

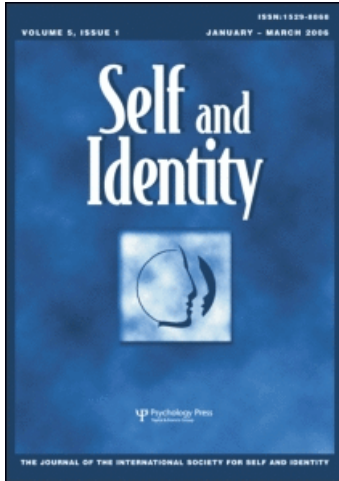
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Self-efficacy Feelings Moderate Implementation Intention Effects

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Self-efficacy was analyzed as a potential moderator of implementation intention effects on goal attainment. Participants' self-efficacy with respect to taking an analytic reasoning test (Advanced Progressive Matrices; Raven, 1976) was manipulated before they formed the goal to perform well. Next, all participants learned about double checking as an effective strategy to improve test performance, but only in the implementation intention condition did they put this strategy into an if-then plan. The analytic reasoning test was comprised of easy, medium-difficult, and difficult items. Implementation intentions advanced performance on difficult items when high self-efficacy had been established, but not when self-efficacy was low. The time participants spent solving the Raven items mediated this implementation intention effect on performance.

Keywords: Goal intentions; Implementation intentions; Self-efficacy; Task difficulty.

To optimize self-regulation is a lifelong challenge (e.g., Bandura, 1997; Baumeister, Heatherton, & Tice, 1994; Gollwitzer & Sheeran, 2006). Self-regulation of goal striving requires one to initiate goal-directed action, persist, disengage when goals become unattainable, and efficiently manage one's resources. A straightforward self-regulation strategy to improve goal striving is to form implementation intentions (Gollwitzer, 1993, 1999). Implementation intentions are if(situation)-then(behavior) plans (e.g., "If situation *y* arises, then I will initiate goal-directed behavior *z*!") that can be formed to supplement goal intentions (e.g., "I intend to achieve/pursue goal *x*!"). They specify in advance when, where, and how one intends to attain a goal.

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By one conscious act of will, implementation intentions delegate effortful control of one's actions by the self to direct control by internal or external situational cues (Achtziger, Gollwitzer, & Sheeran, 2008).

In a recent meta-analysis (Gollwitzer & Sheeran, 2006), implementation intentions turned out to have a medium-to-large positive effect ($d=0.65$) on goal attainment over and above setting mere goal intentions. For example, adding implementation intentions to goal intentions considerably improved participants' completion rates of goal intentions that were difficult to enact (e.g., writing an assigned paper over the Christmas holidays from 32% to 71%; Gollwitzer & Brandstätter, 1997, Study 2). Current research has further observed that implementation intentions are effective even under conditions that do not appear amenable to self-regulation (Gollwitzer, Gawrilow, & Oettingen, in press). For example, implementation intentions benefit goal attainment even when goal striving is limited by opponents (e.g., in tennis matches, Achtziger et al., 2008, or negotiations, Trötschel & Gollwitzer, 2007) or automatic antagonistic responses (e.g., habitual failure to recycle waste, Holland, Aarts, & Langendam, 2006; chronic high emotional reactivity in phobics, Schweiger Gallo, Keil, McCulloch, Rockstroh, & Gollwitzer, 2009).

Prerequisites for Implementation Intention Effects

Thus far, implementation intentions seem to represent a foolproof self-regulatory strategy to promote the translation of goal intentions into actual behavior. However, as William James (1890) reminds us in his *Principles of Psychology* (Chapter 26 on the will, p. 486), willing becomes real "either immediately upon the willing or after certain preliminaries have been fulfilled." Accordingly, the present research probed prerequisites for implementation intention effects by focusing on a person's sense of self-efficacy.

Mediating Processes

Foremost, past implementation intention research has identified various mediating processes of implementation intention effects. These mediating processes certainly qualify as important prerequisites; only if these processes run smoothly can strong implementation intention effects be expected (e.g., Aarts, Dijksterhuis, & Midden, 1999; Webb & Sheeran, 2007, 2008). First, the mental representation of the specified cue in the if-component needs to be in a heightened state of activation to guarantee easy cognitive accessibility of this cue. Second, an implementation intention has to forge a strong link between the anticipated situational cue specified in the if-component and the intended response in the then-component to guarantee the automatic initiation of this response.

These two mechanisms allow for what has been referred to as strategic automaticity of action control achieved by forming implementation intentions (Gollwitzer & Schaal, 1998). To qualify as automatic, action control has to carry features of reduced controllability, redundancy of conscious intent, immediacy, and efficiency (e.g., Bargh, 1994, 1997; Logan, 1992; Shiffrin & Schneider, 1977). Indeed, when people actively hold a focal goal (e.g., for a subsequent action), situations specified in an implementation intention attract peoples' attention even during the pursuit of a goal other than the focal goal (Wieber & Sassenberg, 2006). When the critical situational cues are presented subliminally, implementation intentions still

manage to facilitate action preparation and initiation, indicating that a conscious intent for action initiation is no longer required (Bayer, Achtziger, Gollwitzer, & Moskowitz, 2009). The behaviors specified in an implementation intention are also initiated immediately once the critical situational cue is actually encountered (e.g., Aarts & Dijksterhuis, 2000; Gollwitzer & Brandstätter, 1997, Study 3; Lengfelder & Gollwitzer, 2001, Study 2). This immediacy of action initiation is found to be efficient, as shown in studies using dual-task paradigms that allow the creation of high cognitive load (Brandstätter, Lengfelder, & Gollwitzer, 2001, Studies 3 and 4). Whereas action control by mere goal intentions draws on effortful cognitive and self-regulatory processes of discrepancy reduction (e.g., Locke & Latham, 1990) and thus is handicapped by cognitive load, this is not the case for action control by additional implementation intentions; the latter operates well even under high cognitive load.

Further supporting the hypothesis that implementation intentions automate the control of goal-directed actions, it was observed that people who have chronic action-control problems particularly benefit from making if-then plans (e.g., opiate addicts in withdrawal; Brandstätter et al., 2001, Study 2; children with ADHD, Gawrilow & Gollwitzer, 2008). Also, individuals with depleted self-regulatory resources (Webb & Sheeran, 2003) have still been shown to benefit from forming implementation intentions. Finally, past implementation intention research has found that the beneficial effects of implementation intentions are stronger when difficult-to-implement goals as compared to easy-to-implement goals are to be attained (Gollwitzer & Sheeran, 2006); assuming that difficult goals (i.e., tasks of high complexity) inherently put strong demands on a person's cognitive system as they tax working memory more than tasks with lower difficulty (Baddeley, 2000), this finding also speaks for the hypothesis that implementation intentions automate action control.

Moderator Variables

Moderators of implementation intention effects also qualify as prerequisites. For instance, for implementation intention effects to occur, people need to be strongly committed to the superordinate goal intention (e.g., De Nooijer, De Vet, Brug, & De Vries, 2006; Gollwitzer, 1999; Orbell, Hodgkins, & Sheeran, 1997; Sheeran, Webb, & Gollwitzer, 2005, Study 1; Verplanken & Faes, 1999) and the superordinate goal intention needs to be in a state of activation (Cohen, Bayer, Jaudas, & Gollwitzer, 2008; Sheeran et al., 2005, Study 2). These prerequisites help to prevent mechanistic plan enactment when people have already disengaged from their goals or find themselves pursuing different goals; in other words, the automaticity achieved by implementation intentions is a goal-dependent automaticity (Bargh, 1989). For example, in a puzzle task study on the goal dependence of implementation intentions (Sheeran et al., 2005, Study 2), implementation intentions that specified how to be fast in solving the puzzles did not lead to faster responses when the goal to be accurate rather than fast was being activated. However, when the goal to be fast rather than accurate was activated, these implementation intentions did in fact produce faster responses.

Moreover, the commitment to the formed implementation intention needs to be strong (e.g., Achtziger, Bayer, & Gollwitzer, 2009, Study 2). When one doubts the appropriateness of an implementation intention, no implementation intention effects can be expected. In line with this assumption, Achtziger et al. (2009, Study 2)

observed weaker implementation intention effects in participants who had been told that they had the type of personality that facilitates goal attainment by staying flexible (low plan commitment), as compared to participants who had been told that they had the type of personality that facilitates goal attainment by sticking to one's plans (high plan commitment).

The Present Research

A high level of perceived self-efficacy (Bandura, 1977, 2001) should also qualify as a prerequisite for implementation intention effects. Perceived self-efficacy is defined as "the belief in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997, p. 3), and it has been observed to improve goal attainment in a substantial array of empirical research (see Bandura, 1997; Judge, Jackson, Shaw, Scott, & Rich, 2007; Stajkovic & Luthans, 1998, for an overview). More specifically, with high levels of self-efficacy, people are more willing to accept challenges, execute complex cognitive strategies, persist despite setbacks, and stay calm in response to threats; with low self-efficacy, people are easily discouraged by failure (Bandura, 1997).

Concerning the impact of self-efficacy on the effectiveness of implementation intentions, two types of self-efficacy feelings seem relevant. First, people may feel efficacious with respect to performing the behavior specified in the then-component of an implementation intention (i.e., they feel capable of successfully executing the specified behavior). Second, people may feel efficacious with respect to performing any behavior needed to reach the superordinate goal intention (i.e., they feel capable of doing whatever is required to attain the goal itself). Whereas the first type of self-efficacy is quite specific as it only targets the execution of the goal-directed behavior specified in the implementation intention, the second type is quite general as it concerns the execution of any instrumental goal-directed behavior. It is this latter type of self-efficacy feeling that the present research was concerned with.

How could a low level of this general self-efficacy feeling limit the effectiveness of implementation intentions? According to Bandura (1997) high self-efficacy leads to heightened persistence to strive for a self-set or assigned goal when attainment of the goal is threatened by encountering difficulties. Given high self-efficacy, people respond to facing difficulties by trying out available strategies to still reach the desired goal whereas people with low self-efficacy do not take this extra effort. Accordingly, we predict that when goal striving becomes difficult, implementation intentions that specify a strategy to reach the goal at hand should have stronger beneficial effects in individuals with high self-efficacy as compared to individuals with low efficacy feelings.

To date, only a few studies have linked implementation intentions to self-efficacy as a dependent or an independent variable. Concerning the former case, a recent meta-analysis of 34 experimental studies by Webb and Sheeran (2008) found that the sample-weighted average effect sizes of the implementation intention effects on self-efficacy were very small ($.02 < d < .10$) and did not approach statistical significance. Thus, forming implementation intentions does not increase self-efficacy, and implementation intention effects cannot be explained by referring to heightened self-efficacy.

Concerning the latter case, one study examined whether self-efficacy with respect to attaining the superordinate goal intention impacts implementation intention

effects (Koestner et al., 2006, Study 2). Koestner and colleagues asked if the effects of implementation intentions on the attainment of self-generated personal goals can be bolstered for the long haul by simultaneously boosting self-efficacy. In this study, participants were randomly assigned to one of three treatment conditions. In the control condition, they completed an irrelevant goal task. In the implementation intention condition, participants made plans of when, where, and how to pursue their most important New Year's resolution. In the implementation intention plus self-efficacy boost condition, participants were additionally required to reflect on their actual New Year's resolutions using three different tasks designed to boost their self-efficacy: they had to think of past mastery experiences (i.e., situations when they achieved a similar goal), vicarious experiences (i.e., situations when a similar individual attained a similar goal), and means of social support (i.e., an individual encouraging their goal). Measuring goal progress via questionnaires e-mailed 20 weeks later, participants reported a significantly higher level of goal progress in the implementation intention plus self-efficacy boosting condition compared to the control condition as well as to the mere implementation intention condition. In accordance with the assumption that high self-efficacy is a prerequisite for implementation intention effects, implementation intentions without a self-efficacy boost did not improve goal progress over the five-month period. In sum, the study provided evidence that high self-efficacy supports the effectiveness of implementation intentions on the attainment of self-generated personal goals, and this over an extended time period.

In addition to self-generated goals, people also have to pursue goals in their everyday life that have been assigned to them by others (e.g., completing a test to get credits for taking a course). As it seems easier to induce high self-efficacy feelings with respect to personal goals as compared to assigned goals, we analyzed in the present research whether the effects of implementation intentions on attaining assigned goals can also be bolstered by a self-efficacy boost. Moreover, in the Koestner et al. (2006, Study 2) experiment, the personal goals (New Year's resolutions) set by the participants can be assumed to be quite challenging (i.e., people often fail to enact their New Year's resolutions). In order to test our hypothesis that self-efficacy only qualifies as a moderator for implementation intention effects when goal striving becomes challenging, in the present research we varied the difficulty level of the tasks to be performed.

Participants were assigned the goal to perform well on a Raven matrices task (Raven, 1976, 2000). First, high or low self-efficacy was induced by asking participants to solve Raven matrices of low or high difficulty. Next, all participants learned that the strategy to double check their initial solutions is an effective way to improve their performance and they then formed the goal intention to solve as many matrices as possible. Participants then either included the strategy to double check their solutions in an implementation intention or not. The subsequent test started with easy matrices that were followed by medium-difficult and then lastly by difficult matrices. We predicted that high self-efficacy participants would show stronger implementation intention effects than low self-efficacy participants when goal striving gets difficult (i.e., the difficult Raven matrices are encountered). Implementation intentions were expected to ensure that good opportunities to act (i.e., when a first solution is found) will not escape one's attention, and that one does not need to deliberate whether it is worthwhile to apply the double-checking strategy once the situation is present. A high level of self-efficacy for the goal to perform well on the Raven matrices task was assumed to represent a prerequisite for participants to

apply the effortful, but helpful, double-checking strategy when facing the difficult to solve Raven matrices.

Method

Design and Participants

The study used a mixed-factor design with Self-Efficacy (low vs. high) and Implementation Intention (yes vs. no) as between-factors, and Task Difficulty (easy vs. medium vs. difficult) as a within-factor. In exchange for €2.50, 25 female and 33 male undergraduate students from the University of Konstanz, with a mean age of 20 years (range 16–50) participated in the study.

Procedure

Upon arrival at the laboratory, participants were seated in front of a computer in separate cubicles. Computerized instructions informed participants that the critical task would be broken up into three separate blocks. In each of the three blocks, they worked on analytic reasoning tasks (see below; Advanced Progressive Matrices, Set II, Raven, 1976, 2000). In total, 12 matrices were presented plus one example matrix.

Self-efficacy manipulation. Participants were first given instructions to solve an example matrix. They were then randomly assigned either to a high self-efficacy condition in which 3 easy matrices were presented (matrix numbers 2, 5, and 6) or to a low self-efficacy condition with 3 difficult matrices (matrix numbers 34, 35, and 36). Participants were allotted six minutes for this set of 3 matrices. After excelling on the easy matrices, participants should have strongly believed in their ability to solve Raven matrices successfully (i.e., high self-efficacy). In contrast, after struggling on the difficult matrices, participants should have doubted their ability to solve the remaining matrices (i.e., low self-efficacy). Vancouver, Thompson, Tischner, and Putka (2002) used a similar method to effectively manipulate self-efficacy.

Manipulation checks. After the self-efficacy manipulation, participants first rated their self-efficacy (5-item scale: “The first three items were easy for me”; “This task is exactly the type of task I like”; “I am confident that I will be able to find many more correct solutions”; “This type of task does not suit me” (reversed); “I think 90 seconds per item is definitely sufficient” ($\alpha = .89$). Their motivation, a 3-item scale: “I like doing such tasks”; “I can get into these kinds of reasoning tasks”; “I find such tasks very interesting” ($\alpha = .78$), and goal commitment: “I am determined to solve as many items as possible”, were assessed subsequently on Likert scales ranging from 1 (*totally disagree*) to 7 (*agree completely*). Further, all participants read that double checking one’s answers helps to avoid the common mistake of proceeding to the next item too quickly (i.e., overlooking relevant stimulus characteristics contributes to confusing multiple strategies, see Kratzmeier & Horn, 1980). This information served to ensure that participants in both conditions were aware of an effective performance-enhancing strategy, namely double checking.

Intention manipulation. Next, the participants were told that setting oneself a performance goal has been shown to actually improve performance. Thus they were asked to set themselves the goal “I want to solve as many items as possible!” After

that, half of the participants in both the low and high self-efficacy groups were randomly assigned to the implementation intention condition and were asked to use the previously explained double-checking strategy in the subsequent task. In order to do so, the subjects were told to combine their goal with the additional implementation intention "And if I have found an initial solution, then I will double check it!" Next, participants were asked to write down either the implementation intention (implementation intention condition) or the mere goal intention (no implementation intention condition) on an additional piece of paper that was placed in an envelope sitting next to the computer in order to improve memorization. In total, this intention formation took about 5 minutes. Thereafter the critical task commenced.

Raven matrices. As the dependent variable, participants worked on nine Advanced Progressive Matrices (APM, Set II; Raven, 1976, German version, Kratzmeier & Horn, 1980) for a maximum of 18 minutes to assess their reasoning ability independent of language and formal schooling. The selected matrices represented a special subsample of the Raven matrices, covering three levels of difficulty (i.e., complexity). On all three levels of difficulty, matrices were selected that were vulnerable to being solved incorrectly because relevant stimulus characteristics were likely to be overseen (Kratzmeier & Horn, 1980) and thus should benefit from the double-checking strategy. For each of the matrices, subjects had to select one of six different result patterns that logically completed a three-by-three matrix pattern. Participants first worked on easy matrices (matrix numbers 18, 19, and 20), then on medium-difficult matrices (matrix numbers 22, 23, and 28), before they worked on difficult matrices (matrix numbers 29, 30, and 31).

Recall task. After completing the Raven matrices, participants were asked to recall and to write down their goal intention or implementation intention on a different sheet of paper. Participants' recall performance was rated by the experimenter on a 4-point scale: 0 (*not remembered at all*), 1 (*incompletely remembered*), 2 (*analogously remembered*), and 3 (*literally remembered*).

Results

Manipulation Checks

Performance on the 2 blocks of 3 matrices used to manipulate self-efficacy was subjected to an univariate ANOVA that revealed a main effect of Self-Efficacy, $F(1, 56) = 149.16, p < .001, \eta^2_p = .73$. As expected, participants in the low self-efficacy group solved significantly less items ($M = 0.53, SD = 0.78$) compared to participants in the high self-efficacy group ($M = 2.75, SD = 0.59$). More importantly, participants reported lower self-efficacy in the low self-efficacy condition ($M = 4.22, SD = 1.26$) than participants in the high self-efficacy condition ($M = 5.20, SD = 0.87$), $F(1, 58) = 11.70, p < .01, \eta^2_p = .17$. In addition, reported motivation (M) and goal commitment (GC) were lower in the low self-efficacy condition ($M_M = 3.72, SD = 1.52; M_{GC} = 5.27, SD = 1.29$) than in the high self-efficacy condition ($M_M = 4.96, SD = 1.07; M_{GC} = 6.04, SD = 1.35$), both $F_s(1, 56) > 4.94, p_s < .05, \eta^2_p > .08$. Performance on the 3 matrices used to manipulate self-efficacy correlated with reported self-efficacy, motivation, and goal commitment, all $r_s > .28, p_s < .05$.

To test whether participants' intention formation differed between the four conditions, the results of the intention recall at the end of the study were subjected to a 2 (Self-Efficacy: low vs. high) \times 2 (Implementation Intention: yes vs. no) ANOVA. No differences between the Implementation Intention or Self-Efficacy conditions, and no interaction effect of Implementation Intention and Self-Efficacy were found, all $F_s < 1$, $p_s > .36$, $\eta^2_p < .02$, indicating that at the end of the study, participants in all four conditions equally effectively reproduced their goal or implementation intentions ($M = 2.29$, $SD = 0.84$). Looking at the percentage of participants per condition who achieved a recall score of at least 2 (*analogously remembered*) or 3 (*literally remembered*), the actual percentages were: 10 out of 14 of the participants in the low Self-Efficacy–Implementation Intention condition, i.e., 71.4%; 8 out of 9 participants in the high Self-Efficacy–Implementation Intention condition, i.e., 88.9%; 13 out of 16 in the low Self-Efficacy–No Implementation Intention condition, i.e., 81.2%; and 15 out of 19 in the high Self-Efficacy–No Implementation Intention condition; i.e., 78.9%). Thus, it can be assumed that in each of the four conditions the intentions have been successfully formed.

Performance: Correct Solutions

To test the predicted three-way interaction, the number of correct solutions for the 9 critical matrices were entered into a 2 (Self-Efficacy: low vs. high) \times 2 (Implementation Intention: yes vs. no) \times 3 (Task Difficulty: easy vs. medium vs. difficult) repeated-measures ANOVA. A significant main effect of Task Difficulty was obtained, $F(2, 53) = 7.19$, $p < .01$, $\eta^2_p = .21$. Participants solved less of the difficult Raven items ($M = 1.12$, $SD = 0.96$) than of the medium–difficult ($M = 1.79$, $SD = 0.91$), $t(57) = 4.36$, $p < .001$, or easy items ($M = 1.62$, $SD = 0.59$), $t(57) = 3.64$, $p < .01$; see Table 1. This main effect of Task Difficulty was qualified by the expected interaction between Implementation Intention, Self-Efficacy, and

TABLE 1 Mean Number of Correct Solutions and Average Time Spent on Correct Solutions (in seconds) on the Raven Matrices as a Function of Self-Efficacy, Implementation Intention, and Task Difficulty ($N = 58$)

Task difficulty	Self-Efficacy			
	Low		High	
	Implementation intention (no)	Implementation intention (yes)	Implementation intention (no)	Implementation intention (yes)
<i>Number of correct solutions</i>				
Easy	1.63 (0.72)	1.71 (0.47)	1.63 (0.50)	1.44 (0.73)
Medium	1.81 (0.83)	1.86 (0.95)	1.79 (0.92)	1.67 (1.12)
Difficult	1.19 (0.98)	1.00 (0.96)	0.79 (0.79)	1.89 (0.93)
<i>Time spent on correct solutions</i>				
Easy	37.76 (19.64)	45.14 (16.59)	43.47 (21.21)	46.75 (40.15)
Medium	39.39 (21.56)	61.91 (43.81)	50.49 (30.03)	32.60 (23.06)
Difficult	46.63 (36.79)	42.69 (38.74)	35.33 (36.92)	90.45 (37.60)

Note: Standard deviations are in parentheses.

Task Difficulty, $F(2, 53) = 4.64$, $p < .05$, $\eta^2_p = .15$. To examine this three-way interaction, simple effect follow-up analyses were computed for each of the two self-efficacy conditions. In the low self-efficacy condition, no Task Difficulty by Implementation Intention interaction effect was found, $F < 1$, $p > .72$, but a simple main effect of Task Difficulty, $F(2, 27) = 8.22$, $p < .01$, $\eta^2_p = .38$. Participants solved less of the difficult items ($M = 1.10$, $SD = 0.96$) than of the medium-difficult ($M = 1.83$, $SD = 0.87$), $t(29) = 3.83$, $p < .01$, or easy items ($M = 1.67$, $SD = 0.61$), $t(29) = 3.20$, $p < .01$. In the high self-efficacy condition, no simple main effect of Task Difficulty, $F < 1.24$, $p > .30$, but the expected Task Difficulty by Implementation Intention interaction effect was obtained, $F(2, 25) = 5.35$, $p < .05$, $\eta^2_p = .30$. Participants in the high self-efficacy group indeed solved more difficult items correctly when adding an implementation intention to their goal intention ($M = 1.89$, $SD = 0.93$) compared to participants in the high self-efficacy group who did not form an implementation intention ($M = 0.79$, $SD = 0.79$), $t(26) = 3.26$, $p < .01$, $\eta^2_p = .29$.

Additional contrast analyses of participants' performance were computed using all four combinations of low and high self-efficacy (SE) with no implementation intentions (NoII) and implementation intentions (II): low SE-NoII, low SE-II, high SE-NoII, and high SE-II. Performance differed on difficult items, $F(3, 54) = 3.10$, $p < .05$, $\eta^2_p = .15$, but not on easy or medium-difficult items, both $F_s < 1$, $p_s > .76$. Participants in the high SE-NoII condition did not differ from those in the two low SE conditions (0 2 - 1 - 1 contrast), $t(54) = 1.14$, $p > .25$. However, participants in the high SE-II condition solved more difficult items ($M = 1.89$, $SD = 0.93$) than participants in the three remaining combinations (3 - 1 - 1 - 1 contrast), $t(54) = 2.72$, $p < .01$. There were no other significant effects, all $F_s < 2.00$, $p_s > .14$, $\eta^2_p < .08$.

To test the alternative explanation that goal commitment or motivation rather than self-efficacy moderated the implementation intention effects on performance, two separate approaches were used. First, including motivation and goal commitment as covariates in a repeated-measures ANCOVA did not change the reported three-way interaction effect between Implementation Intention, Self-Efficacy, and Task Difficulty, $F(2, 49) = 4.46$, $p < .05$, $\eta^2_p = .15$. None of the other effects (main effects of II, SE, and Task Difficulty; main effects of the covariates and their interactions with II) reached conventional levels of significance, all $F_s < 1.59$, $p_s > .21$, $\eta^2_p < .07$. Second, using motivation or commitment instead of self-efficacy as a third factor (using median splits) in the $2 \times 2 \times 2$ ANOVAs, the three-way interaction effect no longer emerged, both $F_s < 2.15$, $p_s > .12$, $\eta^2_p < .08$. With the exception of main effects of Task Difficulty, both $F_s > 8.17$, $p_s < .01$, $\eta^2_p > .23$, no other effects (main effects of II; main effects of motivation, commitment and their interactions with II) reached conventional levels of significance, all $F_s < 1.50$, $p_s > .23$, $\eta^2_p < .06$.

Moreover, these two approaches were also followed when computing the number of correct solutions for the difficult matrices. They were first subjected to a 2 (Self-Efficacy: low vs. high) \times 2 (Implementation Intention: yes vs. no) ANCOVA with commitment and motivation as covariates. In line with our assumptions, the Self-Efficacy interaction with Implementation Intention stayed significant, $F(1, 50) = 5.68$, $p < .05$, $\eta^2_p = .10$. No other effects (main effects of SE and II; effects of the covariates and their interactions with II) reached conventional levels of significance, all $F_s < 1.33$, $p_s > .25$, $\eta^2_p < .03$. Second, using motivation or commitment instead of self-efficacy as a second factor (using median splits) in the 2×2 ANOVAs, the

two-way interaction effect no longer emerged, both $F_s < 1.44$, $ps > .23$, $\eta^2_p < .03$. No other effects reached significance, all $F_s < 2.33$, $ps > .13$, $\eta^2_p < .02$.

Performance: Time Spent

Running the same repeated-measures ANOVA with the average time spent on correctly solved Raven items using the Greenhouse–Geisser correction again revealed a significant three-way interaction, $F(1.75, 94.71) = 8.66$, $p < .01$, $\eta^2_p = .14$ (see Table 1). A main effect of Implementation Intention was also observed, $F(1, 54) = 5.11$, $p < .05$, $\eta^2_p = 0.09$, such that participants in the implementation intention condition spent more time working on the matrices ($M = 53.26$ s, $SD = 3.84$ s) than participants in the condition without implementation intention ($M = 42.18$ s, $SD = 3.05$ s). To examine the three-way interaction effect, simple effect follow-up analyses were computed for each of the self-efficacy conditions. In the low self-efficacy condition, no main effect of Task Difficulty and no Task Difficulty by Implementation Intention interaction effect were found, both $F_s < 1.03$, $ps > .37$. In the high self-efficacy condition, no simple main effect of Task Difficulty, $F < 2.54$, $p > .10$, but the expected Task Difficulty by Implementation Intention interaction was obtained, $F(2, 25) = 6.44$, $p < .05$, $\eta^2_p = .34$. Participants in the high self-efficacy group indeed spent more time on difficult items when adding an implementation intention to their goal intention ($M = 90.45$ s, $SD = 37.60$ s) compared to participants in the high self-efficacy group who just formed a goal intention ($M = 35.33$ s, $SD = 36.92$ s), $t(26) = 3.67$, $p < .01$, $\eta^2_p = .34$. Additional contrast analyses of participants' time spent on the correctly solved items were computed using all four self-efficacy and implementation intention combinations (see above). Time spent differed on difficult items, $F(3, 54) = 4.68$, $p < .01$, $\eta^2_p = .21$, but not on medium–difficult or easy items, both $F_s < 1$, $ps > .76$. Participants in the high SE–II condition spent more time on correctly solved difficult items ($M = 90.45$ s, $SD = 37.60$ s) than participants in the three remaining combinations (3 – 1 – 1 – 1 contrast), $t(54) = 3.60$, $p < .01$. Moreover, participants' time spent in the high SE–NoII condition did not differ from that in the remaining two low self-efficacy combination conditions (0 2 – 1 – 1 contrast), $t(54) = 0.85$, $p > .39$. There were no other significant effects, all $F_s < 1.83$, $ps > .17$, $\eta^2_p < .07$.

To test the alternative explanation that goal commitment or motivation rather than self-efficacy moderated the implementation intention effects on performance, the two separate approaches were used again. First, including motivation and goal commitment as covariates in a repeated-measures ANCOVA with the average time spent on correctly solved Raven items using the Greenhouse–Geisser correction did not change the reported three-way interaction effect between Implementation Intention, Self-Efficacy, and Task Difficulty, $F(1.74, 87.09) = 4.13$, $p < .05$, $\eta^2_p = .08$. With the exception of a main effect of Implementation Intention, $F(1, 50) = 4.19$, $p < .05$, $\eta^2_p = .08$, no other effects (main effects of SE; main effects of the covariates and their interactions with II) reached conventional levels of significance in either analysis, all $F_s < 2.71$, $ps > .10$, $\eta^2_p < .06$. Second, using motivation or commitment instead of Self-Efficacy as a third factor (using median splits) in the $2 \times 2 \times 2$ ANOVAs, the three-way interaction effect no longer emerged, both $F_s < 2.46$, $ps > .10$, $\eta^2_p < .05$. With the exception of main effects of Implementation Intentions, both $F_s > 4.70$, $ps < .05$, $\eta^2_p > .08$, no other effects (main effects of motivation, commitment, and Task Difficulty; and their interactions with II) reached conventional levels of significance, all $F_s < 1.24$, $ps > .27$, $\eta^2_p < .03$.

Moreover, these two approaches were also used to analyze the average time spent on correctly solved difficult matrices. Subjecting time to a 2 (Self-Efficacy: low vs. high) \times 2 (Implementation Intention: yes vs. no) ANCOVA with commitment and motivation as covariates did not change the expected Self-Efficacy by Implementation Intention interaction effect, $F(1, 50) = 5.88, p < .05, \eta^2_p = .11$. No other effects reached conventional levels of significance, all $F_s < 2.23, p_s > .14, \eta^2_p < .05$. Second, using motivation or commitment instead of Self-Efficacy as a second factor (using median splits) in the 2×2 ANOVAs, the two-way interaction effect no longer emerged, both $F_s < 1.23, p_s > .27, \eta^2_p < .03$. With the exception of a main effect of Implementation Intention in the 2 (Implementation Intention: yes vs. no) \times 2 (motivation: low vs. high) ANOVA, $F(1, 54) = 4.02, p = .05, \eta^2_p = .07$, no other effects reached statistical significance, all $F_s < 2.68, p_s > .10, \eta^2_p < .05$.

Performance Mediation

To test whether time spent on items mediated the performance-enhancing effect of implementation intentions for high self-efficacy subjects on the correctly solved difficult items, a mediation analysis following Kenny, Kashy, and Bolger (1998) was computed (see Figure 1). In Step 1, regressing the number of correct solutions by those in the high self-efficacy, difficult task condition ($n = 28$) on Implementation Intention yielded a significant correlation, $r = .54, p < .01$. In Step 2, the average time spent on correctly solved items by high self-efficacy subjects was regressed on Implementation Intention as a potential mediator; it yielded a significant correlation, $r = .58, p < .01$. In Step 3, Implementation Intention and average time spent on correctly solved items at the difficult task level was simultaneously entered into the regression analysis, which reduced the effect of Implementation Intention on performance to $\beta = .05, t(28) = 0.41, ns$, while the effect of response time was significant at $\beta = .84, t(28) = 6.78, p < .001$. A Sobel test (Sobel, 1982) of the indirect effect indicated a full mediation of the intention effect on performance via time spent working on the correctly solved matrices, $z = 3.23, p < .01$.

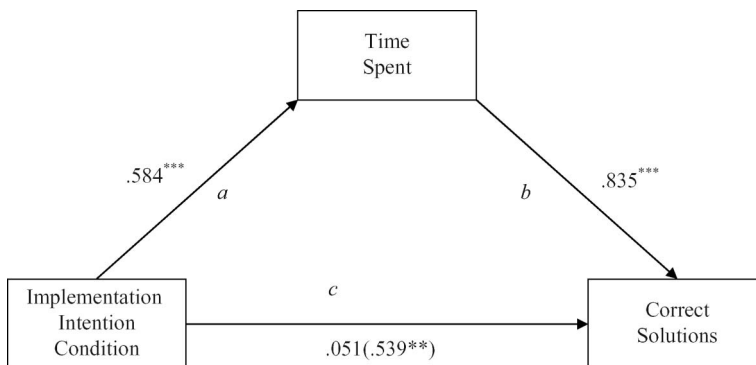


FIGURE 1 Path diagram illustrating average time spent on correct solutions as a mediator of the relation between Implementation Intention condition and correct solutions of the difficult task items for the high self-efficacy condition ($n = 28$). For path *c* the zero-order correlation of Implementation Intention condition with the correct solutions is given in brackets. Note: $**p < .01$; $***p < .001$.

To test the alternative explanation that implementation intentions merely counteracted the effects of the self-efficacy manipulation on participants' goal commitment and motivation, a further mediation analysis was computed. However, commitment and motivation neither significantly correlated with Implementation Intention or performance on the difficult items, all r s $< .22$, p s $> .13$, nor reduced the effects of Implementation Intention on performance on the difficult items for high self-efficacy participants ($n=28$) or for all participants ($n=58$), all β s $< .19$, t s < 1.08 , p $> .28$. Thus, implementation intention effects on performance were not mediated by changes in goal commitment or motivation caused by the self-efficacy manipulation.

Discussion

We examined whether beneficial effects of implementation intentions on striving for difficult goals occur only when high self-efficacy feelings are established. Indeed, implementation intentions improved participants' performance in solving Raven matrices when self-efficacy was high and the items to be solved were cognitively demanding (i.e., high-complexity items). Apparently, when the task difficulty ranges between the low to the medium-difficult stages, goal intentions already allow for high performance levels in both the low and high self-efficacy participants; thus there is no need to furnish one's goal intentions with implementation intentions. It is only with difficult tasks that implementation intentions matter; however, this effect is qualified by the level of self-efficacy. Only in high self-efficacy participants do implementation intentions reveal their performance enhancing effects; actually, in the present study implementation intentions raised the performance level from 26% to 63%. Interestingly, this effect of implementation intentions on performance was completely mediated by response time on correctly solved items, implying that using the strategy specified in the implementation intention (i.e., double checking) was the primary reason for the observed improved performance.

Self-efficacy as a Prerequisite for Implementation Intention Effects

Concerning the process by which low self-efficacy impedes implementation intention effects, one has to keep in mind that whenever difficulties arise low self-efficacy leads to a reduction in people's willingness to try out new strategies and to persist in their application (Bandura, 1997). This implies that the moderating role of self-efficacy on implementation intention effects in the face of difficulties should only be evident when effortful new strategies are specified that require persistent application (as was the case with the strategy of double checking in the present study). In other words, the kind of strategy specified in one's implementation intention (more rather than less effortful) might be critical for self-efficacy in playing a moderating role.

In the present study, the high self-efficacy manipulation positively affected participants' motivation and commitment. However, the various statistical analyses performed on participants' performance on the Raven test items suggest that the observed moderating role of self-efficacy on implementation intentions for the performance on difficult items cannot be attributed to the changes in motivation and commitment produced by the self-efficacy manipulation. Still, one wonders whether low self-efficacy might have undermined participants' commitment to the implementation intention itself. Although most participants in the two implementation intention conditions actually formed an implementation intention (as indicated

by the fact that in each of the implementation intention conditions more than 70% of the participants correctly recalled the implementation intention at the end of the study), those with low self-efficacy might have thought that the plan to engage in the extra effort of double checking their solutions does not make any sense. Indeed, when using the double-check strategy was called for (i.e., when difficult matrices had to be performed), it was only the implementation intention participants in the high self-efficacy condition who relied on this strategy and this reliance paid off as is indicated by the mediation analysis.

Implementation Intention Effects in the Face of Cognitive Demand

Task difficulty turned out to be an additional prerequisite for implementation intention effects. Given that self-efficacy was high, implementation intentions compared to goal intentions improved performance only on difficult items, but not on the easy or the medium–difficult task items. This finding suggests that goal intentions often suffice to control a person’s actions effectively. It is only when the person is cognitively burdened that implementation intentions are needed, as only the latter manage to automate action control (i.e., strategically create automaticity; Gollwitzer, 1999; Gollwitzer & Sheeran, 2006), thus allowing for high performances even under conditions of high cognitive load.

Performance between implementation intention and no implementation intention participants did not differ between easy and medium–difficult matrices. We presume that participants of both groups were relatively confident in their solutions on the easy and medium–difficult tasks and therefore did not feel a need to apply the strategy of double checking their results. When participants were no longer certain about the accuracy of their solutions (difficult matrices), the double-checking strategy became relevant, but it was only the implementation intention participants who managed to use it.

Moreover, performance did not differ between low and high levels of self-efficacy. Again, participants in both self-efficacy conditions might have been relatively confident in their solutions on the easy and medium–difficult tasks and therefore did not need the problem-solving strategy of double checking. However, when they were struggling with the difficult items and the strategy of double checking was called for, participants with high self-efficacy for the goal intention managed to engage in it—given that this effortful strategy was specified in an implementation intention. Thus, one might speculate that the potential increase of persistence in the face of difficulty that is provided by a high level of self-efficacy may only materialize in an increased performance when various strategies are available to tackle the problem. However, as participants’ confidence in their solutions and the availability of the double-checking strategy while participants worked on the difficult items were not measured, further research is needed to confirm these assumptions.

Implications for Implementation Intention Research

The present findings contribute to the literature on implementation intention effects on goal attainment. The study demonstrates that even on an analytical reasoning task like the Advanced Progressive Matrices (Raven, 1976, 2000), performance can be improved by forming implementation intentions. In the presented research, the strategy of double checking the initial solution before progressing to the next item was included in implementation intentions. Although all participants were aware of this

strategy, only participants in the implementation intention condition transferred it into an if-then contingency. As a result, participants in the implementation intention condition, whose self-efficacy was high, took more than twice as much time as those in the other conditions to answer the difficult items. Thus, these findings strongly support the assumption that the if-then contingency is essential to automate action control and to ensure successful realization of a goal intention when cognitive demands are high (e.g., Gollwitzer & Sheeran, 2006; Webb & Sheeran, 2007, 2008).

In addition, the present research suggests that for the participants in the high self-efficacy group, time spent on correctly solved Raven items mediated the effects of implementation intentions on performance on the difficult items. This also supports the proposed automation of action control through implementation intentions: Despite the high cognitive demands and potential worry cognitions when working on the difficult items, the implementation intention to double check the solution actually made subjects contemplate their answers longer, thus improving their performance by eliminating careless errors (Kratzmeier & Horn, 1980). Although using response time as an indicator of applying the double-checking strategy may seem questionable (e.g., one might argue that participants simply rested before tackling the next item), the fact that only those in the implementation intention group spent extended times render such alternative explanations unlikely. As more direct tests of the application of the double-checking strategy would have interfered with participants' performance (e.g., thought sampling; Klinger, 1978), they were not applied in the present study.

Besides specifying cognitive strategies such as double checking in the then-part of an implementation intention, specifying motivational responses like strengthening one's self-efficacy, have been shown to improve test performance as well. In a recent study by Bayer and Gollwitzer (2007), specifying a self-efficacy assuring inner speech in an implementation intention ("And if I start a new item, then I'll tell myself: I can solve it!") also improved Raven test performance relative to mere goal intentions. Thus, including the self-instruction strategy in implementation intentions ensures that high self-efficacy as a prerequisite for implementation intention effects is fulfilled.

Does the effectiveness of implementation intentions in enhancing self-efficacy (Bayer & Gollwitzer, 2007) mean that all prerequisites for implementation intention effects can simply be fulfilled by specifying them in implementation intentions? To answer this question, it is important to differentiate the content of implementation intentions in terms of strategies from their automatic effects on attention and action initiation. Only when effective strategies are available to influence the moderator variables, can the application of implementation intentions have its intended effects on goal attainment. Conversely, strategies can be applied that are effective in influencing a moderator variable of implementation intentions without requiring the automatic effects of implementation intentions (e.g., goal-setting trainings to ensure high goal commitment and motivation; see Oettingen, Pak, & Schnetter, 2001). Therefore, future research might not only explore if implementation intentions can be used to address their prerequisites (e.g., implementation intentions that combine both motivational and cognitive responses in their then-component), but also if supplemental strategies can be used as well.

Moreover, future research might also explore whether the specification of appropriate if- and then-components of an implementation intention qualifies as an additional prerequisite for implementation intention effects. Situational cues that are specified in the if-component have to be general enough to occur in a wide range of appropriate contexts (Wieber, Odenthal, & Gollwitzer, 2009). However, if-components also need be specific enough to avoid deliberation of whether one

should act or not in the face of the specified cue (Parks-Stamm, Gollwitzer, & Oettingen, 2007; Wieber & Sassenberg, 2006). By specifying then-components, people must link goal-directed behaviors to the if-component such that they will objectively be able to perform them when the anticipated situation arises. Thus, a high level of control over the execution of the behavior specified in the then-part (Bandura, 1997) and, if possible, control over the consequences of the behavior should qualify as prerequisites for implementation intention effects.

Implications of Implementation Intentions Sensitivity to Self-efficacy

The present research suggests that without experiencing high self-efficacy for a goal, implementation intentions that include complex strategies that require determined persistence to overcome problems during goal striving do not affect goal striving positively. Yet, is this prerequisite adaptive for people's goal pursuits? Does it help them to meet their goals? One might be tempted to suggest that it would be more advantageous if implementation intention effects did not require high self-efficacy with respect to the superordinate goal. However, one has to keep in mind that a sense of high self-efficacy signals to the person that there is a history of success in the goal domain in question. Consequently, the person can readily commit themselves to the goal at hand as the perceived feasibility is high. If implementation intentions would promote goal attainment with respect to any goals and not just the goals to which people feel highly committed (because these goals are experienced as highly attractive and also quite feasible; Gollwitzer, 1990), people would quickly become vulnerable to overextension in the sense of trying to realize too many of their wants and wishes.

Conclusion and Outlook

Based on the present findings on prerequisites for implementation intention effects with regard to self-efficacy, future research designing implementation intention interventions might want to include modules ensuring that this prerequisite is fulfilled (e.g., self-efficacy boosting exercises, see Koestner et al., 2006; goal-setting trainings, Stadler, Oettingen, & Gollwitzer, 2009). Furthermore, future research may explore additional prerequisites for implementation intentions. For example, personality factors (see Gollwitzer, 2006) such as lack of conscientiousness (Webb, Christian, & Armitage, 2007) or low social perfectionism (Powers, Koestner, & Topciu, 2005) might also qualify as further prerequisites. Finally, in addition to exploring prerequisites, the combination of implementation intention effects and other successful strategies to improve self-regulation (e.g., social support, adapting to environmental and socio-structural factors) seems to be a promising route to optimize the benefits of implementation intentions for meeting the lifelong challenge of effective self-regulation.

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