning test under either a mere achievement goal intention, an additional self-efficacy strengthening implementation intention, or an additional self-efficacy strengthening goal intention. In both studies, participants with self-efficacy strengthening implementation intentions outperformed the mere achievement goal intention participants. Moreover, Study 2 showed that additional self-efficacy strengthening goal intentions were not as effective as additional self-efficacy strengthening implementation intentions. The results are discussed in terms of their contribution to research on both self-efficacy and implementation intentions.

Self-efficacy is defined as a personal judgment of one's ability to perform actions leading to desired outcomes (Bandura, 1997). Expectations of personal efficacy determine which goals people choose, whether they initiate the relevant actions, how much effort they will expend in doing so, and how long effort will be sustained in the face of adversity. People who have a low sense of self-efficacy are easily discouraged by failure, whereas those who feel able to perform critical goal-directed actions intensify their efforts when their performances fall short. By affecting people's acceptance of challenges, persistence despite setbacks, execution of complex cognitive strategies, and calmness versus anxiety in the face of threat, higher self-efficacy perceptions generally promote superior performance.

Two decades of empirical research point to the positive relationship of self-efficacy and respective achievements in different domains (e.g., clinical, educational, organizational, sports, and health; Bandura, 1997; Stajkovic & Luthans, 1998).

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For example, in the health domain self-efficacy is associated with achieving self-improvement goals related to smoking (Carey, Snel, Carey, & Richards, 1989) and healthy eating (Schwarzer & Renner, 2000). In organizational settings, self-efficacy facilitates job search (Ellis & Taylor, 1983), managerial performance (Wood, Bandura, & Bailey, 1990), naval performance at sea (Eden & Zuk, 1995). And, finally, in the academic domain, self-efficacy improves persistence in studying and course grades (Lent, Brown, & Larkin, 1984), and research productivity of university faculty members (Taylor, Locke, Lee, & Gist, 1984).

Another way in which achieving desired outcomes can be improved is forming implementation intentions (Gollwitzer, 1999). The often observed intention-behavior gap (between intended desired outcomes and actual goal attainment) can be effectively reduced if people furnish their intentions (goals) with specific plans of how to reach them. Therefore, Gollwitzer (1996, 1999) differentiates between two types of intentions: (1) goal intentions defining desired outcomes or behaviors (e.g., "I want to achieve outcome X!" or "I want to perform behavior X!"), and (2) implementation intentions specifying when, where, and how a given intention will be realized (e.g., "When situation Y arises, then I will initiate Z!"). Implementation intentions are subordinate to goal intentions. Again, a bulk of lab and field studies in different domains (e.g., interpersonal, health, and achievement; see meta-analysis by Gollwitzer & Sheeran, 2006) indicates that people who furnish their goal intentions with implementation intentions are more successful in goal striving and goal attainment than people with mere goal intentions.

Implementation intentions seem to facilitate the attainment of difficult goals in particular. For instance, when goals had to be acted on at inconvenient times (Gollwitzer & Brandstätter, 1997), when they were somewhat unpleasant to perform (Orbell, Hodginks, & Sheeran, 1997), or when they were easily forgotten (Sheeran & Orbell, 1999), furnishing these goals with implementation intentions led to a higher goal attainment rate. Furthermore, implementation intentions facilitate the control of unwanted influences on an ongoing goal pursuit. They shield the focal goal pursuit from distractions, conflicts, and bad habits, thus allowing for successful goal realization even in the face of hindrances (Gollwitzer, Bayer, & McCulloch, 2005).

In the present research, in two experimental studies we tested whether implementation intentions lead to better performance on scholastic tests as compared to mere goal intentions (i.e., "I intend to correctly solve as many problems as possible!"). Most important, we introduced a new type of implementation intention embracing the importance of self-efficacy beliefs as demonstrated by Bandura (1997) and colleagues (Maddux & Gosselin, 2003). More specifically, we wanted to know whether implementation intentions that specify a self-efficacy strengthening response in the "then-part" that is then linked to a critical cue in the "if-part" ("And if I start a new problem, then I'll tell myself: I can solve it!") manage to improve participants' performance in scholastic tests. So far, only cognitive (e.g., nonstereotypical beliefs; Gollwitzer & Schaal, 1998) and behavioral responses (e.g., performing a Go/No-Go task; Brandstätter, Lengfelder, & Gollwitzer, 2001) have been specified in implementation intentions, and thus we wondered whether specifying a motivational response would also evidence beneficial effects on goal attainment. In order to explore the beneficial effects of implementation intentions that specify motivational responses, we focused on self-efficacy-related responses as self-efficacy beliefs are established, powerful motivational determinants of academic achievement (Bandura, 1997).

How Implementation Intentions Support Goal Attainment

Implementation intentions are expected to facilitate goal attainment by psychological processes related to both the anticipated situation (specified in the “if” component of the plan) and the intended response (specified in the “then” component). Because forming implementation intentions implies the selection of a critical future situation (e.g., a good opportunity), it is assumed that the mental representation of this situation becomes highly activated (Achtziger & Gollwitzer, 2006; Gollwitzer, 1999). Compared to those who merely hold a goal intention, people who form additional implementation intentions exhibit increased accessibility of the critical cue. In various studies, implementation-intention participants have been shown to be more capable of noticing, attending to, and remembering these cues as compared to goal-intention participants (Gollwitzer, Bayer, Steller, & Bargh, 2002, unpublished).

Linking a particular goal-directed response (specified in the “then-part”) to a situational cue (specified in the “if-part”) also delegates the control of this response to the respective situational cue (Gollwitzer, 1993). Once this cue is encountered, response initiation proceeds swiftly and effortlessly, and it does not require the person’s conscious intent. Accordingly, the execution of a response specified in an implementation intention should exhibit features of automaticity (Gollwitzer, 1999) such as immediacy, efficiency, and a lack of awareness (Bargh, 1994). Immediacy has been tested by looking at response latencies to critical cues and the match of the point in time of actual performance with the point in time specified in the implementation intention (Gollwitzer & Brandstätter, 1997). The efficiency of implementation intentions is supported by studies that varied cognitive load either through experimental manipulations varying the difficulty of a dual task (Brandstätter et al., 2001, Studies 3 and 4; Lengfelder & Gollwitzer, 2001) or through the selection of critical samples known to suffer from chronic high cognitive load (e.g., schizophrenic patients, heroin addicts under withdrawal; Brandstätter et al., 2001, Studies 1 and 2). Finally, there is evidence that the effective operation of implementation intentions does not require people to be consciously aware of either the anticipated situation or the respective goal intention (Bayer, Moskowitz, & Gollwitzer, 2002, unpublished; Sheeran, Webb, & Gollwitzer, 2005). In sum, forming implementation intentions means that people can enhance the rate of goal completion by strategically switching from conscious and effortful self-regulation of goal-directed responses to automated, stimulus-controlled goal striving.

How Self-Efficacy Beliefs Are Strengthened

People’s beliefs about their personal efficacy constitute a major aspect of their self-knowledge. Bandura (1982, 1997) suggests that self-efficacy beliefs are constructed from four principal sources of information. The first source, *performance mastery experiences*, refers to self-efficacy derived from recalling previous accomplishments. For example, an individual who successfully recovered from knee surgery may feel capable of recovering from further upcoming surgeries. A second source of efficacy information is *vicarious experiences* that alter efficacy beliefs through observing the attainments of similar others. Vicarious experiences are presumed to lead to heightened self-efficacy because the observer persuades her/himself that if others (i.e., the actors) like her/him can succeed, s/he can also. Moreover, self-efficacy may be strengthened by *verbal persuasion* from other people that one is capable of achieving

one's goals. Social encouragement and support is thought to facilitate the upholding of self-efficacy and thus the exertion of greater effort when complications arise during goal striving. The last source of self-efficacy information refers to the *physiological and affective states* from which people can infer their capabilities, strengths, and vulnerabilities. Stressful and taxing events generally elicit emotional arousal, which in turn has informative value with regard to personal competence. Moreover, Maddux and Gosselin (2003) suggest a fifth source of self-efficacy information. Self-efficacy may also be influenced by *imagining* oneself or others in hypothetical situations. Such images may just be inadvertent ruminations, but they may also be intentional self-efficacy enhancing mental simulations and thus amount to self-efficacy enhancing strategies.

Self-efficacy beliefs are commonly the result of the integration of various pieces of information stemming from different sources. In forming their efficacy judgments, people thus have to deal with all kinds of efficacy-relevant information, and they have to weight and integrate this information. There is little empirical work on how people achieve this task. Still, various interventions based on combining cognitive restructuring with performance mastery have been used to curb self-belittling habits in judging one's capabilities (Bandura, 1997; Bandura & Locke, 2003; Maddux & Gosselin, 2003).

In some experiments, people received veridical feedback about their actual performance and their efficacy beliefs were changed by subsequent false, but favorable, normative comparisons. For example, Bouffard-Bouchard (1990) instilled high-efficacy beliefs in students by suggesting that they were of higher or lower standing compared to bogus peer norms, irrespective of their actual standing. Students whose perceived efficacy was falsely raised in this manner set higher goal standards for themselves, used comparatively more efficient problem-solving strategies, and achieved higher intellectual performances. In other interventions, efficacy beliefs were changed without asking people to execute the critical behavior. Even though no personal performance data were available to reappraise one's capabilities, efficacy beliefs were still raised and the respective performance increased. Such direct ways of changing a person's self-efficacy beliefs include introducing a favorable anchor (e.g., Cervone & Peake, 1986), using observational means (e.g., modeling; Bandura, Reese, & Adams, 1982), and mental simulation in combination with symbolic desensitization (Bandura & Adams, 1977). In further studies, high self-efficacy beliefs were induced by verbal self-guidance (e.g., children who were markedly deficient in reading were first asked to study reading strategies and then requested to apply these strategies when reading; Schunk & Rice, 1993). In sum, these findings suggest that self-efficacy beliefs can be influenced by different kinds of interventions, whereby interventions with actual success experiences are most commonly used (Williams, 1995).

In both of the present studies, we used inner (private) speech to strengthen participants' self-efficacy. Meichenbaum and Goodman (1971) demonstrated that impulsive children profit from self-regulation training in which they are trained to talk to themselves. Children who were taught to use private speech (e.g., "Good, I'm doing fine so far. Remember go slow.") made fewer errors in different performance measures (e.g., the Matching Familiar Figures Test), whereas cognitive modeling alone, in which the experimenter just modeled a set of behaviors and the children observed him, did not improve the performance of impulsive children.

In the present studies, participants were asked to tell themselves that they could solve the problems entailed by the academic test at hand. Participants were asked to

form “if–then” plans (i.e., implementation intentions) in which critical points (cues) during test performance (i.e., starting to work on the next problem) were specified in the “if-part”, and making a self-efficacy strengthening private statement in the “then-part”. As “if–then” plans are known to automate the initiation of the specified responses once the critical cue is encountered, we expected self-efficacy strengthening statements triggered by these “if–then” plans to be very effective in raising test performance.

Overview of the Present Research

Two studies were designed to explore whether self-strengthening implementation intentions can be used to improve performance on a mathematics test (Study 1) and a logical reasoning test (Study 2). In Study 1, participants performed the test under two different conditions. The first was a mere achievement goal intention condition, in which all participants were instructed to tell themselves: “I will correctly solve as many problems as possible!” The second condition was an implementation intention condition, in which participants furnished this achievement goal with the following self-efficacy strengthening implementation intention: “And if I start a new problem, then I will tell myself: I can solve it!”. Participants who had formed the additional self-efficacy strengthening implementation intention should achieve higher test scores than participants of the mere achievement goal intention condition.

In Study 2, we wanted to replicate the findings of Study 1 using a different academic test (i.e., an analytic reasoning test). Additionally, we wanted to compare the effectiveness of different forms of strengthening self-efficacy, as one might argue that a general goal to feel self-efficacious should also succeed in facilitating participants’ performance. To test this assumption, we kept the achievement goal intention and the self-efficacy strengthening implementation intention conditions of Study 1 but added a third condition, the self-efficacy strengthening goal intention condition. Participants in this latter condition were also asked first to form the achievement goal intention of correctly solving as many problems (test items) as possible. They were then asked to use the following self-efficacy strengthening goal intention: “And I will tell myself: I can solve these problems!” This self-efficacy strengthening statement differed only in its format from the implementation intention condition. Still, we expected that participants in the self-efficacy strengthening implementation intention condition would outperform participants in the self-efficacy strengthening goal intention condition, because implementation intentions allow for more efficient (i.e., automatic) action control than goal intentions.

Study 1: Performing a Mathematics Test

The influence of a person’s self-efficacy beliefs on performance in mathematics is well documented. For example, Pietsch, Walker, and Chapman (2003) observed a positive relationship between self-efficacy and performance in mathematics among 416 high school students. It is also known that female students consider success in mathematics to be more difficult to achieve than male students (e.g., Eccles, 1983; Mau & Lynn, 2000; Pintrich & De Groot, 1990; Wigfield, Eccles, MacIver, Reumann, & Midgley, 1991), and past research on the effects of implementation intentions has shown that difficult goals benefit more from implementation

intentions than easy goals (Gollwitzer & Brandstätter, 1997). Accordingly, we decided to run Study 1 with female participants.

Method

Participants. Forty female high school students in the 12th grade (aged $M=18.02$, $SD=0.69$) were invited for a one-day visit to the University of Konstanz, and all agreed to take part in the experiment. The participants were rewarded with 2 Euros and a chocolate bar.

Design. The study follows a one-factorial design with the between-factor goal condition varying goal intention vs. implementation intention. The number of correctly solved problems in the math test was assessed as the dependent variable.

Procedure. Participants were randomly assigned to the goal intention and implementation intention condition. The experiment was carried out in groups of three to five participants, and all instructions were given in written form. The female experimenter distributed a booklet informing participants that the test assessed math skills. First, they were asked about their age, sex, and last year's math grade. As implementation intentions are commonly found to work better when people feel that the respective goal is difficult to attain (Gollwitzer & Sheeran, 2006), we asked for sex because having to indicate that one is female at the start of a math test is known to induce stereotype threat, which in turn makes a successful test performance more difficult (Ben-Zeev, Fein, & Inzlicht, 2005; Cadinu, Maass, Rosabianca, & Kiesner, 2005; Schmader & Johns, 2003; Spencer, Steele, & Quinn, 1999). Participants were also asked to rate how much they liked math problems and how important math skills were to them on a 7-point scale (from 1 = *absolutely not/not important at all* to 7 = *very much/very important*). To assess their self-efficacy regarding mathematics, they were asked to agree (mark "yes") or disagree (mark "no") with the following statement: "I am uncertain whether my math skills are good enough for this test." Agreement was coded as "0" (i.e., low self-efficacy beliefs) and disagreement as "1" (i.e., high self-efficacy beliefs). Finally, we asked participants for their outcome expectations (i.e., to estimate how many of the problems of the math test they expect to solve correctly; the answer scale ranged from 0% to 100%).

On the next page in the booklet, different instructions were given depending on condition. The goal intention condition was instructed to form the following achievement goal intention: "I will correctly solve as many problems as possible!" The participants of the implementation intention condition were first asked to form this goal intention, and then requested to add the following self-efficacy strengthening implementation intention: "And if I start a new problem, then I will tell myself: I can solve it!" All participants were instructed to take 3 minutes to memorize these self-directed instructions.

Then, the experimenter gave the signal to start the math test. The test consisted of 14 individual, multiple-choice math problems developed by two mathematics high school teachers. Participants were given 10 minutes to work on the test. Afterwards, participants were asked about their achievement goal commitment ("How strongly were you committed to accurately solving as many math problems as possible?"). They had to answer this question using a 7-point scale (ranging

from 1 = *not at all* to 7 = *very*). Finally, participants were debriefed, and then thanked and paid.

Results

Equivalence of groups. Goal intention (GI) participants as compared to implementation intention (II) participants tended to have marginally better math grades [1 = *excellent* to 6 = *very bad*; $M_{GI} = 2.3$, $SD = 0.84$ vs. $M_{II} = 2.7$, $SD = .79$; $t(37) = 1.85$; $p = .07$] as well as higher ratings for liking to solve math problems [$M_{GI} = 4.8$, $SD = 1.15$ vs. $M_{II} = 4.1$, $SD = 1.16$; $t(38) = 1.96$, $p = .06$]. Participants' self-perceived importance of math skills did not differ between groups [$M_{GI} = 4.5$, $SD = 1.23$ vs. $M_{II} = 4.1$, $SD = 1.50$; $t(38) < 1$, *ns*]. As expected, participants in both experimental groups held weak compared to strong self-efficacy beliefs [GI: 75% weak vs. 25% strong self-efficacy beliefs; II: 65% weak vs. 35% strong self-efficacy beliefs]; there was no difference between groups, $\chi^2(1, N = 40) = 0.46$, *ns*. Finally, both goal intention and implementation intention participants also had rather moderate outcome expectations as assessed in terms of the percentage of problems expected to be solved [$M_{GI} = 68\%$, $SD = 23.21$; $M_{II} = 57\%$, $SD = 19.69$]; goal intention participants tended to be more optimistic than implementation intention participants, $t(38) = 1.76$, $p = .09$.

The post-experimental ratings of achievement goal commitment tended to be stronger for goal intention participants than for implementation intention participants [$M_{GI} = 4.71$, $SD = 0.98$ vs. $M_{II} = 4.10$, $SD = 1.16$; $t(38) = 1.79$, $p = .09$].

Dependent variable. A one-factorial ANOVA on the number of correctly solved math problems revealed a significant difference between the two conditions, $F(1, 38) = 5.11$, $p = .03$. On average, participants in the goal intention condition solved only 2.80 ($SD = 2.09$) problems correctly, whereas participants in the implementation intention condition solved 4.30 ($SD = 2.11$). Thus, the hypothesis that forming efficacy strengthening implementation intentions should facilitate participants' math performance was supported. Most importantly, when we included background variables known to affect math test performance, i.e., math grades, liking for math, importance of math skills, outcome expectations, and self-efficacy beliefs; all of these variables also correlated positively with the achieved test scores in the present sample: .18 (*ns*), .40 (.01), .13 (*ns*), .21 (*ns*), .51 (.001), respectively, as covariates in the one-factorial ANOVA on participants' test performance, the difference between the two groups stayed significant; actually, we observed an even stronger effect, $F(1, 33) = 9.20$, $p = .005$. This finding indicates that the better test performance of implementation intention participants as compared to goal intention participants is not due to differences of the two groups in relevant background variables.

We also analyzed the influence of commitment to the goal of correctly solving as many tasks as possible on the math test. Overall, goal commitment correlated positively with performance overall, albeit not significantly ($r = .22$, *ns*). When we included the goal commitment variable as a covariate in the one-factorial ANOVA on participants' test scores, we again found a stronger effect of condition, $F(1, 36) = 8.32$, $p = .006$, indicating that implementation intentions did not facilitate test performance via an increase in goal commitment.

Discussion

Participants were asked to complete a math test under two different instructions. Half of the participants were asked to form the mere achievement goal intention: "I will correctly solve as many problems as possible!" The other half of the participants had to furnish this goal intention with the following self-efficacy strengthening implementation intention: "And if I start a new problem, then I will tell myself: I can solve it!" We observed that participants in the implementation intention condition showed a better performance in the math test than participants in the mere goal intention condition, indicating that self-efficacy strengthening implementation intentions facilitate successful goal pursuit in a challenging achievement situation. In line with earlier research, we propose that forming implementation intentions is a very successful strategy of goal implementation (Gollwitzer & Sheeran, 2006).

The results of this study provide two further insights. First, implementation intentions are usually formed by specifying a situational cue in the "if" part and linking it to goal-directed cognitive or behavioral responses in the "then" part. In the present study, a critical situational cue (i.e., starting a new problem) in the "if" part was linked to a motivational response (i.e., a private self-efficacy strengthening statement) in the "then" part. Interestingly, this pre-programmed, inner self-motivating speech sufficed to produce better test performance. This suggests that implementation intentions can also be used to ameliorate motivational problems of goal implementation (such as self-doubts in the face of challenging test items).

Second, it is well documented that various background variables (e.g., math grades, liking of mathematics, importance of math skills, self-efficacy beliefs, outcome expectations) predict math test performance (e.g., Pietsch, Walker, & Chapman, 2003). Indeed, in our sample liking for math problems and self-efficacy beliefs were significantly positively related to participants' test scores; grades, outcome expectations, and perceived importance of math skills showed a nonsignificant positive relation. But when we controlled for differences in all of these variables between the goal intention and implementation intention condition by computing a covariance analysis, we observed that the condition effect on achieved test scores stayed significant. Accordingly, we can safely interpret this difference in terms of the induction of implementation intentions.

In past research on self-efficacy, self-efficacy beliefs have been manipulated by various strategies devoid of behavioral training: e.g., anchoring (Cervone & Peake, 1986); observation (Bandura, Reese, & Adams, 1982); visualization (Bandura & Adams, 1977); imagination (Williams, 1995); and persuasion (Schunk, 1982). In the present study, we also tried to strengthen participants' self-efficacy beliefs without engaging participants in behavioral training. Our manipulation was particularly parsimonious, as we only asked our participants to form a plan with respect to when they would have to execute an inner, self-efficacy strengthening statement. Still, this simple strategy managed to have performance-enhancing effects.

But there remained a number of critical questions. First, one wonders whether self-efficacy strengthening inner speech needs to take the format of an implementation intention? Maybe it suffices that participants simply form the goal intention to be self-strengthening, such as "And I will tell myself: I can solve these problems!" To test this possibility, a further control condition (i.e., a self-efficacy strengthening goal intention condition) was included in the second experiment.

Second, in the present study it remains unclear whether the implementation intention manipulation produced its effect by strengthening participants' self-efficacy

during test taking, or whether it already induced high self-efficacy beliefs at the outset of taking the test. Past implementation intention research suggests that the intended responses of the “then-part” of an implementation intention are elicited only in the presence of the situational cues specified in the “if-part” (e.g., Gollwitzer & Brandstätter, 1997). Accordingly, the implementation intention used in the present study (“And if I start a new problem, then I will tell myself: I can solve it!”) should strengthen people’s self-efficacy not at the point in time when the plans are formed but rather while taking the test—that is, when self-efficacy is needed most.

Study 2: Performing an Analytic Reasoning Test

In a second study, participants were asked to take the Raven’s Advanced Progressive Matrices test (RAPM), which is a well-established nonverbal test measuring general intelligence and in particular logical reasoning (Raven, 1962; German version by Kratzmeier, 1976). The Raven test is a widely used intelligence test both in research and applied settings. In each test item (problem), one is asked to find the missing picture (pattern) in a series of pictures. Problems get progressively harder, requiring greater cognitive capacity to encode, analyze, and correctly solve the problem. Differences in test scores are explained by a broad range of person variables (e.g., general intelligence, analytic reasoning skills, knowledge, efficacy beliefs, and motivation; Matthews, 1999).

The aim of this second study is to replicate our finding of Study 1 that participants with a self-efficacy strengthening implementation intention outperform participants with a mere achievement goal intention on an academic test. Moreover, we wanted to explore whether implementation intention participants also outperform participants who intend to strengthen self-efficacy via forming a respective goal intention. As implementation intentions facilitate automatic responding to specified situational cues, implementation intention participants should strengthen their self-efficacy immediately, efficiently, and without a further conscious intention, whenever the specified cue is encountered (i.e., starting to work on a new problem). This should put them at an advantage as compared to the self-efficacy strengthening goal intention participants who have to strengthen their self-efficacy in a more effortful (conscious) manner—which should be hard to do while performing a high cognitive resources demanding test such as the RAPM.

In Study 2 we asked male college students to participate. As we had only used female participants in Study 1, we wondered whether the observed implementation intention effect holds true for men as well. Also, we used the RAPM test to create a challenging testing situation, as implementation intentions are known to unfold their beneficial effects in particular when goal attainment is perceived as difficult. The RAPM test is widely used and thus readily recognized by test takers as a serious test of their intelligence.

Method

Participants. Fifty-two male students of the University of Konstanz, aged 20 to 33 years, participated in the study ($M = 22.7$; $SD = 2.24$). They were recruited in the lobby of the University of Konstanz and received 4 Euros for participation.

Design. This study followed a one-factorial design with three conditions. All participants were first asked to form a high achievement goal. Participants were then

either given no further instruction (achievement goal intention group: AGI), a self-efficacy strengthening implementation intention (SII), or a self-efficacy strengthening goal intention (SGI). The dependent variable was the number of correct solutions found on the RAPM test.

Procedure. Participants were randomly assigned to the three conditions, and tested in groups of two to four. All instructions were given in written form. First, participants had to answer a short questionnaire assessing their self-concept concerning analytic reasoning (“How high is your ability to think analytically?”), their liking of analytic reasoning problems (“How much do you like solving analytic reasoning problems?”), and the perceived importance of possessing skills in analytic reasoning (“How important is analytic reasoning for you?”). Participants had to answer each of these questions on 7-point scales (ranging from 1 = *not at all* to 7 = *very much*). Finally, the participants were requested to indicate their outcome expectations (“How much of the test will you solve correctly?”) on a continuous 0% to 100% answer scale.

On the next page participants’ goal orientations was manipulated. All participants were given the achievement goal intention: “I will correctly solve as many problems as possible!” One third of the participants received no further instructions (mere achievement goal intention condition). Participants in the self-efficacy strengthening implementation intention condition were asked to furnish this achievement goal with the following implementation intention: “And if I start a new problem, then I will tell myself: I can do it!” Moreover, participants in the self-efficacy strengthening goal intention condition were asked to furnish their achievement goal intention with the following self-efficacy strengthening goal intention: “And I will tell myself: I can do these problems!”

After the experimental manipulation, and prior to starting on the RAPM test, participants were asked to answer the following three self-efficacy items: “I believe that I can solve this test easily,” “I am uncertain whether my logical skills will be good enough to solve this test,” and “I have doubts on whether I will achieve a good test performance” on 7-point scales (ranging from 1 = *not at all* to 7 = *very much*). The ratings were combined to an index of self-efficacy (Cronbach’s $\alpha = .67$).

The test presented to participants consisted of 25 Raven matrices arranged in order of increasing difficulty (Kratzmeier, 1976), and participants were allowed to work on the test for 20 minutes. Afterwards, participants received a final questionnaire assessing their commitment to the achievement goal intention (“How committed did you feel to the goal to correctly solve as many problems as possible?”). Participants were asked to answer this question on a 7-point scale (ranging from 1 = *absolutely not* to 7 = *very much*). Finally, participants were debriefed, thanked, and paid.

Results

Equivalence of groups. Participants of the three conditions reported similar ratings for liking analytical reasoning problems [$M_{AGI} = 5.05$, $SD = 1.43$; $M_{SGI} = 4.47$, $SD = 1.39$; $M_{SII} = 4.94$, $SD = 1.24$; $F < 1$, *ns*], possessing analytic reasoning skills [$M_{AGI} = 4.72$, $SD = 1.07$; $M_{SGI} = 4.88$, $SD = 0.92$; $M_{SII} = 4.64$, $SD = 1.61$; $F < 1$, *ns*], perceived importance of such skills [$M_{AGI} = 6.05$, $SD = 1.21$; $M_{SGI} = 5.88$, $SD = 1.05$; $M_{SII} = 5.94$, $SD = 1.19$; $F < 1$, *ns*], and outcome expectancies [$M_{AGI} = 90.58$, $SD = 14.02$; $M_{SGI} = 83.75$, $SD = 17.27$; $M_{SII} = 81.62$, $SD = 15.58$; $F = 1.1$, *ns*].

The post-experimental ratings of commitment toward the achievement goal tended to be marginally different between the three conditions [$M_{AGI} = 3.47$, $SD = 2.57$; $M_{SII} = 4.43$, $SD = 1.1$; $M_{SGI} = 3.00$, $SD = 2.39$; $F(2, 48) = 2.91$, $p = .06$]. Participants with self-efficacy strengthening implementation intentions reported a marginally stronger commitment compared to participants in the self-efficacy strengthening goal intention condition, $t(32) = 2.17$, $p = .08$. No further comparisons reached significance.

Dependent variable. A one-factorial ANOVA on the number of correct solutions revealed a significant effect of condition, $F(2, 49) = 2.99$, $p = .05$. In planned comparisons it was observed that participants in the self-efficacy strengthening implementation intention condition achieved the highest level of performance. They outperformed participants in the mere achievement goal intention condition [$M_{GI} = 14.88$, $SD = 2.58$; $M_{SII} = 17.29$, $SD = 3.54$; $t(49) = 2.23$, $p = .03$], as well as those in the self-efficacy strengthening goal intention condition [$M_{SGI} = 15.10$, $SD = 3.37$; $t(49) = 1.99$, $p = .05$]. The performance level of the mere achievement goal intention condition did not differ significantly from the performance level of the self-efficacy strengthening goal intention condition ($t < 1$).

Further analyses. Self-efficacy ratings measured prior to taking the RAPM test did not differ between groups [$M_{AGI} = 4.87$, $SD = 1.14$; $M_{SII} = 5.04$, $SD = 0.99$; $M_{SGI} = 5.04$, $SD = 1.07$; $F < 1$, *ns*], indicating that self-efficacy was neither raised by the self-efficacy strengthening goal intention nor the self-efficacy strengthening implementation intention. Moreover, we observed that these self-efficacy ratings only showed moderate, nonsignificant positive correlations with test performance overall and within each of the three groups (r s between .07 and .37, *ns*).

As in Study 1, we checked whether further performance-related variables could be responsible for the observed results. When including these variables as covariates in the ANOVA on test performance, the difference between the three conditions stayed significant, $F(2, 42) = 3.88$, $p = .03$, $F(2, 42) = 3.52$, $p = .03$. Possessing analytic

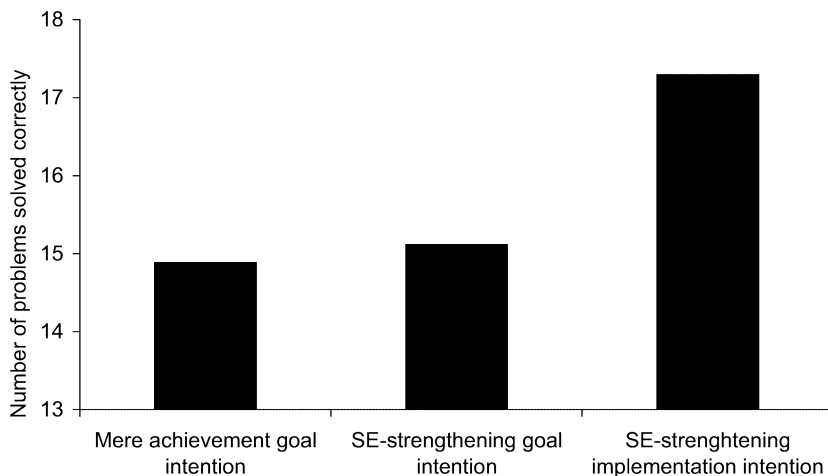


FIGURE 1 Number of solved problems in the Raven test (Study 2) by achievement goal intention, self-efficacy strengthening goal intention, and self-efficacy strengthening implementation intention conditions.

reasoning skills, liking of analytic reasoning problems, perceived importance of such skills, and outcome expectation were neither significantly related overall nor within each experimental condition with participants' test performance (all r s < .20). Moreover, as participants' commitment toward their achievement goal was the highest within the implementation intention condition, we also included this variable as a covariate in the one-factorial ANOVA on test performance. This analysis revealed that the difference between the three conditions still stayed significant, $F(2, 40) = 4.05$, $p = .03$, indicating that the implementation intention effect cannot be explained by referring to an increase in goal commitment. As a support of this conclusion, participants' commitment ratings neither correlated significantly with test performance overall nor within each experimental condition (all r s < .20).

Discussion

In Study 2 we replicated the finding of Study 1 that participants with a self-efficacy strengthening implementation intention showed a higher test performance than participants with a mere achievement goal intention. This replication is particularly noteworthy as we used a well-established intelligence test (i.e., the Raven Advanced Progressive Matrices test). Even though the RAPM test is considered to be rather valid and reliable (Raven, 2000), self-efficacy strengthening implementation intentions managed to improve participants' test performance on the spot. Apparently, implementation intentions that specify taking on a new problem (test item) in the "if" part and a motivational response in the "then" part (i.e., strengthening self-efficacy) are an effective volitional tool for improving performance on intelligence tests, even though such tests are traditionally considered to be rather unaffected by volition.

In Study 2, we also examined whether a self-efficacy strengthening goal intention suffices to improve participants' test performance. As it turned out, test performance improved only when participants were instructed to form self-efficacy strengthening implementation intentions. This finding is important for several reasons. First, many of the field and laboratory studies investigating the benefits of implementation intentions (e.g., on health behaviors, job safety, environment protection; see meta-analysis by Gollwitzer & Sheeran, 2006) do not use an additional condition that spells out the "then" part of the implementation intention in terms of a further goal intention. Therefore, in these studies the benefits of implementation intentions as compared to mere goal intentions could potentially be based on having access to additional information on how to act. In the present study, we can clearly rule out this alternative account as suggesting the use of the strategy of strengthening one's self-efficacy in terms of a mere goal failed to lead to higher test scores. Only when this strategy was suggested to participants in the format of an "if-then" plan did positive effects on test performance emerge.

Second, the observed differences between self-efficacy strengthening implementation intentions and self-efficacy strengthening goal intentions further support the assumption (Gollwitzer, 1999) that implementation intentions—by specifying situational cues—recruit different action control processes than goal intentions. Whereas the latter instigate effortful, conscious processes, the former trigger automatic processes. Assuming that performing the RAPM test is quite demanding and thus burdens cognitive capacities, it is not surprising that only self-efficacy strengthening implementation intentions managed to be effective. In sum, it is not enough to inform people about beneficial strategies, they also have to be instructed in a way that allows them to implement them efficiently.

In Study 2, participants' self-efficacy ratings were measured after the experimental manipulation of participants' goal orientation and prior to performing the RAPM test. If suggesting a self-efficacy strengthening strategy had immediately affected the level of participants' self-efficacy beliefs, differences in self-efficacy ratings should have evidenced in the three conditions. But this was not the case! Apparently, implementation intentions did not positively affect participants' test performance at a conscious level by heightening their self-efficacy beliefs at the outset of the test. Rather, the self-efficacy strengthening implementation intention affected participants' self-efficacy beliefs while taking the test (i.e., at each start of a new test item, participants automatically assured themselves of high self-efficacy).

Finally, Bandura (1997) suggests that self-efficacy beliefs influence behavioral outcomes in various different (i.e., cognitive, motivational, and affective) but complementary ways. For instance, self-efficacy beliefs are said to positively affect participants' quality of thinking. Indeed, we observed that self-efficacy strengthening implementation intention participants found the highest number of correct solutions, whereas the number of problems that participants worked on did not differ between the three conditions ($M_{GI} = 19.44$, $SD = 3.01$; $M_{SIG} = 20.23$, $SD = 3.80$; $M_{SII} = 20.71$, $SD = 3.13$; $F < 1$). This pattern of findings indicates that the higher test scores of implementation intention participants in the present study are more likely based on a higher quality of analytic thinking during the test session, rather than on simply increasing one's speed of working on the test. Still, it seems possible that not only cognitive but also affective and motivational processes may have been involved. For example, implementation intention participants may have become less insecure after experiencing difficulties with a given problem (test item). No matter whether a finished problem was experienced as very challenging or not, they may have always approached the next problem in a self-assured manner. But such process hypotheses will have to be investigated in further research.

General Discussion

Implementation intentions help people to overcome various problems of goal implementation (e.g., getting started with goal-directed behavior, protecting ongoing goal pursuit from getting derailed by tempting distractions or bad habits, stopping unproductive persistence, and overextending one's self-regulatory resources; Gollwitzer & Sheeran, 2006), and thus have been found to facilitate goal attainment in many different life domains (e.g., health, achievement, emotion regulation, interpersonal thoughts and behaviors). High beliefs of self-efficacy also have a strong positive impact on meeting one's goals: they facilitate effort exertion and task persistence, and they contribute to relevant cognitive and affective aspects of performing well (Bandura, 1997).

Therefore, in the present line of research an integration of the self-efficacy approach suggested by Bandura (1997) and the action-control approach suggested by Gollwitzer (1999) was attempted. More precisely, implementation intentions were geared towards strengthening self-efficacy when performing a math test (Study 1) and an analytic reasoning test (Study 2). In both studies it was observed that participants who had formed additional self-efficacy strengthening implementation intentions (i.e., "And if I start a new problem, then I will tell myself: I can solve it!") outperformed participants with a mere achievement goal (i.e., "I will correctly solve as many problems as possible!") or participants (Study 2) who formed a mere self-efficacy strengthening goal intention (i.e., "And I will tell myself: I can solve these

problems!”). These are the first studies testing the efficacy of implementation intentions linking a specific situational cue to a motivational response. Our results suggest that this type of implementation intention also facilitates goal attainment, and thus it appears that individuals have a choice with respect to specifying the “then-parts” of their implementation intentions: they can either specify the goal-directed responses directly or a motivational response that facilitates the performance of goal-directed activities in general.

Limitations of the Present Research

Even though we found the predicted effects of self-efficacy strengthening implementation intentions, we can only speculate on how these implementation intentions improved participants’ test scores. So far, we can exclude the possibility that the mere assignment of a self-efficacy strengthening implementation intention already produced higher self-efficacy beliefs, which in turn produced higher test scores. When we assessed self-efficacy beliefs right after the manipulation in Study 2, no heightened self-efficacy was observed in the implementation intention condition as compared to the goal intention conditions. So it appears that the performance enhancing effects of self-efficacy strengthening implementation intentions unfolded while participants were taking the tests. Still, we do not know yet which of the performance-enhancing processes associated with self-efficacy beliefs actually produced the heightened test scores observed in the implementation intention condition. Bandura (1997) identifies four processes through which self-efficacy beliefs influence behavioral outcomes. First, self-efficacy beliefs facilitate decisions to take on challenging tasks (Hackett & Betz, 1989). Once one pursues a task, a second process comes into play. Self-efficacy perceptions affect effort and task persistence (e.g., Cervone & Peake, 1986). Third, self-efficacy affects affective experiences so that people with a high sense of efficacy do experience less anxiety when facing threats (e.g., Bandura, Cioffi, Taylor, & Brouillard, 1988). Finally, efficacy beliefs are said to influence the quality of cognitive functioning as the performance of cognitively complex laboratory tasks (Cervone & Wood, 1995), everyday problem-solving (Artistico, Cervone, & Pezzuti, 2003), and memory performance (Berry, West, & Dennehey, 1989) were all found to benefit from high self-efficacy beliefs. As further analyses of the test performance of Study 2 participants indicated that implementation intentions did not affect the number of problems tackled but the number of problems that were solved correctly, heightened quality of analytical thinking seems to be responsible for the observed implementation intention effects. This assumption is in line with findings that implementation intentions create automaticity of action control that preserves cognitive resources (Gollwitzer & Sheeran, 2006). It seems possible, though, that anxiety reduction might also have contributed to the enhanced test performances observed with implementation intention participants. However, as we did not assess participants’ level of anxiety during test performance (e.g., by monitoring physiological arousal), the present studies are mute to this issue.

Finally, one wonders whether the beneficial effects of self-efficacy strengthening implementation intentions produce costs in the sense of the “pathology of high expectations” (Janoff-Bulman & Brickman, 1982), meaning that people with favorable expectations fail to recognize or admit that certain outcomes are beyond their control. Repeated efforts to master such uncontrollable situations lead to increased stress, and loss of resources such as time and energy. Is action control by self-efficacy strengthening implementation intentions vulnerable to this maladaptive

persistence? Aspinwall and Richter (1999) tested whether optimists show maladaptive persistence in the presence of alternative tasks (i.e., they offered an initial set of 7 unsolvable anagrams followed by 14 solvable anagrams). It was observed that people with high optimism or self-mastery beliefs were able to disengage from unsolvable tasks in order to allocate effort to solvable tasks. This finding suggests that self-efficacy strengthening implementation intentions may also foster flexibility in goal striving, and may not be associated with maladaptive rigid persistence (Gollwitzer, Bayer, & McCulloch, 2005).

Self-efficacy Interventions

By affecting people's acceptance of challenges, persistence despite setbacks, execution of complex cognitive strategies, and calmness versus anxiety in the face of threat, high self-efficacy perceptions generally promote superior self-regulation and achievement. Thus, it seems important to investigate how high self-efficacy beliefs are installed and maintained (Bandura & Locke, 2003).

The benefits of intervention programs to install high self-efficacy beliefs have been amply demonstrated. For example, in a study by Sanderson and Jemmott (1996), participants who received a behavioral intervention program focusing on communication skills or technical skills to facilitate HIV prevention showed greater condom use self-efficacy, more positive condom use attitudes, and stronger intentions to use condoms than did controls. Three-month follow-up data revealed that participants who were not in a steady dating relationship but had received this intervention reported more consistent condom use than did control participants. But cognitive restructuring methods were also found to be effective. In such interventions, people did not execute the critical behavior, instead self-efficacy beliefs were solely changed by observational means (Bandura, Reese, & Adams, 1982), persuasive influences (Bouffard-Bouchard, 1990; Schunk, 1982), or introducing trivial information that biased perceived self-efficacy (Cervone & Peake, 1986).

In our studies, we also used a cognitive intervention. We strengthened self-efficacy by asking participants to make "if-then" plans: "And if I start a new problem, then I will tell myself: I can solve it!" This strategy is easy to explain and apply, and these features qualify self-efficacy interventions based on forming "if-then" plans (i.e., implementation intentions) as very cost efficient. But will interventions based on implementation intentions produce stable effects over time as is observed with other intervention programs (e.g., Sanderson, & Jemmott, 1996)? Possibly, individuals who use self-efficacy strengthening implementation intentions quickly recognize that this strategy allows for a higher test performance, and thus will again use such self-instructions in other test situations. Moreover, self-efficacy strengthening implementation intentions lead to better test performances and thus to first-hand mastery experiences, which in turn bring self-efficacy to stable high levels (Bandura, 1997). Self-efficacy strengthening implementation intentions may thus lift test taking self-efficacy to stable high levels that facilitate any future test taking.

Applied Relevance

Bandura (1997) argues that psychological treatment should not solely provide specific remedies for particular problems. Psychological treatment should rather focus on self-enablement by providing people with the knowledge, competencies, and resilient self-beliefs to exercise some measure of control over the quality and

direction of their lives. Effective functioning thus requires developing the means for exercising control over self-debilitating patterns of thought, emotional distress, and behavior patterns that impair people's relationships with themselves and others. From our point of view, teaching people to use implementation intentions is a promising route towards achieving such needed self-enablement.

On top of this, Baumeister and Vohs (2003) remind us that self-regulation capacity is limited. Therefore, self-regulation that is more on the automatic rather than the effortful side should be preferred when it comes to striving for one's goals. As implementation intentions unfold their effects in an efficient (automatic) manner, people should resort to forming implementation intentions as the preferred self-regulation strategy whenever they anticipate, or are already in, a state of self-regulatory depletion (Gollwitzer & Bayer, 2000).

Conclusion

In past research, implementation intentions ("if-then" plans) specified a critical situation in the "if-part" (i.e., when and where to act) and linked it to a goal-directed behavior in the "then-part" (i.e., how to act towards the goal). In the present research, implementation intentions linked a critical situation to a motivational response: a self-efficacy strengthening covert statement. Such implementation intentions led to better academic test performances as compared to both setting oneself a mere achievement goal and setting oneself an additional self-efficacy strengthening goal intention. Thus, implementation intentions may not only trigger the automatic initiation of specified goal-directed behavior, but also general motivational states or qualities. The present research focused on feelings of high self-efficacy, but other motivational inputs (e.g., promotion orientation, learning orientation) may also be recruited by implementation intentions.

References

- Achtziger, A., & Gollwitzer, P. M. (2006). Motivation and volition during the course of action. In J. Heckhausen & H. Heckhausen (Eds.), *Motivation and action*. London: Cambridge University Press.
- Artisticco, D., Cervone, D., & Pezzuti, L. (2003). Perceived self-efficacy and everyday problem solving among young and older adults. *Psychology and Aging, 18*, 68–79.
- Aspinwall, D. A., & Richter, L. (1999). Optimism and self-mastery predict more rapid disengagement from unsolvable tasks in the presence of alternatives. *Motivation and Emotion, 23*, 221–245.
- Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37*, 122–147.
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.
- Bandura, A., & Adams, N. E. (1977). Analysis of self-efficacy theory of behavioral change. *Cognitive Therapy and Research, 1*, 287–308.
- Bandura, A., Cioffi, D., Taylor, C. B., & Brouillard, M. E. (1988). Perceived self-efficacy in coping with cognitive stressors and opioid activation. *Journal of Personality and Social Psychology, 55*, 479–488.
- Bandura, A., & Locke, E. A. (2003). Negative self-efficacy and goal effects revisited. *Journal of Applied Psychology, 88*, 87–99.
- Bandura, A., Reese, L., & Adams, N. E. (1982). Microanalysis of action and fear arousal as a function of different levels of perceived self-efficacy. *Journal of Personality and Social Psychology, 41*, 586–598.

- Bargh, J. A. (1994). The four horsemen of automaticity: Awareness, efficiency, intention, and control in social interaction. In R. S. Wyer, Jr., & T. K. Srull (Eds.), *Handbook of social cognition* (2nd ed., pp. 1–40). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Baumeister, R. F., & Vohs, K. D. (2003). Self-regulation and the executive function of the self. In M. R. Leary & J. P. Tangney (Eds.), *Handbook of self and identity* (pp.197–217). New York: Guilford Press.
- Bayer, U. C., Moskowitz, G. B., & Gollwitzer, P. M. (2002). *Implementation intentions and action initiation without conscious intent*. Unpublished manuscript.
- Ben-Zeev, T., Fein, S., & Inzlicht, M. (2005). Arousal and stereotype threat. *Journal of Experimental Social Psychology, 41*, 174–181.
- Berry, J. M., West, R. L., & Dennehey, D. M. (1989). Reliability and validity of the memory self-efficacy questionnaire. *Developmental Psychology, 25*, 701–713.
- Bouffard-Bouchard, T. (1990). Influence of self-efficacy on performance in a cognitive task. *Journal of Social Psychology, 130*, 353–363.
- Brandstätter, V., Lengfelder, A., & Gollwitzer, P. M. (2001). Implementation intentions and efficient action initiation. *Journal of Personality and Social Psychology, 81*, 946–960.
- Cadinu, M., Maass, A., Rosabianca, A., & Kiesner, J. (2005). Why do women underperform under stereotype threat? *Psychological Science, 16*, 572–578.
- Carey, M. P., Snel, D. L., Carey, K. B., & Richards, C. S. (1989). Self-initiated smoking cessation: A review of the empirical literature from a stress and coping perspective. *Cognitive Therapy and Research, 13*, 323–341.
- Cervone, D., & Peake, P. K. (1986). Anchoring, efficacy, and action: The influence of judgmental heuristics on self-efficacy judgments and behavior. *Journal of Personality and Social Psychology, 61*, 257–266.
- Cervone, D., & Wood, R. (1995). Goals, feedback, and the differential influence of self-regulatory processes on cognitively complex performance. *Cognitive Therapy and Research, 19*, 521–547.
- Eccles, J. (1983). Expectancies, values, and academic behaviors. In J. T. Spencer (Ed.), *Achievement and achievement motives: Psychological and sociological approaches* (pp. 75–146). San Francisco: Freeman.
- Eden, D., & Zuk, Y. (1995). Seasickness as a self-fulfilling prophecy: Raising self-efficacy to boost performance at sea. *Journal of Applied Psychology, 80*, 628–635.
- Ellis, R. A., & Taylor, M. S. (1983). Role of self-esteem within the job search process. *Journal of Applied Psychology, 68*, 632–640.
- Gollwitzer, P. M. (1993). Goal achievement: The role of intentions. *European Review of Social Psychology, 4*, 141–185.
- Gollwitzer, P. M. (1996). The volitional benefits of planning. In P. M. Gollwitzer & J. Bargh (Eds.), *The psychology of action: Linking cognition and motivation to behavior* (pp. 287–312). New York: Guilford.
- Gollwitzer, P. M. (1999). Implementation intentions: Strong effects of simple plans. *American Psychologist, 54*, 493–503.
- Gollwitzer, P. M., & Bayer, U. C. (2000). *Becoming a better person without changing the self*. Paper presented at the Self and Identity Pre-conference of the Annual Meeting of the Society of Experimental Social Psychology, Atlanta, Georgia.
- Gollwitzer, P. M., Bayer, U. C., & McCulloch, K. C. (2005). The control of the unwanted. In J. A. Bargh, J. Uleman, & R. Hassin (Eds.), *Unintended thought* (Vol. 2, pp. 485–515). New York: Guilford Press.
- Gollwitzer, P. M., Bayer, U. C., Steller, B., & Bargh, J. A. (2002). *Delegating control to the environment: Perception, attention, and memory for pre-selected behavioral cues*. Unpublished manuscript.
- Gollwitzer, P. M., & Brandstätter, V. (1997). Implementation intentions and effective goal pursuit. *Journal of Personality and Social Psychology, 73*, 186–199.
- Gollwitzer, P. M., & Schaal, B. (1998). Metacognition in action: The importance of implementation intentions. *Personality and Social Psychology Review, 2*, 124–136.

- Gollwitzer, P. M., & Sheeran, P. (2006). Implementation intentions and goal achievement: A meta-analysis of effects and processes. *Advances of Experimental Social Psychology*, *38*, 69–119.
- Hackett, G., & Betz, N. E. (1989). An exploration of the mathematics self-efficacy/mathematics performance correspondence. *Journal for Research in Mathematics Education*, *20*, 261–273.
- Janoff-Bulman, R., & Brickman, P. (1982). Expectations and what people learn from failure. In N. T. Feather (Ed.), *Expectations and actions: Expectancy-value models in psychology* (pp. 207–237). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Kratzmeier, H. (1976). *Raven-Matrizen-Test: Advanced progressive matrices*. Weinheim, Germany: Beltz.
- Lengfelder, A., & Gollwitzer, P. M. (2001). Reflective and reflexive action control in patients with frontal brain lesions. *Neuropsychology*, *15*, 80–100.
- Lent, R. W., Brown, S. D., & Larkin, K. C. (1984). Relation of self-efficacy expectations to academic achievement and persistence. *Journal of Counseling Psychology*, *31*, 356–362.
- Maddux, J. E., & Gosselin, J. T. (2003). Self-efficacy. In M. R. Leary & J. P. Tangney (Eds.), *Handbook of self and identity* (pp. 218–238). New York: Guilford Press.
- Mathews, G. (1999). Personality and skill: A cognitive-adaptive framework. In P. L. Ackerman, P. C. Kyllonen & R. D. Roberts (Eds.), *The future of learning and individual differences research: Process, traits, and content* (pp. 251–273). Washington, DC: American Psychological Association.
- Mau, W.-C., & Lynn, R. (2000). Gender differences in homework and test scores in mathematics, reading and science at tenth and twelfth grade. *Psychology, Evolution & Gender*, *2*, 119–125.
- Meichenbaum, D. H., & Goodman, J. (1971). Training impulsive children to talk to themselves: A means of developing self-control. *Journal of Abnormal Psychology*, *77*, 115–126.
- Orbell, S., Hodgkins, S., & Sheeran, P. (1997). Implementation intentions and the theory of planned behaviour. *Personality and Social Psychology Bulletin*, *23*, 945–954.
- Pietsch, J., Walker, R., & Chapman, E. (2003). The relationship among self-concept, self-efficacy, and performance in mathematics during secondary school. *Journal of Education Psychology*, *95*, 589–603.
- Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology*, *82*, 33–40.
- Raven, J. C. (1962). *Advanced progressive matrices*. London: H. K. Lewis.
- Raven, J. C. (2000). The Raven's progressive matrices: Change and stability over culture and time. *Cognitive Psychology*, *41*, 1–48.
- Sanderson, C. A., & Jemmott, J. B. (1996). Moderation and mediation of HIV-prevention interventions: Relationship status, intentions, and condom use among college students. *Journal of Applied Social Psychology*, *26*, 2076–2099.
- Schmader, T., & Johns, M. (2003). Converging evidence that stereotype threat reduces working memory capacity. *Journal of Personality and Social Psychology*, *85*, 440–452.
- Schunk, D. H. (1982). Effects of effort attributional feedback on children's perceived self-efficacy and achievement. *Journal of Educational Psychology*, *74*, 548–556.
- Schunk, D. H., & Rice, J. M. (1993). Strategy fading and progress feeding: Effects on self-efficacy and comprehension among students receiving remedial reading services. *Journal of Special Education*, *27*, 257–276.
- Schwarzer, R., & Renner, B. (2000). Social-cognitive predictors of health behavior: Active self-efficacy and coping self-efficacy. *Health Psychology*, *19*, 487–495.
- Sheeran, P., & Orbell, S. (1999). Implementation intentions and repeated behavior: Augmenting the predictive validity of the theory of planned behaviour. *European Journal of Social Psychology*, *29*, 349–369.

- Sheeran, P., Webb, T. L., & Gollwitzer, P. M. (2005). The interplay between goal intentions and implementation intentions. *Personality and Social Psychology Bulletin*, *31*, 87–98.
- Spencer, S. J., Steele, C. M., & Quinn, D. (1999). Stereotype threat and women's math performance. *Journal of Experimental Social Psychology*, *35*, 4–28.
- Stajkovic, A. D., & Luthans, F. (1998). Self-efficacy and work-related performance: A meta-analysis. *Psychological Bulletin*, *124*, 240–261.
- Taylor, M. S., Locke, E. A., Lee, C., & Gist, M. E. (1984). Type A behavior and faculty research productivity: What are the mechanisms? *Organizational Behavior and Human Performance*, *34*, 402–418.
- Williams, S. L. (1995). Self-efficacy, anxiety, and phobic disorder. In J. E. Maddux (Ed.), *Self-efficacy, adaptation, and adjustment: Theory, research and application* (pp. 69–107). New York: Plenum Press.
- Wigfield, A., Eccles, J. S., MacIver, D., Reuman, D., & Midgley, C. (1991). Transitions at early adolescence: Changes in children's domain-specific self-perceptions and general self-esteem across the transition to junior high school. *Developmental Psychology*, *27*, 552–565.
- Wood, R. E., Bandura, A., & Bailey, T. (1990). Mechanisms governing organizational performance in complex decision-making environments. *Organizational Behavior and Human Decision Processes*, *46*, 181–201.