ACTION CONTROL BY IMPLEMENTATION INTENTIONS: EFFECTIVE CUE DETECTION AND EFFICIENT RESPONSE INITIATION

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Past research has demonstrated that implementation intentions (i.e., if–then plans) facilitate goal striving by two processes: increasing the activation of the anticipated situational cue (the if–process) and automating the goal–directed response to that cue (the then–process; Gollwitzer, 1999; Webb & Sheeran, in press). Two studies investigated the implications for the course of goal striving guided by implementation intentions. When implementation intentions achieved their effects by facilitating cue identification (the if–process), alternative cues were disregarded (Study 1). On the contrary, when implementation intentions achieved their effects by the automation of the critical response (the then–process), alternative goal–directed responses were still considered (Study 2). We discuss these results with respect to the functioning of implementation intentions and the use of alternative means in planned goal pursuit.

People can decide in advance how they intend to strive for their goals by forming implementation intentions. An implementation intention is an if–then plan that specifies a behavior to be performed in response to an anticipated situational cue; it is subordinate to the related goal intention (Gollwitzer, 1993, 1999). Whereas a goal intention specifies merely a desired event in the form of "I intend to perform/achieve X!" (e.g., to exercise frequently/to be thin), an implementation intention specifies both an anticipated critical situation and a response that helps to realize the desired event. Thus, an implementation intention formed to reach the goal "to exercise frequently" would follow the form of, "If Situation Y arises (e.g., If I approach an elevator), then I will perform Behavior Z (e.g., then I will take the stairs)."

Implementation intentions greatly improve the rate of goal attainment (Gollwitzer & Sheeran, 2006). In an early demonstration of the power of implementation intentions, Gollwitzer and Brandstätter (1997) asked participants to complete a writing assignment (a report on how they spent Christmas Eve) no later than two days after Christmas Eve. In this study, 71% of the implementation intention participants completed the assignment, compared to only 32% of the control participants. The effects of implementation intentions have been replicated and expanded in the health domain (Sheeran & Orbell, 2000; Steadman & Quine, 2004; Sheeran, Milne, Webb, & Gollwitzer, 2005), prospective memory (Chasteen, Park, & Schwarz, 2001; Cohen & Gollwitzer, in press), executive functions (Cohen, Bayer, Jaudas, & Gollwitzer, in press), and in clinical populations (Lengfelder & Gollwitzer, 2001). A recent meta–analysis of 94 independent studies demonstrated a medium to large effect size of implementation intentions (Gollwitzer & Sheeran, 2006).

UNDERLYING IMPLEMENTATION INTENTION EFFECTS: TWO DISTINCT PROCESSES

Implementation intentions are built on a theoretical framework positing that goal pursuit is comprised of two distinct cognitive tasks: the identification of a goal–relevant situation or opportunity to act, and the initiation and enactment of a goal–directed response. Thus, forming an implementation intention is proposed to facilitate goal pursuit by both increasing the accessibility of the situational cue and automating the response to that cue through situation–response linkages (Gollwitzer, 1993, 1999; Gollwitzer, Bayer, & Mc Culloch, 2005).

The If–Process

Implementation intentions increase the accessibility of anticipated situational cues specified in the if–component of the plan. Selecting a specific situational cue for the if–portion of the implementation intention entails deciding in ad-

vance which of the many possible upcoming opportunities will be used to achieve one's goal. The selected cue is thus given a preferential status that is proposed to lead to a heightened state of activation that persists over time until the plan is executed or the goal is reached (Gollwitzer, 1993).

This heightened accessibility of the situational cue has been demonstrated by facilitated cue detection. Participants showed superior detection of a critical figure in an embedded figures task when it was specified in the if–part of an implementation intention (Steller, 1992). Webb and Sheeran (2004) found this improvement in cue identification ensues without an increase in false positives (i.e., erroneously responding to similar cues). Specifically, participants with implementation intentions responded faster to critical cues than did goal participants, but were not more likely to respond to similar but inappropriate cues (Webb & Sheeran, Study 3). The authors thus demonstrated that the improved identification of planned cues through implementation intentions reflects an increased activation rather than response bias.

Using a dichotic–listening paradigm (Gollwitzer, Bayer, Steller, & Bargh, 2002), it was also found that words describing the situation used in the if–part of the implementation intention were more disruptive to focused attention in implementation intention participants compared to mere goal intention participants. These findings provide further evidence that the heightened accessibility of the cue specified in an implementation intention draws attention to the planned critical situation even when one is busy with other things.

Finally, Aarts, Dijksterhuis, and Midden (1999) tested the heightened accessibility of the situational cue specified in an implementation intention by assigning participants the goal to redeem a coupon. Half of the participants were asked to furnish this goal with an implementation intention. The heightened accessibility of the situational cue specified in the if–component was demonstrated in a lexical decision–making task; shorter response latencies to cue–related words were observed in the implementation intention group relative to a goal–only group. Aarts and colleagues then showed that this heightened activation mediated the relationship between planning and goal completion. In sum, there is evidence that forming an implementation intention increases the activation of the mental representation of the situational cues specified in the if–component.

The Then–Process

Implementation intentions also facilitate goal pursuit by automating the initiation of the planned behavioral response (specified in the then–component) upon contact with the critical situational cue. This means that once a link is formed between the critical situation and the behavior in the form of an if–then plan, the individual encountering the cue is able to enact the pre-

determined response immediately, efficiently, and without a second act of conscious will (i.e., the action initiation shows features of automaticity, Bargh, 1994). This automaticity has been supported in several studies demonstrating response immediacy (Gollwitzer & Brandstätter, 1997; Orbell & Sheeran, 2000), efficiency (Brandstätter, Lengfelder, & Gollwitzer, 2001; Lengfelder & Gollwitzer, 2001), and initiation without conscious intent (Bayer, Achtziger, Gollwitzer, Malzacher, & Moskowitz, 2006).

For example, Brandstätter and colleagues (2001) provided evidence for the hypothesis that implementation intentions reduce the cognitive capacity necessary to enact the goal–directed response. In a dual task paradigm, participants in a goal intention condition intended to press a button as fast as possible when one–digit numbers, but not letters, appeared on a computer screen (Go/NoGo task; Brandstätter et al., 2001, Study 3). Participants in an implementation intention condition additionally formed the if–then plan to press the response button particularly fast if the number "3" appeared. Two cognitive load conditions were additionally created. Participants in a low cognitive load condition freely associated to a list of meaningless syllables while completing the Go/NoGo task, whereas participants in a high cognitive load condition memorized this list. Implementation intention participants showed an increase in the speed of responding to the number "3" compared to the goal intention condition participants. Importantly, this speed–up effect occurred regardless of whether the simultaneously performed cognitive load task was easy or difficult.

In a further study (Brandstätter et al., 2001, Study 4), cognitive load was manipulated differently. While completing the Go/NoGo task, participants tracked a circle moving on the computer screen by keeping it within either a 4×4 cm^2 box (easy dual task: low load) or a 2.2×2.2 cm^2 box (difficult dual task: high load). Participants in the goal intention condition were asked to press a button as fast as possible when numbers, but not when letters appeared within the moving circle. Participants in the implementation intention condition additionally formed the if–then plan to press the response button particularly fast if the number "3" appeared. As in Study 3 of Brandstätter et al. (2001), participants in the implementation intention condition showed a speed–up effect with respect to the number "3" under both low and high load. These studies provide evidence for the efficiency of implementation intentions. They seem to create strong links between the planned situation and response, automating responses to that cue like a habit (Aarts & Dijksterhuis, 2000), which makes action control less draining on available resources. In sum, there is evidence that the then–process associated with implementation intentions allows the planned response to be enacted with little cognitive resources.

A recent study by Webb and Sheeran (in press) simultaneously tested the impact of both the cue accessibility associated with the if–component and the automatic response initiation associated with the then–component of the implementation intention. Participants were instructed to either famil-

iarize themselves with a target non–word (*avenda)* in order to speed their re-sponse to that item, or to form an implementation intention to respond particularly quickly to this target non–word. A sequential priming para-digm was used to measure the accessibility of the target non–word (*avenda*) as well as the association between the target non–word and the planned re-sponse. They found that the strength of each of these processes associated with implementation intentions independently mediated the effect of im-plementation intentions on goal attainment. In sum, the effects of imple-mentation intentions on the planned route of goal pursuit seem to be driven by both of these complementary processes.

FORMING IMPLEMENTATION INTENTIONS: IMPLICATIONS FOR GOAL STRIVING

The two processes on which implementation intentions are based (i.e., cue ac-tivation and response automation) have so far been analyzed in terms of their mediational effects on increased rates of goal attainment. More specifically, it has been asked if desired outcomes are more easily achieved by both the heightened activation of the specified critical situational cue and the automa-tion of the planned goal–directed behavior (e.g., Webb & Sheeran, in press; Aarts et al., 1999). The present research goes one step further and asks how these proposed processes shape the path of goal striving (i.e., the way in which people try to achieve their goals). In other words, we focus on the route to the goal rather than the rate of goal attainment, and we are particularly in-terested in the use of unplanned goal–relevant opportunities and responses. What would the underlying processes of implementation intentions suggest about the effect of implementation intentions on the use of alternative, non–specified opportunities and responses during goal striving?

The If–Process and Cue Detection

The research on the if–process reviewed above provides evidence that im-plementation intentions increase the activation of the situational cue speci-fied in the if–part of the implementation intention. This suggests that out of all the potential goal–relevant situations one might encounter in which a goal–directed behavior could be performed, the implementation intention makes the selected one more readily attended to. Indeed, attention research observes that active maintenance of a cue does shift attention to it even when not goal–relevant (Downing, 2000). Such top–down attentional biases were first identified by William James (1890) in terms of an "active" mode of at-tention, in which items of interest automatically draw attention to them-selves. However, as cognitive resources and attention are limited (Wegner, 1994; Wegner & Bargh, 1998), any increased readiness to attend to a given cue or situation should result in a corresponding inattention to alternative

goal–relevant situations (Broadbent, 1958; Kahneman, 1973). It follows that any facilitated identification of the critical cue specified in an implementation intention should be associated with a weakened identification of alternative goal–relevant cues. Accordingly, as compared to individuals who act on mere goals only, individuals who have furnished their goals with implementation intentions should not only show a stronger identification performance for the specified critical cue but also a weaker identification performance for alternative, nonspecified cues.

The Then–Process and Response Initiation

Conversely, the research on the then–process of implementation intentions reviewed above (i.e., the automation of the specified response) would suggest the possibility of "having one's cake and eating it too." Because forming an implementation intention automates the initiation of the planned goal–directed response, enacting the goal–directed behavior specified in the then–component of an implementation intention should require little cognitive capacity. Because the planned response is so efficient, implementation intentions should allow the individual to initiate alternative goal–directed responses with the same ease as is possible for individuals without a plan (i.e., those operating on a goal intention only). Unlike the process associated with the if–component of implementation intentions that actually reduces a person's attention to alternatives and thus weakens the identification of alternative situational cues, the process associated with the then–component should protect one's use of alternatives and leave the initiation of alternative goal–directed responses intact.

THE PRESENT RESEARCH

Past research suggests that implementation intentions affect goal striving as follows: First, the effect of implementation intentions on the cue identification aspect of goal striving should be a reduced use of novel opportunities (i.e., unplanned situational cues) relative to a goal–only group. The more effective identification of the specified situational cue should be associated with a reduced identification of alternative goal–relevant situations in which to act. Second, the effect of implementation intentions on response initiation should not require additional cognitive capacity, thereby leaving the use of unplanned goal–directed responses intact. The efficient initiation of the planned goal–directed response (as a result of automation) should be associated with a sustained use of alternative goal–directed responses.

   To test these hypotheses, it was necessary to differentiate the effect of implementation intentions on the cue identification versus the response initiation aspects of goal pursuit. Based on past implementation intention research (e.g., Aarts & Dijksterhuis, 2000; Gollwitzer & Brandstätter, 1997), we rea-

soned that if a task is easy, an if–then plan should not have a noticeable effect; but if a task is difficult, the effect of implementation intentions will become evident relative to a goal–only group. Thus, we created a task paradigm that allowed us to vary whether the observable task performance was primarily based on cue identification or response initiation by varying the difficulty of these two aspects of task performance (i.e., either cue detection was difficult and the response initiation was easy, or the other way around). This way, we could test the two opposing hypotheses about the consequences of implementation intentions on the cue identification and response initiation aspects of goal striving (i.e., the facilitation of the if–process leads to disregard for alternatives, whereas the facilitation of the then–process does not).

More specifically, for both studies reported, participants identified and responded to words in a story that was played for them very quickly. In Study 1, it was difficult to identify goal–relevant words (cues), but easy to select a response. Thus, we were able to test the hypothesis that implementation intentions should facilitate the identification of the specified cues, but hamper the identification of alternative goal–relevant cues. In Study 2, it was easy to identify goal–relevant words, but difficult to select a goal–relevant response. Thus, we were able to test the second hypothesis that implementation intentions should facilitate the initiation of the specified response without impeding the initiation of alternative goal–directed responses. This approach allowed us to study the effects of these two consequences of implementation intentions on the course of striving for a task goal when implementation intentions either primarily facilitated task performance via the cue identification process (Study 1) or the response initiation process (Study 2).

STUDY 1: EFFECTIVE CUE IDENTIFICATION BY IMPLEMENTATION INTENTIONS

Participants listened to a recorded story written expressly for this experiment. They were assigned the task goal of classifying five–letter words by typing the first letter of these words into the keyboard. This task requires difficult identification by counting letters of words but easy responding by typing the first letter of an identified word. Here, implementation intention effects on task performance are based on facilitated cue identification and should thus lead to a weakened performance with respect to other five–letter words (i.e., alternative goal–relevant cues).

METHOD
   Participants. In exchange for partial course credit 56 undergraduates from New York University volunteered to participate.
   Procedure. Participants were run individually by a female experimenter. They were told that the study was exploring the processing of music lyrics and the spoken word. They were informed that in the present study they

would be asked to type in the first letter of some of the words they would hear. All participants then completed a short practice task in which they tried to type the first letter of each word they heard in a short song, to familiarize themselves with the equipment, task instructions, speed of presentation, and volume settings.

All participants were first told that their task goal was to identify five–letter words, and once identified, to type in the first letter of that word as quickly as possible. All participants were then informed that the two most common five–letter words in the story were "Laura" and "mouse." The experimenter then held up an index card displaying these two words, and demonstrated on these cards that the first two letters were "L" and "M" as an example of how they should respond when they heard these words. This was done to ensure that participants in both the mere goal intention and the implementation intention conditions were verbally and visually introduced to the target words as well as the correct response to those words, so that all participants were familiarized with the words and the correct responses, and understood their importance in the task. Participants in the implementation intention condition were then read two if–then plans, "If I hear the word 'Laura,' then I will immediately press the L; if I hear the word 'mouse,' then I will immediately press the M." For all participants, the experimenter then reiterated that the goal for the task was to type in the first letter of the word as quickly as possible for "each and every five–letter word" they hear.

All participants then listened to a story that contained 45 five–letter words. Of these words 23 were the target words established by the instructions, "Laura" and "mouse." All participants were expected to focus primarily on these target words. There were also 22 alternative five–letter words that were each only presented one time in the story. Participants typed the first letter of each five–letter word they identified as quickly as possible into the computer while they listened to the story over headphones. The story continued to play at a set speed independent of their responses. Because of the speed of the story and the number of potential goal–relevant opportunities and responses, it was virtually impossible to identify and respond to all 45 words as the story was played. Therefore, successful performance on this task is achieved by staying alert for new words and responding quickly to each identified opportunity.

After completing this task, participants were questioned for prior experience with implementation intention experiments, and asked for the strategies they used while completing the task. Participants were then fully and carefully debriefed.

RESULTS

The dependent variables were the number of correctly entered five–letter target words and alternative five–letter words. For both studies, the data were

subjected to a square–root transformation for the statistical analyses reported below, as recommended for raw counts of frequencies (Howell, 2002). For the sake of clarity, we will present the nontransformed means in the graphs.

A MANOVA was conducted on the two dependent variables, yielding a significant interaction, Hotelling's $F(2, 55) = 6.23$, $p < .005$ (transformed). Analyses of the transformed target and alternative word counts supported our predictions. Participants who had formed implementation intentions ($M = 21.35$, $SD = 2.07$) identified and responded to significantly more target words than the goal participants ($M = 19.74$, $SD = 2.60$), $t(56) = 2.03$, $p < .05$. This reflects an expected facilitation of the words specified in the implementation intentions. As expected, participants in the implementation intention condition also showed a significant cost in identifying alternative words, $t(56) = 2.55$, $p = .01$. Those in the implementation intention condition ($M = 10.58$, $SD = 4.54$) recognized less alternative words than those in the goal group ($M = 12.37$, $SD = 2.71$). Overall, there was no difference between the two groups in overall task goal attainment (target and alternative words combined, $p > .80$). (See Figure 1).

As expected, implementation intentions also served to increase the speed of response to the target words (i.e., Laura and Mouse). When responding to the target words, participants who had formed implementation intentions ($M = 1.19$, $SD = .25$) responded faster than those who had merely formed a goal intention ($M = 1.57$, $SD = .42$), $t(56) < .001$. The average target response latency and the number of target opportunities identified (counts) are highly correlated, $r = -.57$, $p < .001$, indicating that participants who achieved comparatively higher counts were also those who responded comparatively faster (i.e., higher counts were not achieved by using a speed–accuracy trade–off strategy of slowing down to achieve better accuracy). A significant correlation was also found between the average response latency for the alternative cues and the number of alternative opportunities identified, $r = -.50$, $p < .001$, with individuals achieving higher response counts again also responding faster.

DISCUSSION

As expected, as compared to mere goal intention participants, implementation intention participants achieved a better identification performance for those five–letter words (planned cues) specified in the if–component but were worse in the identification of other five–letter words (alternative cues). This finding suggests that the benefits of forming implementation intentions for the identification of specified situational cues are associated with a reduced identification of unspecified alternative cues. In line with a limited resource model of selective attention (Broadbent, 1958; Kahneman, 1973), implementation intentions facilitated attention to specified cues at the expense of alternative goal–relevant cues.
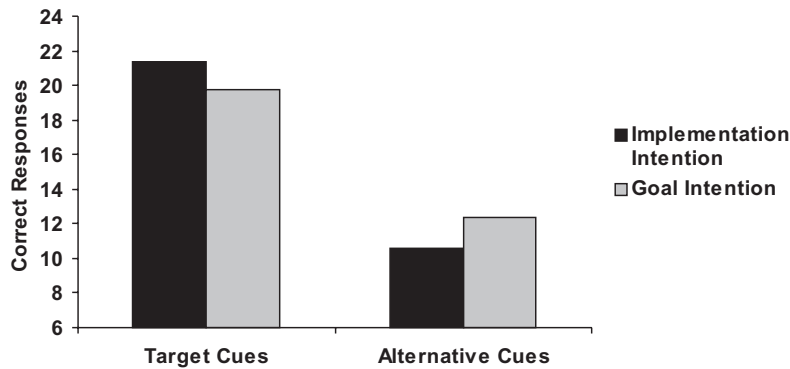
FIGURE 1. Mean correct target and alternative responses by goal condition when letter-counting is required for cue identification, Study 1.

Whereas Study 1 analyzed the consequences of forming implementation intentions on the identification of opportunities to act (specified and nonspecified cues), Study 2 focuses on the effect of implementation intentions on the response initiation process of goal striving. It is hypothesized that because implementation intentions automate the planned response, efficiently initiating the response specified in the then–component of the implementation intention should not be associated with a reduced utilization of alternative goal–directed responses. Participants with implementation intentions are thus not expected to show a reduction in the initiation of alternative goal–directed responses relative to goal–only participants.

STUDY 2: EFFICIENT RESPONSE INITIATION BY IMPLEMENTATION INTENTIONS

In order to explore the effect of the then–process triggered by implementation intentions (i.e., the automation of the goal–directed response) on the course of goal striving, the experimental task was altered so that the task demands required for cue identification and response initiation were reversed. Participants were asked to identify words that started with a D (a simple identification task), and respond by counting the number of letters in that word (a difficult response task). Because counting letters is a difficult task requiring much cognitive capacity, implementation intentions should achieve their beneficial effects on task performance by automating response initiation rather than by facilitating cue detection. As implementation intentions are assumed to facilitate response initiation by automation (i.e., action

initiation becomes efficient), we expected that the initiation of alternative goal–directed responses should not be hampered.

METHOD

Participants. In exchange for partial course credit 58 undergraduates from New York University volunteered to participate.

Procedure. Participants were run individually by a female experimenter. They were told that the study was exploring the processing of music lyrics and the spoken word. They were told that they would be counting and typing the number of letters for some of the words they would hear. All participants then completed a short practice task in which they tried to count the number of letters in words from a song in order to familiarize themselves with the equipment, task instructions, speed of presentation, and volume settings.

The procedure was similar to the first study, but the task required for cue identification and response initiation were reversed. Thus, all participants were first told their goal in the task was to identify words starting with a "D," and then count the number of letters in that word to type it into the computer as quickly as possible. In order to establish two target responses, all participants were informed that the two most common D–words in the story were "Danny" and "dragon." The experimenter then held up an index card displaying these two words, and demonstrated on these cards that "Danny" has five letters and "dragon" has six letters, as an example of how they should respond when they heard these words. This was done to standardize the information provided about the target words and the correct responses to those words in the mere goal and the implementation intention condition. Participants in the implementation intention condition were additionally read two if–then plans, "If I hear the word 'Danny,' then I will immediately press the 5; if I hear the word 'dragon,' then I will immediately press the 6." For all participants, the experimenter then reiterated that the task goal was to type in the number of letters as quickly as possible for "each and every word beginning with a D" they hear.

All participants then listened to a recorded story that contained 44 words beginning with a D. The two target words, "Danny" and "dragon," containing five and six letters, respectively, were each presented 11 times, resulting in a total of 22 possible target responses. Twenty two other words beginning with D were presented to allow for alternative goal–directed responses. The number of letters in these alternative words varied from 3 to 9, averaging 5.4 letters in length. Participants typed the number of letters of each word beginning with a D as quickly as possible into the computer while they listened to the story over headphones. The story continued at a set speed independent of their responses. Because of the speed of the story and the large number of potential goal–relevant opportunities and responses, it was virtually impossible to identify and respond to all 44 words as the story was played.

Therefore, successful performance in this task is obtained by staying alert for new words and responding quickly to each identified opportunity.

After completing this task, participants were questioned for prior experience with implementation intention experiments (no one reported such experiences), and asked for the strategies they used while completing the task. Participants were then fully and carefully debriefed.

RESULTS

The dependent variables were the number of correct responses entered for the target words (Danny and dragon) and the alternative D–words. A MANOVA was conducted on the two dependent variables, yielding a significant interaction, Hotelling's $F(2, 57) = 5.90$, $p = .005$ (transformed). Analyses of the transformed target and alternative response counts supported our predictions. Participants who had formed implementation intentions ($M = 19.81$, $SD = 2.37$), as compared to the goal group ($M = 16.83$, $SD = 4.08$), showed significantly more correct responses to the target words, $t(58) = 3.40$, $p = .001$. This reflects an expected facilitation of the responses specified in the implementation intentions. Participants in the implementation intentions condition ($M = 12.35$, $SD = 3.87$) did not show a cost relative to the goal group ($M = 11.55$, $SD = 3.82$) in alternative goal–directed responses, but rather a small, non–significant facilitation of their responses to alternative goal–relevant opportunities, $t(58) = .75$, *ns.* Overall, participants who had formed implementation intentions ($M = 32.16$, $SD = 5.03$) performed significantly better than those with a mere goal ($M = 28.38$, $SD = 6.93$) in overall task performance, $t(58) = 2.44$, $p < .02$. (See Figure 2).

Again, participants with implementation intentions responded faster to the target words ($M = 1.31$, $SD = .38$) than mere goal participants ($M = 1.51$, $SD = .40$; $t(58) = 1.87$, $p = .06$). Moreover, a significant correlation was again found between the number of correctly–entered target responses and the target response latencies, $r = -.64$, $p < .001$, with higher counts being associated with faster response times. A correlation indicating that high counts go along with fast responses was also observed for alternative words, $r = -.21$, $p = .05$ (one–tailed). As in Study 1, these findings suggest that implementation intention participants did not achieve higher performance scores by slowing down, as would be predicted by a speed–accuracy trade–off explanation of the data.

DISCUSSION

In Study 2, the provided implementation intentions effectively facilitated the responses specified in the implementation intention, but did not hamper the initiation of alternative responses. Therefore, we can conclude that the automation of the response offered by implementation intentions, which has been observed to conserve cognitive resources for secondary tasks
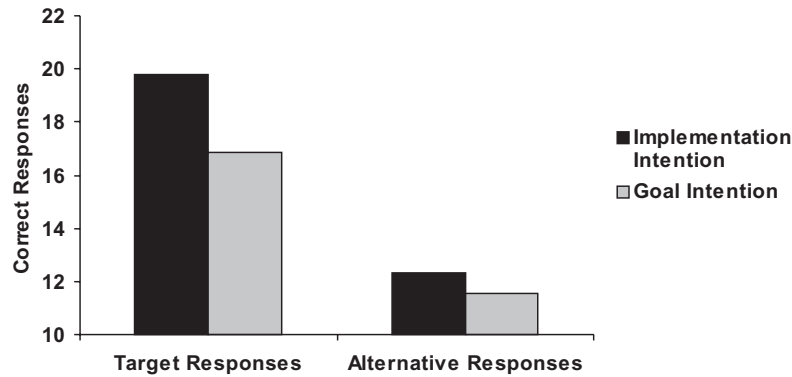
FIGURE 2. Mean correct target and alternative responses by goal condition when letter-counting is required for response initiation, Study 2.

(Brandstätter, et al., 2001), allows the individual to utilize alternative goal–directed responses as freely as a person who has not formed an if–then plan. The facilitation of the planned response proceeds efficiently (i.e., without burdening cognitive resources), thus allowing the effective initiation of alternative goal–directed responses. Because implementation intention participants experience a facilitation of the planned responses, and can execute alternative responses with as much ease as the goal–only group, the results also indicate a beneficial effect of implementation intentions on overall goal attainment.

GENERAL DISCUSSION

The results of the present two studies on the course of goal pursuit support the process assumptions about how implementation intentions achieve their effects (Gollwitzer, 1993, 1999). The assumption that the situational cues specified in the if–component become highly activated and thus draw attention is supported by the finding that the beneficial effects of implementation intentions on the identification of the critical cue are associated with less effective identification of alternative cues (Study 1). The assumption that the initiation of the response specified in the then–component becomes automated (i.e., efficient) is supported by the finding that the beneficial effects of implementation intentions on the initiation of the critical response are not associated with a reduction in the initiation of alternative goal–directed responses (Study 2).

Thus the present research offers further evidence on how implementation intentions work. Whereas our research does so by studying the qualities of

goal striving that is guided by implementation intentions (i.e., what means are used to accomplish the goal), past research has done so by focusing on the incremental rate of goal attainment achieved via each process (e.g., Aarts et al., 1999; Webb & Sheeran, in press). Moreover, whereas our research looked at the separate effects of either the if–process or the then–process by manipulating whether the cue identification aspect or the response initiation aspect of the task at hand was difficult to achieve, past research has done so by assessing the postulated mediator variables of heightened cue accessibility and increased automaticity of responding (Aarts et al., 1999; Webb & Sheeran, in press).

RELATED RESEARCH

Potential costs of implementation intentions have been explored before. For instance, Webb and Sheeran (2004) searched for costs in accuracy (e.g., increase in false positives) as a possible consequence of the accelerated speed of responding to specified cues offered by implementation intentions (e.g., a speed–accuracy trade–off, Rabbitt & Vyas, 1970). Webb and Sheeran (2004, Study 3) did not find evidence for such a cost; participants with implementation intentions did not mistake similar (ambiguous) cues for the specified cue. The present research explores a different potential cost of implementation intentions: a cost to overall goal attainment due to reductions in the identification of unplanned cues. Whereas no costs were observed with the initiation of alternative responses, costs did emerge with respect to the identification of alternative cues. These findings support the proposed processes underlying the effects of implementation intentions (i.e., heightened activation of the specified cue in the if–component and automated initiation of the planned behaviour through the then–component; Gollwitzer, 1993, 1999).

As our research speaks to considering alternative means to achieve a goal (i.e., alternative cues and alternative goal–directed responses), it relates to theories that model the interactions between goals and means. For instance, in their theory of goal systems, Kruglanski, Shah, Fishbach, Friedman, Chun, and Sleeth–Keppler (2002) refer to the number of possible means serving the same end as the size of the equifinality set. Shah and Kruglanski (2003) define a means as "any activity, event, or circumstance perceived as likely to contribute to the attainment of a goal. Thus, a behavioral strategy aimed at improving task performance, or a situation regarded as an 'opportunity' for advancing one's objective would both qualify as means in the present sense" (2003, p. 1109). So, in their conceptualization, both specified and unspecified goal–relevant situations and responses may be considered means. If one is willing to accept this conceptualization, the present research can be understood as exploring how a heightened focus on a particular means affects one's readiness to utilize other potential means within the

equifinality set. The Kruglanski et al. model predicts that, because of the competitive activation within goal structures, activation of one means should come at a cost for the activation of alternative means. Support for this model was found in research showing the activation of a specific (focal) goal inhibited the accessibility of alternative goals (Shah, Friedman, & Kruglanski, 2002), and that activation of alternative goals may pull attention away from focal goals (Shah & Kruglanski, 2002). In line with these findings, in Study 1 we found implementation intentions facilitate the identification of the pre–selected situational cue (i.e., a focal means) at the expense of alternative cues.

However, by disentangling the identification process from the response initiation process, the current studies suggest that activation of one means does not necessarily have to be at the expense of another. Study 1 suggests the cue identification process is characterized by the competition principle spelled out by Kruglanksi and colleagues. However, things seem to be different when it comes to response initiation as explored in Study 2. The efficiency offered by the then–component of the implementation intention allows gains in the utilization of the planned response without an associated cost in initiating alternative responses. This discovery was made possible by separating the identification and response initiation processes experimentally in the present studies.

ACTION CONTROL BY IMPLEMENTATION INTENTIONS IN EVERYDAY LIFE

In the past, research has studied the beneficial effects of implementation intentions on goal attainment by focusing on the use and enactment of the specified cues and behaviors. The research paradigm used in the present studies allowed us to analyze the use of both the planned routes and alternative non–planned routes to goal attainment. Thus the present research provides insights into when planning out one route of goal striving by an if–then plan may compromise the use of alternative routes to the desired goal. What are the implications of our findings for using implementation intentions to self–regulate one's goal pursuits in everyday life? Our research suggests that people should consider three issues when forming implementation intentions.

First, as selecting a certain situational cue for the if–component of an implementation intention may inhibit the identification of alternative cues, the person forming implementation intentions should take great care to always select a situational cue that has a high frequency of appearance. Some goal pursuits are characterized by the fact that there exists one particular situation that is used most frequently to move towards the goal. For instance, if someone with a goal to include vegetables in dinner every night passes the same

vegetable stand on the way home every day, an implementation intention "If I walk by the vegetable stand, then I will buy vegetables for dinner" may account for a large proportion of the available opportunities to act toward the goal. In that case, it makes sense to accept the inhibition of alternative opportunities in exchange for such a reliable improvement in the use of the specified opportunity (i.e., the vegetable stand) through an implementation intention. However, if the implementation intention specifies only one of a large number of possible opportunities that each account for the same, modest proportion of possible goal–relevant situations, the cost of increased attention to the selected opportunity may be too high. For example, if the specified opportunity accounts for only 10% of the opportunities in which it is possible to act toward the goal, the implementation intention could impede taking advantage of the other 90% of possible goal–relevant opportunities.

A second consideration that the present findings suggest is the ease of identification of opportunities to act. Some cues are very easily recognized as goal–relevant, whereas others are not. If one's goal is to quit smoking, for instance, the presence of a pack of cigarettes is an obvious situational cue. The results of the present research suggest that one need not worry about the suppression of alternative opportunities if the goal–relevant situation specified in the implementation intention is blatant (as in Study 2). Rather, it is when the goal–relevant situation is difficult to recognize (as in Study 1) that forming implementation intentions are associated with costs for identifying alternative opportunities.

Third, the necessity of immediacy and efficiency in the initiation of the goal–directed response for goal attainment should be taken into account. If the response needs to be fast and efficient (e.g., with emergency room doctors and nurses), forming implementation intentions is a very promising way to proceed. The present findings corroborate previous empirical demonstrations of the efficiency of action initiation by implementation intentions (Gollwitzer & Brandstätter, 1997; Brandstätter et al., 2001), and more importantly, illustrate that this facilitation of the specified goal–directed response is not associated with costs in terms of hampered initiation of possible alternative goal–directed responses.

CONCLUSION

The present analysis may be extended beyond the laboratory setting in future research by investigating action control by implementation intentions in the context of real–world interventions designed to improve goal attainment. An implementation intention applied to goal pursuits that require the use of multiple difficult–to–recognize opportunities (e.g., ways to save electricity, meet new people, or conserve water) should result in smaller gains to overall goal attainment. An implementation intention should most benefit

goal pursuits that contain a single overwhelming means with an obvious situational cue. Future research might thus apply the current findings to effective intervention development by raising the questions of how many implementation intentions are to be formed and how to specify the if–component and then–component of implementation intentions so that participants' overall goal attainment is maximized.

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