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# Changing Simple Energy-Related Consumer Behaviors: How the Enactment of Intentions Is Thwarted by Acting and Non-Acting Habits

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## Abstract

Achieving ambitious CO<sub>2</sub> emission reductions require changing mundane consumer behaviors in addition to increasing modern technology's energy-saving potential. Frequently, energy-related behaviors, however, may occur highly and thus tend to become habitual. On basis of the notion that habits represent automatic reactions to situations, and hence, are hard to control, we examined whether the capability to perform or abstain from performing actions depends on the type of habit established. We tested whether an acting habit (switching off the light upon leaving a room) supports execution of the intention to act (switching it off), but hinders the intention to abstain from acting (not switching it off). Conversely, a habit of not switching off the light (a non-acting habit) is expected to obstruct execution of the intention to switch the light off, but facilitates the intention to not switch it off. Results

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support these ideas, and underscore the importance of differentiating between habits resulting from frequently acting and frequently not acting.

### **Keywords**

energy conservation, habits, acting habits, non-acting habits, intentions

Recent changes in the global agenda have spurred efforts to reduce energy consumption, and, hence, CO<sub>2</sub> emissions. In accordance with the 1997 Kyoto Protocol, for instance, the European Union committed itself to reach a reduction in greenhouse gas emissions of 8% less than 1990 levels by 2010, and in response to the Fourth Assessment Report of the intergovernmental panel on climate change (IPCC) this percentage was subsequently increased to 20% by 2010. Notwithstanding the lack of global agreement on emission reduction during the recent UN Climate Change Conference in Copenhagen, many countries still aim to achieve such serious emission reductions. Achieving these, however, require substantial efforts to reduce energy use, stretching beyond obvious fields as industry and transportation and into the household. In fact, some experts have argued that the best opportunity to achieve energy savings in a cost-effective manner is to focus on household appliances and domestic lighting (Bertoldi, Ricci, & de Almeida, 2000).

Significant improvements in the advancement of energy efficiency in the household have been made, leading to introduction and dissemination of energy-saving light bulbs, solar-heating systems, and photovoltaic systems on the consumer market. Although it is estimated that the use of the best currently available technology could reduce present energy consumption by 30% (Bertoldi et al., 2000), it would be a mistake to focus solely on energy efficiency improvements while neglecting consumer behavior (see Herring, 2006). Indeed, changing consumer behavior may result in a substantial contribution to the energy-saving potential of modern technology. Although exact figures are difficult to estimate, some researchers have argued that the use of motivation techniques and feedback information to change wasteful consumer behaviors may result in a minimum energy reduction of 10% (Darby, 2000; see Abrahamse, Steg, Vlek, & Rothengatter, 2005). Determining how this can best be achieved requires a thorough understanding of the execution of the relatively simple behaviors of which household activities consist, especially, as we will argue below, the extent to which habituation underlies these behaviors.

Attempts to change consumer behavior largely fall into the categories of consequence strategies, such as providing feedback or rewards, and antecedent

strategies, aiming to influence motivational factors such as preferences and intentions (Abrahamse et al., 2005; Gifford, 1997). Such interventions rely on the assumption that behavior is largely governed by reasoned action, and thus that provision of, say, information about one's energy use will lead to adaptations in behavior through conscious processes and motivated reasoning. There is an abundance of literature, however, to suggest that everyday life behaviors are more under the influence of habits than intentions, especially those performed repeatedly in stable contexts (for instance, see Aarts & Dijksterhuis, 2000a, 2000b; Ouellette & Wood, 1998). Most environmentally relevant behaviors that consumers are confronted with in or around the household, such as waste recycling, travel mode choice and light regulation take place repeatedly in stable contexts; accordingly, many researchers have incorporated habits in their behavioral models (see Bamberg, 2002, 2006; Bamberg & Schmidt, 2003; Klöckner & Matthies, 2004; Knussen, Yule, MacKenzie, & Wells, 2004; Matthies, Kuhn, & Klöckner, 2002).

In line with common views on habituation, these models treat habits as the result of frequently performing the focal behaviors. With repetition, the performance of the focal behavior becomes automatic (Verplanken & Aarts, 1999). Not only does this imply performance of behavior to become mentally efficient, as it allows behavior to be performed largely without awareness and in parallel with other behavioral or cognitive tasks, it also becomes more difficult to control (Posner & Snyder, 1975; Verplanken & Orbell, 2003; Wood, Quinn, & Kashy, 2002). Thus, repeatedly performing a particular behavior, for example, taking the car to go to work each day, may actually overrule someone's intention to deviate from this behavior, such as not using the car but the bicycle instead. However, the question whether frequently *not* performing certain behavior may result in habit formation has so far not attracted scientific attention. At first glance, the idea that nonactions may also become habits may seem rather implausible, as it appears to be at odds with the notion of habituation being efficient. After all, it implies that we would all have habits for all the actions that we abstain from doing on a regular basis, such as punching someone we like, or running people over on the street (that is, assuming one is inclined to adhere to the rules of proper conduct in social interactions and traffic). However, as we will argue below, it becomes less implausible if habits are conceptualized as events encapsulated in a larger behavioral unit with which they are inextricably bound (e.g., Aarts, Paulussen, & Schaalma, 1997; Bargh, 1990; Triandis, 1977; Verplanken & Aarts, 1999). Thus, a non-acting habit (e.g., a habit not to switch off the light when leaving the room) may simply consist of an automatically triggered sequence of actions in which the crucial action, switching the light off, is not incorporated.

Examples of behaviors that have negative consequences in terms of energy use once they are omitted abound in daily life. Neglecting to switch off electronic equipment after use or lights in unoccupied rooms, for instance, causes increased household energy consumption. If indeed repetition of such omitted behaviors would lead to habituation as well, this would imply that the role of habits in everyday life would be considerably larger than previously thought, and, consequently, the chances of success in attempting to reduce household energy use by conventional means would be significantly smaller. The present study therefore focuses on how established behavioral patterns may exert an influence on the execution of environmentally friendly behavior. Expanding on the idea that habits represent automatic reactions to situations, and hence are hard to suppress (Aarts & Dijksterhuis, 2000a; Bargh, 1994; Bargh & Gollwitzer, 1994; Verplanken & Aarts, 1999), we investigate whether the likelihood that both commission and omission of simple energy-relevant behaviors are adopted depends not only on the existence of habits to act, but also on habits not to act. Therefore, we designed an experiment that focused on light regulation behavior and tested whether (a) acting habits of switching off the light upon leaving a room hinder the intention to abstain from acting (i.e., the intention to not switch off the light), but support execution of an intention to act (to switch it off), and (b) non-acting habits of not switching off the light obstruct the intention to execute the act (switching off the light), but facilitate the intention to abstain from it (to not switch off the light).

## Interference of Habits

The enactment of intentions is a crucial aspect in the process underlying the control of goal-directed behavior (e.g., Austin & Vancouver, 1996; Fishbein & Ajzen, 1975; Gollwitzer, 1993; Locke & Latham, 1990). Thus, someone's goal to become an environmentally conscious person may cause this person to form intentions to reduce household energy consumption, or, more specifically, to reduce energy by switching off lights in unoccupied rooms. However, some behaviors are highly repetitive in nature; switching off the light in one's living room, for instance, constitutes behavior that may occur on a daily basis. Although the initial occurrences of such behaviors may be initiated by consciously formed intentions, frequent repetition will likely cause them to become habitual (e.g., James, 1890; Ronis, Yates, & Kirscht, 1989; Triandis, 1980). Indeed, a meta-analysis by Ouellette and Wood (1998) showed that behaviors that are performed incidentally are accurately predicted by consciously formed intentions toward the behavior, whereas behaviors that are executed frequently (e.g., on a daily basis) and consistently in a stable context

showed a direct influence of past behavior rather than intentions. In other words, frequent or habitual behavior tends to be evoked without (much) deliberation and thought, rather than being guided by conscious intentions (Aarts, Verplanken, & van Knippenberg, 1998; Ronis et al., 1989; Triandis, 1980). Thus, intending to behave in line with what one usually does in a specific situation is efficient and, likely, successful. Intentions to deviate from the usual course of action, however, are less likely to lead to a successful conclusion, as the habitual nature of the usual behavior may interfere with what was intended.

The interference of habits partly stems from the fact that frequently exhibited behaviors tend to become automatic. Bargh (1990; Bargh & Gollwitzer, 1994) suggests that frequent, or habitual behaviors are mentally represented as strong associations between situations and behavioral decisions, and that the representation of the behavior (and hence the resulting action itself) can be automatically elicited by the mere perception of the situation with which it is linked (see Aarts & Dijksterhuis, 2000a). Importantly, these findings not only imply that habitual actions are automatically evoked, but also that automatic activation may occur regardless of whether a conscious intention to act has been formed (see Bargh, 1994; Shiffrin & Schneider, 1977; Wegner & Bargh, 1998). In other words, the behavioral intention to deviate from the normal behavior may not be capable of "overruling" the activation of a habitual program, resulting in an action slip, especially when attentional resources are absorbed by other tasks (Heckhausen & Beckmann, 1990; Norman, 1981; Reason, 1979; see Aarts & Dijksterhuis, 2000b; Gilbert, 1989; Macrea, Bodenhausen, Milne, & Jetten, 1994; Wegner, 1994).

## **Habits as Automated Behavioral Sequences**

It is important to stress that most habits do not merely consist of singular actions that have acquired an automatic nature. Instead, they concern actions which coincide with related behaviors in fixed sequences. Switching off the light upon leaving the living room, for instance, would normally be preceded by such behaviors as getting up from one's chair and walking toward the door, and followed by closing the door on the way out. With repetition, the behaviors that precede and follow the focal act are just as likely to become automated as the focal act itself. Congruously, Mittal (1988) argued that the habit of fastening one's seat belt is a mere component in a sequence of "if-then" links. As this sequence occurs more often, these links may be subsumed or "compiled" into one procedural instance (Anderson, 1983; Shiffrin & Dumais, 1981). In other words, what began as a sequence of selected actions (e.g., "if I have opened the car door then I will sit down behind the wheel," followed by "if

I am seated then I will buckle up,” and finally “if I have buckled up then I will start the engine and drive away”) will end up as a more abstract behavioral goal or unit (e.g., “entering the car to drive off”). In other words, habits should be conceived of as actions encapsulated in larger behavioral units with which they are inextricably bound (e.g., Aarts et al., 1997; Bargh, 1990; Triandis, 1977; Verplanken & Aarts, 1999).

Findings in neurobiology provide support for this line of reasoning. Graybiel (1998), for instance, argued for a “sensorimotor form of chunking” (p. 119). According to this view, repetition causes a gradual recoding in parts of the brain, which results in the subsumption of representations of motor action sequences so that they can be activated as single performance units. Indeed, a series of studies on neuronal activity in rats that had learned a procedural maze task showed that habituation resulted in overall restructuring of neuronal response patterns in the sensorimotor striatum (Jog, Kubota, Connolly, Hillegaart, & Graybiel, 1999). Specifically, beginning and end of an often repeated behavioral procedure were emphasized by newly acquired neuronal responses, whereas beginning and end of the separate behavioral elements incorporated in this procedure were de-emphasized, that is, their related neuronal responses decreased as compared to their initial levels. In other words, these findings illustrate that, in the process of habituation, the isolated action elements are actually subordinated to the overall procedure, effectively recoding whole sequences of behavior into singular performance units that can be triggered by specific contexts (Jog et al., 1999; see also Aarts & Custers, 2009, for this neurological pruning effect). The contention that, with more practice, the execution of behavior is identified and monitored at a more abstract or higher level is consistent with others who have been proposing such a process before (e.g., Carver & Scheier, 1981; Vallacher & Wegner, 1987; Wyer & Srull, 1989; see also Schank & Abelson, 1977).

In short, energy-related household activities may both benefit and suffer from the occurrence of habit intrusions. Especially when consumers are distracted or preoccupied with other activities, as will often be the case in real life situations, habits may overrule intentions. Insofar as intended behavior is congruent with habitualized behavior in a certain situation, that is, one intends to behave in line with what one usually does, the likelihood of behavior going as planned increases. However, automatic activation of the habitualized actions may well turn out to be a nuisance when intended behavior opposes the habit. As such, a consumer’s intention to start behaving in a more energy-efficient manner, for example, going to work by bicycle from now on, may simply be overruled by the less desirable behavioral routine of taking the car to work, as always. The phenomenon of habit intrusion could

therefore prove to play a major role in the effectiveness of interventions designed to change consumers' energy-related behavior for the better. Moreover, the view on habits as actions subsumed in automated sequences of behavior, rather than singular actions, potentially has considerable repercussions for the actual range of everyday life behaviors that may be subjected to the process of habituation. Specifically, habit formation may not only apply to consumers frequently performing a certain action, but also to frequently not doing so; we argue here that such situations will lead to so-called non-acting habits. Assuming that non-acting habits comprise similar properties as acting habits, that is, automatically not performing an action on the mere perception of the situation, it may be anticipated that non-acting habits also hinder the execution of intentions, leading to more errors.

## **Non-Acting Habits**

Very little is known about the influence of habits that pertain to situations in which individuals frequently abstain from performing an action as part of a sequence or routine. Yet, opportunities for such non-acting habits to emerge abound in everyday life. For instance, repeatedly not changing washing machine settings from default to a lower temperature, to disconnect electronic equipment rather than leave it in standby mode, or to switch off lights when leaving an unoccupied room may eventually lead to habits not to do so. As argued before, the notion that frequently occurring, isolated events of nonaction become habits would at first sight imply that everyone would have countless habits not to perform certain behaviors. Although habits are commonly thought of as requiring only limited mental control, having multitudes of them would nevertheless heavily tax our cognitive resources. However, the proposed phenomenon of non-acting habits should be interpreted in the light of the conceptualization discussed earlier, that is, that of habits as events encapsulated in a larger behavioral unit.

Results of a correlational study by Mittal (1988), one of very few researchers to address the issue of non-acting habits, indeed suggest that repeatedly not using seat belts when driving might ultimately lead to a habit not to buckle up. Whereas the acting habit of fastening your seat belt was argued to consist of a series of "if-then" links, that is, "if I have opened the car-door then I will sit down behind the wheel"—"if I am seated then I will buckle up"—"if I have buckled up then I will start the engine and drive away," Mittal argued the corresponding non-acting habit to consist of a slightly different sequence of actions, that is, "if I have opened the car-door then I will sit down behind the wheel"—"if I am seated then I will start the engine and



drive away,” subsumed into one more abstract behavioral goal or unit, “entering the car to drive off.” In both the acting and non-acting habit, this same unit may be activated automatically, but will lead to opposing behaviors. Whereas the acting habit may cause people to find themselves driving with their seat belts on, the non-acting variant likely causes people to skip putting on seat belts before driving off, regardless of whether behavioral intentions to drive safely had been formed.

Similar to seat belt usage, light regulation or other energy-relevant behaviors in the household do not occur in isolation; rather, it may also be embedded in a sequence of other related behaviors, in which one particular act consistently follows upon another, for example, getting up from one’s chair, walking toward the door, switching off the light, and exiting the room. Consequently, neglecting to switch off the light probably also occurs frequently in a rather fixed behavioral sequence or unit in which using the light switch is not incorporated, for example, getting up from one’s chair, walking toward the door, and exiting the room. Thus, the actual difference between an acting and non-acting habit may rest on the idea that both consist of representations of a sequence of strongly connected condition-action units representing an abstract behavioral unit, one of which is omitted in the latter. Once activated by the situation, these behavioral units serve as an automated guide for further action performance, and may run to completion either in line with or contrary to consciously formed intentions.

In sum, the present line of reasoning suggests that efforts to reduce energy consumption in the household by persuading the public to change simple energy-related behaviors may be highly ineffective if these behaviors have become routines. Indeed, the effectiveness of strategies influencing consumers to omit or replace undesirable behavioral elements in existing sequences of behavior, such as setting a washing machine’s thermostat to low rather than high temperatures, taking the bicycle to work instead of the car, or dressing more warmly rather than increasing room temperature, may prove to be ineffective if established habits to do otherwise intrude. On the basis of the earlier discussion, we would expect detrimental effects of habit intrusion to befall strategies aiming to make consumers incorporate a new behavioral element in already existing behavioral sequences, such as turning off the light upon leaving an unoccupied room. Although consumers may actually endorse the objective of reducing energy consumption and are motivated to change their behavior accordingly (either by enacting an intention to act or an intention to not act), people may nevertheless fail to execute their good intentions if deviating habits have been established, as opposed to when habits were in line with intended behavior in the first place.

## The Present Research

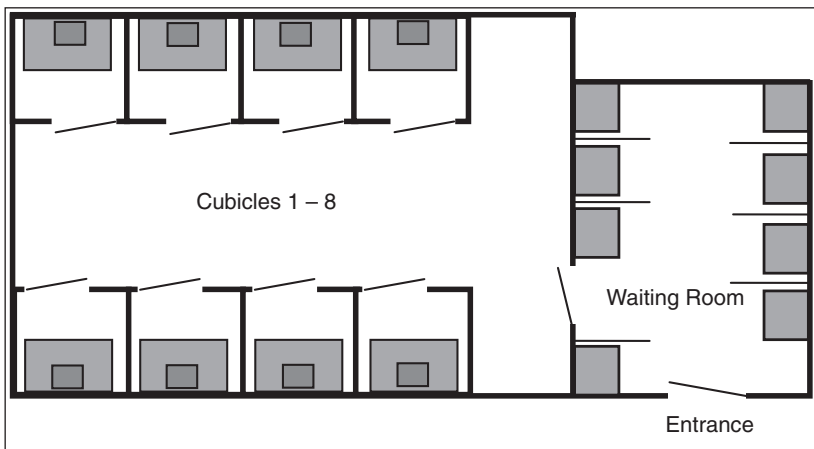
To illustrate how acting and non-acting habits may determine the success of people's attempts to reduce household energy consumption, an experiment was designed in which acting and non-acting habits were pitted against explicit intentions to perform the focal act or not. For this purpose, we focused on manually turning off the light upon leaving a room (the focal act). For some participants in our experiment this focal act was made into a habit by requiring participants to repeatedly leave the room, ostensibly to formulate correct sentences with words memorized from the computer screen, and to turn off the light each time they did so. Other participants also left the room repeatedly, but did not have to turn off the light (non-acting habit). Furthermore, a control group was added in which no habit was induced at all; these participants were also requested to formulate sentences with the memorized words, but they did so without leaving the room. Later, half of the participants were supplied with the intention to not perform the focal act, whereas for others performing the focal act was reinforced. At the end of the experiment, we observed the extent to which participants were successful in acting in accordance with these intentions when attentional resources are devoted to something else (that is, when doing a memory task). Thus, we assessed how many errors were made as a function of (acting and non-acting) habit.

On the basis of the considerations outlined earlier, we argue that people's ability to act on intentions to adjust simple behaviors depend on whether these behaviors are in conformance or in conflict with habits. Specifically, acting in line with a request to perform the focal act will be easier when an acting habit has been formed, as opposed to a non-acting habit. Conversely, following a request not to perform the focal act will be easier when a non-acting habit has been formed, as opposed to an acting habit. Hence, we anticipated an interaction between habit and intention on the number of behavioral errors made.

## Method

### *Participants and Design*

A total of 99 undergraduates, of which 48 were women, participated in this experiment in return for a payment of approximately US\$5. They were randomly assigned to the cells of a 3 (Habit: acting habit vs. non-acting habit vs. control)  $\times$  2 (Intention: acting vs. non-acting) between participants design.



**Figure 1.** Diagram of the laboratory

Note: The space on the left houses eight cubicles, each fitted with a PC and light switches near the door (inside the cubicle); on the right is the waiting room with eight tables and chairs, used by participants to complete each memory trial (acting and non-acting habit conditions only).

## Procedure

The laboratory consisted of two separate spaces. One of these was a waiting room, where participants entered the lab and subsequently waited for their turn to partake in studies; the other comprised eight cubicles, each fitted with a computer (see Figure 1 for a diagram of the laboratory).

On arrival at the laboratory's waiting room, each participant was taken to one of the cubicles, and seated behind the computer. Information presented on-screen informed participants that they would participate in research supposedly conducted to study memory performance under different circumstances. More specifically, participants learned that they had to perform two so-called "sentence memory tasks," that is, two sets of memory tests, when simultaneously being required to perform other, behavioral tasks. As will be outlined later, the first sentence memory task was used as a habit formation procedure, and the second was used to measure the dependent variable.

*Habit formation procedure.* The different habit conditions were created as part of the first sentence memory task, consisting of 10 trials and one preceding practice trial. For each trial three words were presented on the screen for the duration of only 5 seconds, which had to be memorized by the participants. The actual memory test required them to write down as many correct sentences with the three memorized words as possible within 1 minute.

In the acting habit and non-acting habit conditions, participants were shown the three words they had to memorize, were subsequently instructed to leave their cubicles to do the memory tests in the waiting room under supervision of the experimenter, and return to their cubicles afterwards. However, participants in the *acting habit* condition were requested to turn off the light each time they left their cubicles by pressing the light switch located next to the cubicle door. Participants in the *non-acting habit* condition were not requested to turn off the light upon leaving their cubicles, because this supposedly happened automatically through motion detection. In the *control* condition participants were instructed to do the memory tests within the confines of their cubicles.

Thus, in the course of the first sentence memory task, participants in the acting habit condition repeatedly switched off the light, whereas those in the non-acting condition repeatedly did not, in effect creating acting versus non-acting habits. No habit was formed in the control group.

*Manipulation of intentions.* Next, all participants were told that at the end of the experiment they would have to do a similar sentence memory task, only this time all participants were told to leave their cubicles to do the memory tests in the waiting room. Furthermore, one half of the participants learned that they had to turn off the light when they left their cubicles. Thus, these participants were supplied with the intention to act. The other participants, however, were told that they should not switch off the light when they left their cubicles, and, thus, received the intention to not act. Subsequently, participants received an unrelated task that served as a filler to remove participants' thoughts about the earlier messages from working memory.

*Behavioral measure: Error rates.* After the filler task, participants were again instructed to memorize three words presented on the screen as part of the second sentence memory task, leave for the waiting room and within 1 minute write down as many correct sentences with these words as they could. This time, however, nothing was told about the required act as to light-regulation. In this way we were able to test behavioral effects of the earlier habit and intention manipulations. To enhance the stability of the behavior measure, all participants were required to complete two trials, and thus left their room twice in this last sentence memory task. The relative number of times (proportions) participants failed to act in accordance with the intention to act or to not act served as the dependent variable (i.e., the error rate). After the measurement of behavior several questions were administered.

*Subjective report of habit strength.* To check whether repeatedly switching off the light upon leaving the room created a qualitatively similar level of habit strength than repeatedly not switching off the light, participants in the acting

and non-acting habit conditions provided self-reports on their behavioral experiences. Specifically, depending on the habit condition participants were asked to indicate how strongly they perceived switching off (or not switching off) the light when leaving the room to be habitual (see also Verplanken & Orbell, 2003, for a similar habit strength measurement procedure). Responses could be given on a 9-point scale (1 = *not habitual* to 9 = *habitual*). This item was not administered in the control group, as no (acting or non-acting) habit was induced here.

*Importance ratings of intentions.* Two questions were posed that measured participants' perceptions as to how valuable and important it was to them to enact the given intention. Thus, for the acting intention condition these items refer to the act of switching off the light, and for the non-acting intention condition these items pertain to the act of not switching off the light. Responses were given on a 9-point scale (1 = *not at all* to 9 = *very much*). These two ratings were averaged ( $r = .46, p < .001$ ) into an index of perceived importance of intention. Accordingly, this index allowed us to check whether potential differences on errors as a function of habit and intentions may be attributed to differences in participants' endorsement of the given intentions.

After the measurement of behavior, participants were debriefed, thanked, paid, and dismissed. The debriefing revealed that none of the participants indicated suspicion as to the actual nature of the experiment. Therefore, we may conclude that participants were unaware of the hypotheses under investigation.

## Results

### *Subjective Report of Habit Strength*

In the acting habit condition the mean habit strength rating (as to switching of the light) was slightly lower than in the non-acting habit condition ( $M = 6.30, SD = 1.55$  vs.  $M = 6.76, SD = 1.35$ ). However, a  $t$  test revealed this difference in the habit strength measure between the two conditions to be non-significant,  $t(64) = 1.27, ns$ . Thus, this pattern of findings indicates that the habit formation procedure was successful in establishing habits to act as well as habits to not act, and that these did not differ in strength.

### *Behavioral Measure: Error Rates*

The proportions of errors across the two trials were subjected to a 3 (Habit: acting habit vs. non-acting habit vs. control)  $\times$  2 (Intention: acting vs. non-acting) ANOVA. The analysis revealed a marginally significant main effect

**Table 1.** Average Error Rates as a Function of Habit and Intention

	Intention		Sign.
	Acting	Non-Acting	
Acting habit	.00	.19	$p = .04$
Non-acting habit	.38	.00	<i>ns.</i>
Control	.22	.06	$p = .002$

Note: Column on the right indicates significant differences between acting and non-acting intentions within habit conditions.

of Intention,  $F(1, 93) = 3.52, p = .06$ . Participants were more likely to make errors when they had the intention to act. Furthermore, the main effect of habit was not significant,  $F(2, 93) = 0.77, ns$ . More important, however, the expected interaction effect between Habit and Intention was significant,  $F(2, 93) = 7.37, p = .001$ . The proportions of errors for each cell in the design are shown in Table 1.

To assess the pattern of the interaction and to test the specific hypotheses, we conducted separate analyses for the acting habit, non-acting habit, and control condition. As can be seen in Table 1, in the acting habit condition participants tended to make more errors when they had the intention to not act than when they had the intention to act,  $t(31) = 2.16, p = .04$ . However, participants who formed a non-acting habit made more errors in the intention to act than in the intention to not act condition,  $t(31) = 3.38, p = .002$ . In the control group no significant difference in error rates was found between the two intention conditions,  $t(31) = 1.38, ns$ .

### Importance Ratings of Intentions

The data presented above show that acting habits are difficult to control by intention to not act. Moreover, a similar and even stronger effect occurred for non-acting habits, these habits proved to be hard to control by intentions to act. One possible reason for these differences in the control of acting versus non-acting habits may be that the importance of the intentions differs. Specifically, one could argue that non-acting habits more strongly overruled the intention to act in comparison with the ability to overrule acting habits by the intention to not act, because the intention to act was less strongly endorsed. To examine this possibility, we first subjected the importance index to an ANOVA, with habit and intention as the independent variables. Next, we performed an ANCOVA on the error rates with the importance index as a covariate.

Inspection of the means resulting from the ANOVA indeed suggested a slight difference between the intention conditions. However, participants tended to endorse the intention to act ( $M = 6.25$ ,  $SD = 1.43$ ) slightly more than the intention to not act ( $M = 5.87$ ,  $SD = 1.28$ ), which actually goes against the reasoning outlined above. In addition, this difference failed to reach the required level of significance,  $F(2, 93) = 2.04$ ,  $p = .16$ . The main effect of habit and the interaction effect between habit and intention were both not reliable,  $F_s < 1$ .

The subsequent ANCOVA, using the intention importance index as a covariate, yielded a pattern of significant results for intention, habit, and the interaction between both, that is very much the same as the one resulting from the original ANOVA ( $F[1, 92] = 4.35$ ,  $p = .04$ ,  $F[2, 92] = .60$ , *ns*, and  $F[2, 92] = 7.37$ ,  $p = .001$ , respectively). Taken together, then, these analyses indicate that the observed pattern of results is not attributable to the “magnitude” of endorsement of the given intentions.

## Discussion

The first conclusion to be drawn is that participants who developed an acting habit of turning off the light upon leaving a room performed worse (i.e., made more errors) when they had intentions to not act, in comparison with those who intended to act. Participants who established a non-acting habit, on the other hand, performed worse when they intended to perform the focal act, as compared to those who were not. Thus, the results suggest that, while being engrossed in a larger activity (e.g., walking in and out rooms and holding information in working memory), both acting and non-acting habits are automatically triggered by the situation, and are, hence, difficult to control by intentions. Intentions to perform the act of switching off the light were facilitated once that behavior had become well-practiced or routinized, but were substantially hampered when the routinized pattern of behavior (i.e., action sequence) did not include this particular act. Conversely, intending to not switch off the light was more likely to be facilitated by a non-acting habit, and inhibited by an acting habit.

It should be noted that the pattern of error rates (that is, the differences between the acting vs. non-acting intention conditions) in the control group, although not significant, looks somewhat similar to the pattern of the non-acting habit group. Whereas this finding may suggest that adopting a new unit of action takes more mental effort and is more burdensome in general, a possible explanation in the context of non-acting habits is that participants already had a habit of not performing the specific action before they entered

the laboratory, caused by repetition in daily life. Such a “pre-existing” habit could very well have had a noticeable effect on the participants in the control condition. Therefore, the price we may have paid by examining a more realistic and familiar behavior is a higher overlap between the control condition and non-acting habit condition, rendering the effects in the two conditions more difficult to disentangle. Importantly, though, the error rates between acting and non-acting intentions in the non-acting habit condition are stronger and significant, indicating that acting on the intention to act was more strongly overruled when participants established a non-action habit (thus rendering a general mental fatigue account for the adoption of new behavior less plausible).

The present study focuses on simple every-day life behaviors that are relevant for the conservation of energy in the household. The results show that the execution of these behaviors could be more problematic than is suggested by their apparent simplicity. The capability of behaving in line with intentions to do something or intentions not to do so, as a result of specific requests, is conditional on the type of habit a person has established. Specifically, it proved to be easier to let behavior be dictated by an already established habit, than to counteract an existing one. Furthermore, it became evident that the principle underlying the activation of habitual behavior applies not only to acting habits, but also to non-acting habits, that is, repeatedly not performing a certain action in a given situation may lead to an uncontrollable habit not to perform that action. In doing so, our results may compliment research on control and automaticity in social behavior (Wegner & Bargh, 1998).

Because both acting and non-acting habits were found to obstruct execution of intended behavior, it is worthwhile to speculate on possible ways in which these habits emerge. Established models of habitual behaviors posit that a strong mental link between situation and goal-directed behavior establishes when the behavior is frequently and consistently selected in a particular situation (Aarts & Dijksterhuis, 2000a; Bargh, 1990; Bargh & Gollwitzer, 1994). Thus, frequent activation of this link causes the goal-directed acting to be automatically activated on the perception of the situation. Of interest is that the experiment described here suggests that the concept of automatic situation-behavior links does not only pertain to “carrying out an action” but also to “not carrying out an action.” This finding offers support for the notion that actions and abstinence from actions (i.e., not performing an act) do not occur in isolation, but should rather be conceived of as mere elements of a sequence of related actions which are subsumed in a single procedural unit (see Anderson, 1983; Shiffrin & Dumais, 1981). Consequently, the difference between acting and non-acting habits may be the presence or absence of



one particular behavioral element in this abstract behavioral unit. And as our findings suggest, it may not only be difficult to abstain from performing this particular behavioral element when it is part of a habitual sequence; it may also prove to be difficult to initiate the particular behavioral element when it is not part of a habit.

Trying to change behavior for the purpose of saving energy on a national or perhaps even a global scale by urging people, for instance, to switch off idle-electronic equipment or lighting in an unoccupied room, could well be unsuccessful, not because people do not consider and hold the proper intentions, but because frequency of past behaviors, that is, their habits, interfere. In such cases we are dealing with an action slip (Heckhausen & Beckmann, 1990; Norman, 1981), rather than a memory failure. A considerable number of the action slips (erroneously doing something else than intended) people are prone to in everyday life stem from habits, that is, intrusion in behavior of something frequently done in the past (strong habit intrusions, e.g., Reason, 1979). The experiment discussed here indicates that, as repeatedly not performing an action in a situation may also become a habit, the occurrence of action slips may manifest itself through not displaying a particular action as well (erroneously doing nothing while intending to do something). The practical relevance of recognizing this lies in the fact that what at first sight seems to be a case of merely forgetting to undertake action (i.e., a prospective memory failure, Brandimonte, Einstein, & McDaniel, 1996), could actually be an action slip, due to a habit of not acting, automatically guided by the situation. As the latter constitutes a far more rigid phenomenon than the former, failing to make the right diagnosis will most likely result in taking inappropriate countermeasures to decrease the likelihood that the particular error will continue to occur in the future; the proverbial knot in the handkerchief might in this case not be a helpful mnemonic strategy as would be the case in situations where mere forgetting is the culprit.

Although in some cases the occurrence of action slips could be as mere inconvenience, the energy reduction aimed at by the European Union in accordance with the Kyoto Protocol and later agreements renders such action slips rather more important. Traditional training or education programs may be inadequate when they do not recognize the need for methods to decrease the influence of past behavior on future behavior (Aarts et al., 1997). Recent treatments of effective goal pursuit suggest that implementation intentions may be a potential tool to achieve this (e.g., Aarts, Dijksterhuis, & Midden, 1999; Gollwitzer & Brandstätter, 1997; Webb & Sheeran, 2007; for a review, see Gollwitzer & Sheeran, 2006). Implementation intentions are defined as plans that link particular actions to specific situations in memory, and thus install strong contingencies

between situational cues and goal-directed responses by going through a mental procedure only once. Actions that lead to goal fulfillment thus gain a degree of automaticity, in the sense of being under direct control of relevant situational cues. This way, the operation of implementation intentions simulates habits (also see Aarts & Dijksterhuis, 2000a; Orbell, Hodgkins, & Sheeran, 1997). Whereas implementation intentions have been shown to serve as effective regulatory tools for goal achievement in general, and behaviors related to the environment in particular (e.g., Bamberg, 2002), the question whether and how these plans break old habits and create new ones has received only little theoretical and empirical attention (but see Holland, Aarts, & Langendam, 2006). An interesting avenue for further research is therefore to investigate how much planning is needed, and what the exact content of the plan should be before action slips are prevented, that is, intentions to not act or intentions to act are enacted despite the presence of acting or non-acting habits.

Although many behaviors are executed repeatedly and consistently in a similar context, the role of habits is largely neglected in contemporary psychological research on the control of human behavior by intentions. As far as research on this topic is conducted it mainly concerns studies on statistical associations between measured constructs of habit, intention and later behavior or, since more recently, cognitive effects as a function of habit strength (for reviews, see Ouellette & Wood, 1998; Verplanken & Aarts, 1999). Frankly speaking, observing direct relations between past and future behavior are not that informative. It tells us that we simply do the things as we did them before, a maxim put forth by behaviorists (Skinner, 1938; Watson, 1914). Therefore, by scrutinizing the effects of habit on cognition (e.g., information processing and decision-making) we hope to gain more knowledge about the possible processes underlying repeated behavior. In the present study we have attempted to develop an experimental paradigm that allows manipulating, and perhaps even causally linking habit, cognition, and future behavior. It is hoped that the present analysis on habit and intention encourages researchers to venture beyond this point, and to shed more light on the processes that make us do or not do what we originally intended. Moreover, we hope that more resources will be dedicated to designing and testing adequate strategies that reduce the risk of doing things we do not want to do, not solely for the benefit of science in general, but also for the safety, health and well-being of human beings and their environment.

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