



Paving the path for habit change: Cognitive shielding of intentions against habit intrusion

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Objective. The objective of the current study was to examine the cognitive processes that make it possible to use intentions to change one's habitual health-related behaviour.

Design. The study used an idiosyncratic approach to investigate personal existing habits and non-habitual behaviours in a within-participants experiment.

Method. Participants first generated habitual and non-habitual behaviours for various daily-life goals (e.g., having lunch, playing sports). Next, they formed intentions to perform non-habitual behaviours in order to attain these goals. Finally, we measured the cognitive accessibility of participants' habitual and non-habitual behaviours with a behaviour recognition task.

Results. The findings showed that habitual behaviours were more accessible than the non-habitual behaviours when no intentions were formed (control goals), showing that habits are more readily accessed in mind. However, when participants had formed intentions to use non-habitual behaviours, habitual behaviours for the same goals were inhibited in mind. This could be the cognitive mechanism that shields intentions from habit intrusion and thus enables the pursuit of non-habitual behaviours.

Conclusion. The current study demonstrates the role of inhibitory processes in shielding non-habitual intentions in memory. These findings are discussed in the context of success and failure in changing health-related habits.

Habitual behaviours form a large part of our action repertoire for daily life. By doing things the way we did them before, we can save the limited resources of our attention for urgent and important matters (James, 1890). If, for example, one always uses the car to go to work, takes a sandwich for lunch, and goes out for a beer to socialize with friends, these behaviours can be performed without much conscious thought. Relying on this automatic pilot, however, is undesirable when one wants to change one's behaviour. In

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fact, this is often the case in health behaviour, where people frequently intend to change their habits in order to pursue a healthier lifestyle. We know very little, however, about the processes that enable behaviour change in situations where behaviour is usually guided by existing habits. If, for example, one decides to drink less alcohol and therefore forms the intention to order soda in the pub, how does this intention overrule the habit of ordering one's usual beer? The present research was designed to demonstrate one of the cognitive processes enabling this mechanism of behaviour change. Specifically, we show that habits can be automatically inhibited when one forms intentions to perform a different behaviour.

Habits develop when we frequently and consistently perform the same behaviour to attain a certain goal (Aarts & Dijksterhuis, 2000a; Bargh, 1990). The strength of a habit is determined by the frequency of having performed the habitual behaviour in the past in a similar context (e.g., Danner, Aarts, & de Vries, 2008; Ouellette & Wood, 1998). Thus, habits are shaped by one's personal history (Aarts, 2007; Danner, Aarts, & de Vries, 2007). Previous research into the cognitive processes underlying habitual behaviours indicates that habits are mentally represented as associations between goals that are pursued (e.g., eating lunch) and the behaviour (e.g., having a sandwich) instrumental for attainment of the goal (Aarts & Dijksterhuis, 2000a, 2000b; Sheeran, Milne, Webb, & Gollwitzer, 2005). Because of these associations, activating the representation of the goal readily triggers the habitual behaviour in mind, which can then automatically be selected and executed to attain the goal without further consideration of other available alternatives (see for a demonstration of this process, Aarts, Custers, & Marien, 2008). Habits are therefore very efficient for much behaviour in daily life (e.g., Danner *et al.*, 2008). Indeed, habits are a strong predictor of many health-related behaviours, such as breakfast consumption, dietary behaviours, and exercising behaviour (e.g., Brug, de Vet, de Nooijer, & Verplanken, 2006; Sutton, 1994; Wong & Mullan, 2009).

Although habits are an important guide for daily activities, we often form intentions for non-habitual behaviours, for example, to have a healthy salad for lunch instead of a sandwich (e.g., Hagger, Chatzisarantis, & Biddle, 2002; Sheeran, Abraham, & Orbell, 1999 for intentions in health behaviour). Such intentions are consciously formed plans to carry out a specific goal-directed behaviour, which are stored in memory to ensure their execution when the opportunity arises (e.g., Goschke & Kuhl, 1993). Intentions have been shown to be an effective mechanism for guiding and for changing behaviour, even for repetitive behaviours in which habits are easily formed, such as condom use, smoking, and exercising (see Webb & Sheeran, 2006, for a recent meta-analysis).

However, how do intentions guide health behaviour when a habit already exists? Given the well-established associations between goals and instrumental behaviours in the case of habits, it is very likely that the goal (e.g., having lunch) automatically activates the habitual behaviour (e.g., taking a sandwich). This automatic activation of habitual behaviours interferes with the non-habitual intention in memory (e.g., taking a salad), and thereby may prevent the execution of this intended, non-habitual behaviour (e.g., Gollwitzer & Moskowitz, 1996; Reason, 1979). However, although this can be difficult (see also Webb & Sheeran, 2006), people do succeed in using intentions to consciously change their health habits (e.g., Chapman & Ogden, 2009; Schwarzer & Luszczynska, 2008; Wood, Quinn, & Kashy, 2002). This raises the intriguing and important question of the cognitive mechanisms that help people to shield their intentions against habit interference and thus make healthier behaviour possible.

Earlier research on the regulation of behaviour has shown that the process of cognitive inhibition often plays a crucial role in the shielding of intentions against

distractions (e.g., Marsh, Hicks, & Bink, 1998; Veling & van Knippenberg, 2006). Shah, Friedman, and Kruglanski (2002), for example, examined the role of inhibition in memory for goal-directed behaviour. They discovered that having a focus goal in mind (e.g., dieting) results in the inhibition of related but competing goals (e.g., snacking), which could function to protect the focus goal against interference from other goals (see also Aarts, Custers, & Holland, 2007). However, the existence of habits was not considered in this work. Similarly, Veling and van Knippenberg (2006) showed that when one holds an intention, information that is semantically related to the content of this intention is spontaneously inhibited, presumably to protect one's intentions against distraction. However, this study, too, did not examine intentions in the context of existing habits. In addition, Veling and Van Knippenberg (2006) tested these inhibitory processes on purely semantic associations, whereas habits consist of instrumental relations between goals and behaviours. It is the functional relation between goals and frequently performed behaviours that crucially distinguish goal-means relations from mere semantic links (Kruglanski *et al.*, 2002; Moskowitz, Li, & Kirk, 2004).

Thus, although inhibition may be crucial, no research has yet been done on the role of inhibition in the context of pre-existing habits. However, understanding the cognitive mechanisms involved in successful implementation of intentions is highly relevant, and particularly so in the domain of health behaviour, where people often try to change their habits by means of conscious intentions. The present study, therefore, was designed to examine how intentions can lead to the inhibition of existing habits, particularly in the domain of health behaviour.

As indicated above, habits are the result of one's personal history of behaviour, making habits unique, and idiosyncratic. Whereas previous work on the cognitive processes underlying habits has predominantly employed a nomothetic approach (e.g., Aarts & Dijksterhuis, 2000a; Sheeran *et al.*, 2005), exposing all participants to the same goals and testing the habitual behaviour as a function of individual differences in habit strength, we suggest that such an approach may not capture the unique properties of habits. The present study therefore uses idiosyncratic (habitual and non-habitual) goal-behaviour combinations generated by participants themselves, which closely represent their personal existing habits. In addition, we included both health behaviours in our study (e.g., having lunch), as well as behaviours that are related to the lives of our student participants more generally (e.g., studying). Although we expect that the effects of intentions will be comparable for both types of behaviours, it is important to test this assumption as this allows us to compare the present results more directly with relevant research examining non-health behaviours.

We first conducted a pilot study to ensure that the procedure used to generate idiosyncratic behaviours indeed yields habitual and non-habitual behaviours for attainment of the same goal. These habitual and non-habitual behaviours should differ in the frequency of their past use and therefore have differential association strengths with the respective goal. At the same time, this should be the case for both health-related behaviours as well as behaviours more generally related to student life. In the actual experiment, then, participants were asked to form intentions to pursue some of the presented goals with their non-habitual behaviours. Next, the cognitive accessibility of the habitual and non-habitual behaviours was measured using a behaviour recognition task. We hypothesized that forming an intention to use a non-habitual behaviour to reach a goal will lead to inhibition of the habitual behaviours, as evidenced by slower recognition of the habitual behaviours compared to when no intentions are formed.

Pilot study

Fifty-one undergraduate students were asked to generate a habitual and a non-habitual behaviour for six different goals by indicating how they usually pursue the indicated goal, and how they pursue this goal when the habitual behaviour is not available. Thus, the nominated behaviours are all relevant to attain the goals. We used goals that were considered important and regularly pursued by this sample of students (having lunch, playing sports, watching television, visiting a bar, checking one's bank balance, studying). To give an example, for the goal of having lunch, several participants reported eating a sandwich as their usual behaviour and eating a salad as an alternative behaviour. Subsequently, we used a goal-behaviour verification task (see Danner *et al.*, 2007 for an explanation of the task procedure) to test whether the habitual behaviour (sandwich) was more accessible upon goal activation (have lunch) than the non-habitual behaviour (salad). The rationale behind the task is that the faster one can verify that a specific behaviour is relevant to attain a goal, the stronger the habits of performing that goal-directed behaviour, and hence, that behaviours will be automatically selected to attain the goal (Aarts & Dijksterhuis, 2000a). Finally, participants were asked how often they had used each behaviour to attain the goal in the past.

Using analysis of variance (ANOVA), the results of this pilot study indicated that the habitual behaviours that participants had generated were indeed more frequently used for the goal than the non-habitual behaviours ($M_{diff} = 7.30$, $SD_{diff} = 0.53$, 95% CI 6.24, 8.37), $F(1, 50) = 191.21$, $p < .001$, $\eta_p^2 = .79$. Analyses of the reaction times across goals showed that the habitual behaviours were more rapidly accessed upon instigation of the goal than the non-habitual behaviours ($M_{diff} = 48.90$, $SD_{diff} = 16.03$, 95% CI 16.70, 81.09), $F(1, 50) = 9.30$, $p = .004$, $\eta_p^2 = .16$. To examine possible differences between the health-related goals (having lunch, playing sports, and visiting a bar) and the goals more generally related to student life (watching television, studying, and checking one's bank balance), goal category (health vs. other) was entered as an extra factor in the ANOVA. Results showed no differences in frequency of using the habitual and non-habitual behaviours between the two goal categories ($M_{diff} = 0.52$, $SD_{diff} = 0.48$, 95% CI $-.044$, 1.48); no main effect of goal category, $F(1, 49) = 1.19$, $p = .28$, as well as no interaction effect with type of behaviour (habitual and non-habitual), $F(1, 49) = 0.42$, $p = .52$. Results of the reaction times in the goal-behaviour verification task showed no main effect of goal category ($M_{diff} = 13.62$, $SD_{diff} = 16.88$, 95% CI -20.31 , 47.55), $F(1, 49) = 0.65$, $p = .42$, and also no interaction effect was found between goal category and type of behaviours (habitual and non-habitual), $F(1, 49) = 0.55$, $p = .46$, suggesting no accessibility differences between the categories of goals. Therefore, all further analyses were collapsed over this factor. Importantly, the accessibility effects disappeared when we controlled in an analysis of covariance (ANCOVA) for the frequency of past usage of the goal-directed behaviours, $F(1, 49) = 0.01$, $p = .92$. Thus, the differences in accessibility of the behaviours were attributable to differences in how often they had been used to reach the respective goals.

Taken together, the pilot study showed that the idiosyncratic procedure indeed yielded habits, as participants generated those behaviours that were most frequently used, most easily came to mind, and hence, have the quality of being automatically selected upon the instigation of the goal. Participants responded more slowly to the non-habitual behaviours as these behaviours were not automatically activated by the goal. This finding is a conceptual replication of the results obtained by Aarts and Dijksterhuis (2000a) and demonstrates that our idiosyncratic approach for generating habitual and non-habitual behaviours is suited to elicit true automatic habits. In addition,

our pilot confirms that the same goal-means associations apply to health behaviours as to other student behaviours. Finally, we provided evidence that this accessibility effect was the result of frequency of past use of the behaviours, as differences in accessibility disappeared when the frequency of past behaviour was controlled for. In other words, the goals automatically triggered the habitual behaviours because these were the behaviours most often used to reach the goals. Importantly, the fact that the habitual behaviours are more accessible upon goal priming than the non-habitual behaviours provides support for the idea that habitual behaviours may interfere with one's intention to use non-habitual behaviours for goal attainment and will therefore be inhibited. This is what we tested in the main study of the current paper.

Method

Participants and design

Fifty-four undergraduate students (38 women and 16 men) participated in exchange for either €4 or course credit. The study concerned habitual and non-habitual behaviours for different goals. In addition, for some goals, participants were asked to form non-habitual intentions, and for other goals, no intentions were formed. Thus, the study had a 2 (type of behaviour: habitual vs. non-habitual behaviour) \times 2 (type of goal: intention vs. control) within-participants design.

Procedure

Behaviour generation

Participants were greeted by the experimenter and seated behind a computer in a separate cubicle. We provided all instructions on the screen. In the first task, we asked participants to generate both habitual and non-habitual behaviours for the goals in an identical manner as in the pilot, for example, they were asked: 'What do you usually have for lunch? What do you have when this option is not available' Hence, for six different goals two behaviours were generated: a habitual (e.g., sandwich) and a non-habitual behaviour (e.g., salad). The goals were the same goals that we used in the pilot study. The second task consisted of an unrelated perceptual filler task to remove all generated behaviours from short-term memory. The task lasted 5 min.

Intention instruction

Next, the intention instructions were provided. In this part of the procedure, participants were instructed to form intentions to use their non-habitual means for three of the six goals ('intention goals'), whereas they formed no intentions with regard to the other goals ('control goals'). Specifically, they were told that 'it is now important for you to form an intention on each of the following means to attain the goals'. For example, for an 'intention goal', when a participant had indicated to usually eat a sandwich for lunch, she was now instructed to form the intention to have a salad for lunch. These instructions were embedded in a cover story to ensure that participants formed and maintained intentions in memory in order to be able to act on them later on (cf. Goschke & Kuhl, 1993). Specifically, participants were told that they would have to execute their intentions at the end of the experiment. This experimental procedure was analogue to the procedure used by Goschke and Kuhl (1993) that has been used widely to study

memory for intentions. To motivate participants to keep the intentions in mind, they were told that no further announcement of this extra task would be given later on and it was up to them to remember the intentions.

We created different sets to counterbalance which of the health and non-health goals were assigned as 'intention goals' and 'control goals', to ensure that results were not attributable to specific goals, and we counterbalanced these sets between participants. As a result of this manipulation, four different types of behaviours were created: the habitual and non-habitual behaviours for the intention goals and the habitual and non-habitual behaviours for the control goals.

Recognition task

Next, accessibility of the different behaviours was assessed with a behaviour recognition task in which participants had to indicate as fast and as accurately as possible whether the presented word was a behaviour or not that they generated earlier in the experiment for one of the goals (see also Danner *et al.*, 2007). As part of this task, 24 words were presented: the 12 idiosyncratically generated (habitual and non-habitual) behaviours provided the yes-answers and 12 other words, not presented before, provided the no-answers. Each trial started with a fixation point appearing at the middle of the screen (500 ms) followed by an empty screen (150 ms) after which a word was presented that stayed on the screen until the participant provided a response. The intertrial time was 1,500 ms. All words were presented randomly, preceded by two warming-up trials.

Memory game

To keep up with the cover story, after the recognition task participants were asked to perform a computerized Memory game, in which they had to match their habitual and non-habitual behaviours with the different goals. We showed participants a grid consisting of 12 cards. On the back of each card, a habitual or non-habitual behaviour was presented. The computer then showed each card one by one to reveal the location of all behaviours. Subsequently, the six goals from the behaviour generation task were presented one at a time and we asked participants to indicate where their non-habitual behaviour for this goal was located.

Finally, some demographics were assessed and participants were paid and thanked for their participation.

Results

Incorrect recognition responses (nearly 10% of the trials) as well as response latencies higher than three standard deviations above the mean (nearly 1% of the trials) were excluded from analyses. We subjected the response latencies to a 2×2 within-participants ANOVA with type of behaviour (habitual vs. non-habitual) and type of goal (intention vs. control) as factors. The mean response latencies are presented in Figure 1.

We found a main effect of type of goal ($M_{diff} = 36.54$, $SD_{diff} = 16.16$, 95% CI 4.13, 68.95), $F(1, 53) = 5.11$, $p = .028$, $\eta_p^2 = .088$, indicating that participants recognized the behaviours related to the 'intention goals' faster than the behaviours related to the control goals. There was no main effect of type of behaviour ($M_{diff} = 21.40$, $SD_{diff} = 15.96$, 95% CI -10.60 , 53.41), $F(1, 53) = 1.80$, $p = .19$. Importantly, however, there

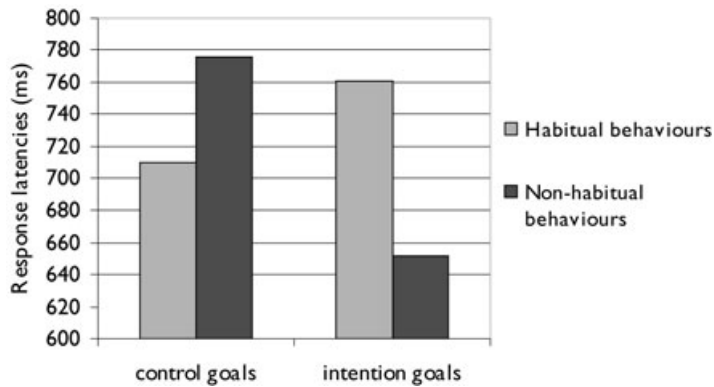


Figure 1. Mean response latencies (ms) for recognizing the habitual and non-habitual behaviours per type of goal (intention vs. control). Higher response latencies indicate slower responses.

was a strong interaction effect between type of behaviour and type of goal, $F(1, 53) = 26.39$, $p < .001$, $\eta_p^2 = .33$. To interpret this interaction effect and to test our specific hypotheses, we conducted simple comparison analyses.

We first tested whether with regard to the control goals, habitual behaviours were more accessible than non-habitual behaviours ($M_{diff} = 65.70$, $SD_{diff} = 24.22$, 95% CI 17.13, 114.28). Results showed that this was indeed the case, $F(1, 53) = 7.36$, $p = .009$, $\eta_p^2 = .12$. This demonstrates that truly habitual and non-habitual behaviours were generated by participants, replicating our results from the pilot study. Second, we tested whether the non-habitual behaviours on which intentions were formed (associated with the 'intention goals'), were more accessible than non-habitual behaviours on which no intentions were formed (associated with the 'control goals'; $M_{diff} = 123.65$, $SD_{diff} = 21.91$, 95% CI 79.70, 167.60). The findings also showed strong support for this, $F(1, 53) = 31.85$, $p < .001$, $\eta_p^2 = .38$, showing that among non-habitual behaviours, intended behaviours were more accessible than unintended behaviours. This finding suggests that the intentions were indeed maintained in memory.

Finally, and most importantly, we examined the accessibility of the habitual behaviours. As hypothesized, we found that the habitual behaviours associated with the intention goals were less accessible than the habitual behaviours associated with the control goals ($M_{diff} = 50.57$, $SD_{diff} = 24.84$, 95% CI 0.74, 100.39), $F(1, 53) = 4.14$, $p = .047$, $\eta_p^2 = .073$, which suggests an inhibition effect. When an intention had been formed to use a non-habitual behaviour to reach a goal, the habitual behaviour that was initially related to this goal was inhibited in mind.

Discussion

The aim of the current study was to examine how intentions to perform non-habitual behaviour to reach a goal are shielded against habit intrusion. This is particularly relevant for health behaviours, where habit change is often desirable (e.g., Sheeran *et al.*, 2005). Our results showed that for goals directly related to health as well as for more general behavioural goals, forming intentions to engage in non-habitual behaviours results in the inhibition of one's habit. This finding provides insight into the cognitive mechanisms by which intentions to behave in a non-habitual manner are protected against interference

by the existing habit: once an intention is formed, the habit is spontaneously inhibited in mind. This suggests that inhibitory processes help to prevent our habits from taking over and thus pave the path for non-habitual intentions to actually change one's behaviour. Thus, our research extends previous work on inhibitory control of intentions by applying it to the context of changing existing habits, and it extends the test of this fundamental mechanism directly into the domain of health behaviour.

Habits and habit change

Our findings may offer a more optimistic view on changing habits than usually advocated in the literature (Norman, 1981; Reason, 1979; Webb, Sheeran, & Luszczynska, 2009). Obviously, habits come in several forms and strengths, and indeed, well-established habits are often not easy to break (e.g., Ouellette & Wood, 1998; Danner *et al.*, 2008). There are many studies showing that habit alteration is a difficult endeavour especially when it concerns strong health-related habits such as breakfast, fruit consumption, or transport mode use (de Bruin, 2010; Gardner, 2009; Wong & Mullan, 2009). Still, people often revert to the use of conscious intentions to modify their behaviour, and succeed (e.g., Holland, Aarts, & Langendam, 2006; Schwarzer & Luszczynska, 2008; Wood, Tam, & Querrero Witt, 2005). Our research builds on this observation and suggests that intentions may indeed be effective for changing habits, in so far as they instigate the process of cognitive inhibition.

Research on behaviour change and self-regulation has developed various methods and interventions to promote the modification of health-related behaviour, beyond the use of mere intentions. One of these techniques is to explicitly furnish one's intentions with plans for enacting them by forming so-called implementation intentions (e.g., Gollwitzer & Sheeran, 2006). Implementation intentions specify how, when, and where the intended behaviour will be performed, and as a consequence of this specific conscious planning, these factors become strongly grounded in memory for triggering the non-habitual behaviour (Papies, Aarts, & De Vries, 2009). There is ample evidence for the effectiveness of implementation intentions with regard to modifying various health behaviours, such as stair use and breast self-examination (e.g., Sheeran *et al.*, 2005; Sniechotta, 2009; Sullivan & Rothman, 2008). A recent study by Webb *et al.* (2009) showed that implementation intentions can also be used for habit change, particularly when habits are relatively weak, but less so when habits were strong (see also Verplanken & Faes, 1999). Other studies, however, seem to be more effective in breaking habits by implementation intentions (Aarts, Dijksterhuis, & Midden, 1999; Holland *et al.*, 2006). As a possible explanation for these inconsistent findings in the literature, we suggest that both mere behavioural intentions, as well as more specific implementation intentions may be particularly effective to the degree that they effectively instigate inhibitory processes. Thus, there may be moderators that either promote or hinder the effective operation of the inhibition process resulting from intentions.

As a result, there are several possible reasons why the implementation of non-habitual intentions may fail. For example, some research has suggested that inhibition may be an effortful process that calls for mental resources, so that it may fail when these resources are not available (Aarts, 2007). Another potential danger is the context in which one's intention has to be implemented. In the context of habits, this is often the same stable environment in which the habitual behaviour is normally carried out (e.g., one wants to change one's breakfast choice, but not the environment in which the breakfast is consumed). Entering the habitual context may automatically activates one's habitual

behaviour (e.g., Danner *et al.*, 2008; Verplanken & Aarts, 1999) and therefore in some cases overrule one's good intentions.

In addition, research on the conditions that render the operation of inhibitory processes effective or not has shown, for example, that inhibitory processes decline with age (Dempster, 1992), are less likely to operate in negative moods (Bäuml & Kuhbandner, 2007), and less likely work effectively when one experiences stress (e.g., Brewin, 2001) or has taken drugs (Fillmore & Rush 2002). Such moderators of inhibition mechanisms might also be relevant for understanding the conditions for successful habit change by means of goal intentions or implementation intentions. In addition, it may be important to consider the actual strength of the existing habits, as strong habits are more difficult to change and we need to identify the circumstances that allow even strong habits to be inhibited. Further research on this subject may endow us with knowledge on how to overrule stronger habits and with ideas on how to improve health promotion interventions, including interventions employing implementation intentions. In addition, future research may explicitly link the cognitive processes examined in the current study to actual success in changing one's behaviour both immediately and in the longer term, as this was not included in the current work. Then, the strength of inhibitory processes may be identified as a mediator of the effects of intentions on actual health behaviour.

Conclusion

We often make plans to reach our goals in different ways by using non-habitual behaviours, while most of our daily activities are habitual in nature (James, 1890). Usually, we plan to replace unhealthy habits by healthier behaviours, for example, to drink soda in the pub instead of beer. In the present study, we demonstrated that the mere activation of a behavioural goal can be enough to trigger one's habitual behaviour, rendering it accessible in mind. More importantly, however, we showed that upon forming a behaviour change intention, inhibitory processes are spontaneously recruited to protect this intention against habit interference. So in order to drink soda, it is important that we inhibit thoughts about beer. Implementation intentions may provide an additional tool to successfully break unwanted habits, particularly when these are not too strong. Future studies may focus on the role of inhibitory processes also in implementation intentions, and ultimately, this may lead to new interventions targeting strong existing habits.

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