Consciousness and Cognition 19 (2010) 21–32

Contents lists available at ScienceDirect

Consciousness and Cognition

journal homepage: www.elsevier.com/locate/concog

Reflecting on the action or its outcome: Behavior representation level modulates high level outcome priming effects on self-agency experiences

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ARTICLE INFO

Article history:
Received 18 September 2009
Available online 13 January 2010

Keywords:
Self-agency
Behavior representation level
Subliminal priming
Action
Outcome

ABSTRACT

Recent research suggests that one can have the feeling of being the cause of an action's outcome, even in the absence of a prior intention to act. That is, experienced self-agency over behavior increases when outcome representations are primed outside of awareness, prior to executing the action and observing the resulting outcome. Based on the notion that behavior can be represented at different levels, we propose that priming outcome representations is more likely to augment self-agency experiences when the primed representation corresponds with a person's behavior representation level. Three experiments, using different priming and self-agency tasks, both measuring and manipulating the level of behavior representation, confirmed this idea. Priming high level outcome representations enhanced experienced self-agency over behavior more strongly when behavior was represented at a higher level, rather than a lower level. Thus, priming effects on self-agency experiences critically depend on behavior representation level.

1. Introduction

Human beings have the ability to reflect on their own actions and resulting outcomes, which enables them to distinguish between outcomes that result from the actions of others and outcomes that result from their own actions. As a result, they can attribute these outcomes to the proper agent. The ascription of authorship is fundamental to social communication in particular, and our society in general. The feeling that one causes one's own actions and their outcomes – also referred to as the experience of personal authorship or self-agency – serves as an important building block for our concept of free-choice, and as such is central to our social beliefs about whether we can and do have an influence on our own behavior.

An important and intriguing question is how we determine our causal influence in the environment leading to the experience of self-agency over behavior. Usually, the mechanism producing these agency experiences derives from our intentions to engage in behavior (e.g., Bandura, 1986; Deci & Ryan, 1985; Haggard, 2005; Jeannerod, 2003). That is, whether we move our finger, push a switch to turn on a light, or illuminate a room, we experience self-agency when the perception of an event or outcome corresponds with the outcome that we consciously intended to realize. However, recent research suggests that we can have a sense of self-agency even when we do not have a prior intention to produce a specific outcome. Building on the idea that self-agency experiences follow from a match between represented outcomes and the actual observation of these outcomes, this research showed that the authorship ascription process is susceptible to primes. Specifically, information that renders the representation of outcomes active before one performs an action and observes the matching outcome enhances the experience of self-agency, even when this information is presented outside of awareness, through subliminal priming (e.g., Aarts, Custers, & Wegner, 2005; Aarts, 2007; Sato, 2009). This suggests that people rely on accessible

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doi:10.1016/j.concog.2009.12.004

representations that pertain to the behavior at hand to establish a sense of personal authorship, and that the authorship ascription process can operate outside of conscious awareness.

The present research aims to extend previous work on priming effects on self-agency experiences by exploring the role of representations of behavior in more detail. Specifically, based on the notion that behavior can be represented at different levels (Vallacher & Wegner, 1987) and that these levels of behavior representation play a role in the experience of self-agency (Pacherie, 2008), we propose that outcome priming effects on self-agency depend on the level at which the agent represents her behavior. For example, when a person represents her own behavior of manually operating a light-switch in terms of 'turning on a light' (high level), rather than 'moving the finger' (low level), priming the high level outcome representation (turning on the light) increases the experienced self-agency over the behavior. Until now, the level at which behavior is represented has received only little theoretical and empirical attention in research on the role of priming in the experience of personal agency. Examining priming effects on self-agency experiences as a function of the level of behavior representation, we believe, does not only increase our understanding of when people experience self-agency in the absence of a prior intention to act. It also contributes to the question of why people who suffer from delusions of control may not experience self-agency in the presence of a prior intention to act, as is the case in for example schizophrenic patients (e.g., Frith, 2005; Wegner, 2002).

The notion that behavior can be represented at different levels has been put forward by several models and theories dealing with the cognitive architecture and control of behavior (e.g., Aarts & Dijksterhuis, 2000; Gallistel, 1985; Powers, 1973; Vallacher & Wegner, 1987). According to Action Identification Theory (Vallacher & Wegner, 1987; Wegner & Vallacher, 1986), any behavior can be identified at multiple levels. Specifically, this theory posits that people who represent their behavior at a low level define their behavior in terms of how an action is done, whereas people who represent their behavior at a higher level define their behavior in terms of why an action is done. This means that what is considered to be the outcome of certain behavior depends on the level at which the behavior is represented. People who represent their behavior at a low level tend to perceive the action in terms of producing sensorimotor consequences or outcomes (i.e., a low level outcome). People who represent their behavior at a high level tend to perceive the action in terms of serving an overarching goal or outcome (i.e., a high level outcome). Research within this framework suggests that levels of behavior representation vary as a function of both context and individual differences and play a role in understanding our own and other people's behavior (Aarts, Gollwitzer, & Hassin, 2004; Kozak, Marsh, & Wegner, 2006; Vallacher & Wegner, 1989; Wegner, Vallacher, Macomber, Wood, & Arps, 1984).

Recently, the idea that behavior can be represented at different levels has also been proposed to play a central role in experiences of self-agency (Belayachi & van der Linden, 2009; Pacherie, 2008). Of particular relevance is Pacherie 's (2008) conceptual model of the phenomenology of action, according to which our intentions can operate dynamically at three different levels: at the level of distal intentions (in terms of overarching outcomes of an action), proximal intentions (in terms of situated outcomes of an action), and motor intentions (in terms of the consequences at the sensorimotor level intrinsically derived from the motor control system). Intentions at each level are assigned a specific role in the guidance and control of behavior. A distal intention does normally not cease to exist once it gave rise to a corresponding proximal intention. Similarly, a proximal intention does not disappear once the corresponding motor intention has been issued. Rather, all three levels of intentions coexist, without the necessity of having an intention at each level in order for behavior to emerge. For example, routine actions can be set in motion by a motor intention and do not always need the guidance and control of proximal or distal intentions (Aarts & Custers, 2009). The model also suggests that the extent to which one experiences self-agency depends on comparisons between the expected and the actual outcomes made at each level of behavior representation. By default, then, intentions pertain to outcome information that guides action control processes at different levels simultaneously. Consequently, self-agency experiences derived from these intentions are more pronounced if the prior intentions and observed outcomes of one's actions correspond at the same levels of behavior representation.

Some suggestive evidence indicating that different levels of behavior representation do indeed affect self-agency experiences comes from studies on action-awareness and monitoring in people suffering from delusions of control, such as patients with schizophrenia and/or affective disorder (Blakemore, Smith, Steel, Johnstone, & Frith, 2000; Franck, Farrer, & Georgieff, 2001; Knoblich, Stottmeister, & Kircher, 2004). For example, in testing their sensory-motor comparator model in the context of the attenuation of self-produced tickle sensations, Blakemore and colleagues (2000) asked their participants to rate the perception of a tactile stimulation on the palm of their left hand. This stimulation was either self-produced or externally produced. Results showed that normal (control) subjects rated the tactile stimulation as less intense when it was self-produced rather than externally produced (see also Blakemore, Wolpert, & Frith, 1998). Interestingly however, patients suffering from delusions of control (i.e., auditory hallucinations and passivity phenomena) failed to show a difference in perception between the self-produced and externally produced behavioral outcome.

The failure of patients suffering from delusions of control to notice this difference illustrates that these patients more often attribute self-generated actions to external agents than people who do not suffer from these delusions (e.g., Frith, Blakemore, & Wolpert, 2000). Such under-attributions of agency might occur because these patients' behavior representations do not correspond with the outcome of their actual behavior, possibly because they lose track of, or do not retain their intentions that caused their behavior (Henry, Rendell, Kliegel, & Altgassen, 2007; Wegner, 2002; Twamley et al., 2008; Altgassen, Kliegel, & Martin, 2008; Jeong & Cranney, 2009). In other words, these patients do not properly monitor their action with the high level behavior representation in mind, but maintain a representation of what they are doing at a lower level (see also Pacherie, 2008). Consequently, if 'touching the palm of the hand' is represented at a low level (e.g., in terms of moving one's finger), then the touch of the hand palm (i.e., the outcome related to a high level behavior representation) may come as a surprise, thereby leading to the under-attribution of agency over behavior.

The work alluded to above underscores the importance of behavior representations in mapping expected (sensory) outcomes on observed ones as a result of intentional (motor) action. However, recent research indicates that people are quite capable of fluently and perfunctorily ascribing authorship of an observed outcome to oneself. People can experience self-agency over behavior even in the absence of a prior intention to act, as long as a representation of the outcome is active prior to the execution of an action (Aarts, 2007; Aarts et al., 2005; Sato, 2009; Wegner & Wheatley, 1999). That is, we feel to have produced an outcome when there is a match between the actual outcome and the outcome that we presaged in our mind. Accordingly, experiences of self-agency over behavior are augmented when the representation of the outcome is primed prior to the performance of an action and matches the actual outcome, even in the absence of a conscious intention to produce the specific outcome.

In a recent study demonstrating this idea, participants and the computer each moved a single gray square in opposite directions on a rectangular path consisting of eight white tiles (Aarts et al., 2005). Participants' task was to press a key to stop the rapid movement of the squares. This action turned one of the eight tiles black. In reality, the computer determined which of the tiles would turn black. From a participant's perspective, though, this black tile could represent the location of either her square or the computer's square at the time they pressed stop. Thus, the participant or computer could have caused the square to stop at the position, rendering the exclusivity of causation ambiguous (cf. Wegner & Wheatley, 1999). Participants either set the intention to stop at a position (a proximal intention, according to the terminology suggested by Pacherie, 2008) or were subliminally primed with that position just before they saw the presented stop at the corresponding location. To measure experiences of self-agency over behavior, participants rated the extent to which they felt to have caused the square to stop. Results showed that both intention and priming increased the sense of self-agency. These findings indicate that on-line self-agency experiences are primarily based on a match between pre-activated and actual outcomes, irrespective of the (conscious or nonconscious) source of this activation. They suggest that people can experience self-agency over behavior even without having the intention to engage in that behavior.

A match between primed and observed behavior representations thus plays a fundamental role in the establishment of personal authorship. Importantly, studies on priming effects on self-agency experiences have so far exclusively focused on the same level of representation of the prime and outcome. That is, capitalizing on the idea that people are generally inclined to take the overall goal of a task (i.e., high level behavior representation) in mind (Vallacher & Wegner, 1987), participants were assumed to represent their behavior in terms of high level outcomes. Hence, priming high level outcome representations (e.g., the stop location of a moving square) augmented their sense of self-agency over behavior (e.g., stopping the square at the presented location). However, because the level of behavior representation can vary across people and situations it remains to be seen whether and how the level of behavior representation modulates priming effects on self-agency experiences. The present research explores this issue in more detail.

Specifically, we conducted three experiments in order to investigate the role of behavior representation level in priming effects on the experience of self-agency over behavior (such as stopping a rotating square on a specific location on the computer screen) while self-causation is ambiguous (Aarts et al., 2005). We propose that priming high level outcome representations (e.g., the position of the stopped square) enhances experiences of self-agency when people represent their behavior at a high level (e.g., stopping the square at a specific location) rather than a lower level (e.g., pushing a button). Following earlier work on priming effects on self-agency experiences (e.g., Aarts, 2007; Aarts et al., 2005; Sato, 2009), we expected these moderating effects of behavior representation level to occur even though the high level outcome representation is primed outside of participants' conscious awareness. In other words, we expected that behavior representation level plays a role in experiences of self-agency over behavior, even in the absence of a prior conscious intention to produce the specific outcomes.

In a first experiment, we used a modified version of a task recently employed in research studying subliminal priming effects on on-line experiences of self-agency in a context where performance of behavior is ambiguous (Aarts, Custers, & Marien, 2009). In this task, participants have to stop a rapidly presented sequence of consumer products and then observe that the sequence stops on one of the products. This task could be represented as pressing a stop-key (lower level behavior representation) or as stopping on a product (higher level behavior representation). Participants were subliminally primed with the products (high level outcome) or not before they observed the stopped product and indicated their sense of self-agency over stopping the product. The moderating role of behavior representation level was investigated by measuring individual differences in the extent to which participants represented their behavior in terms of producing the high level outcomes in the task at hand. In the second experiment, using the stopping of the rotating square paradigm (Aarts et al., 2005), participants were again primed with high level outcome information, but this time we measured participants' general dispositions toward behavior representation levels with the validated Behavioral Identification Form (BIF; Vallacher & Wegner, 1989). Finally, in the third experiment we manipulated participants' task-related behavior representation level.

2. Experiment 1

In the first experiment, participants learned to stop a sequence of eight (consumer) products rapidly presented on the computer screen by a key-press that was immediately followed by the presentation of one of the eight products. Next, they learned that during the remaining part of the experiment the products in the sequence would be removed and replaced by eight briefly flashed letter strings, and that pressing the stop-key during the alternation of these strings would be followed by one of the previous eight products. In addition, it was told that the presented product might also be determined by the computer. It was explained that this adaptation of the task was used to examine experiences of behavior when the performance of behavior is ambiguous (cf. a gamble machine, in which one stops rapidly rolling symbols by pushing a button). In reality, the computer always determined the product. As a measure of self-agency (Aarts et al., 2005; Sato & Yasuda, 2005; Wegner & Wheatley, 1999), participants indicated to what extent they felt that they had stopped the presented product.

The replacement of the products by letter strings served three important experimental purposes: (1) the presentation of the letter strings prevented participants from determining which product was on the screen at the moment they pressed the key to stop the sequence of products, and hence from using it as a predictor for which product would appear; (2) removing the products and presenting the letter strings ensured that the products would not serve as primes by themselves during the sequence interval; (3) the sequence of strings allowed us to prime specific outcome information (i.e., the product names) in the absence of participants' awareness before they stopped the sequence. Thus, although our task allows participants to have agency over pressing the stop-key, they cannot predict the exact outcome of that action, hereby rendering the experience of self-agency over stopping the product sensitive to the priming manipulation. At the end of the experiment, participants indicated the extent to which they represented the task in terms of how the action was done (that is, pressing the stop-key; a low level behavior representation) or in terms of why the action was done (that is, to stop a specific product; a high level behavior representation). This measure enabled us to test priming effects on self-agency as a function of the level of representation of the task-related behavior.

Based on the line of reasoning addressed before, we expected that priming high level outcome (product) representations of behavior is more likely to augment the experience of self-agency over stopping the products when participants represent their behavior in terms of producing these higher level outcomes rather than producing lower level outcomes (e.g., in terms of pressing a stop-key).

2.1. Method

2.1.1. Participants and design

Forty-four undergraduates participated in this experiment in return for course credit or a small fee. All participants were presented with two types of trials: trials in which the high level outcome representation (the product that would be presented after the key-press) was primed and control trials without such primes. Hence, priming constituted a within-participant factor. Additionally, participants' task-related behavior representation level was measured and used as a between-participant factor.

2.1.2. Experimental task and procedure

Participants worked on the task individually. They were told that the study was designed to examine people's experiences of behavior and how these experiences come and go. For this purpose, they would operate a kind of vending machine that was programmed on a computer. Specifically, they learned to stop a sequence of eight (consumer) product words rapidly presented in the middle of the computer screen by pressing a designated key on the keyboard upon seeing the message ***STOP***. The products were neutral to our sample of participants (e.g., spoon, ball-point). Participants were told that upon pressing the stop-key, the rapid alternation of the product words would stop and that the product on which they had stopped the sequence would appear at the bottom of the screen (in the virtual drawer of the vending machine). Each trial began with a start cue, proceeded with the alternation of the product words, and at some point, the STOP-cue. The product words were presented for 170 ms, with a 30-ms blank screen in between. The stopped product was presented 100 ms after participants pressed the stop-key and remained on the screen for 600 ms.

After some practice, participants were told that the task would change a bit to examine experiences of behavior when the performance of behavior is ambiguous. Specifically, they learned that the eight products would no longer be presented on the screen, but instead would be replaced and symbolized by the alternation of eight different strings of capital letters (e.g., PAEXJDF). Hence, they were told that now stopping the sequence of briefly flashed letter strings would be followed by the presentation of a product. In addition, they were told that the presented product after they pressed the stop-key could also be determined by the computer (in fact, the computer always determined the presented product). Participants thus were led to believe that either they themselves or the computer could be the cause of the presented product. It was further told that the time of a trial could vary, and therefore it was stressed that participants should keep focused on the strings to not miss the STOP-cue. In actuality, the sequence of briefly flashed letter strings lasted about 6 s. After each presented product, participants indicated to what extent they felt that they had stopped the product. This agency feeling was measured on a 10-point scale [*not at all me* (0) – *absolutely me* (9)]. Each of the eight products was presented as an outcome four times—twice in the prime condition and twice in the no-prime condition. The experimental task thus consisted of 32 trials. Trials were presented randomly. Participants first practiced the task to figure out when and how to press the stop-key and then moved onto the experimental task.

2.1.3. Product priming

The name of the product (in capital letters) was either subliminally primed or not within the presentation stream of letter strings (for a subliminality check of this procedure, see Aarts et al., 2009). Each letter string was presented for 170 ms, and

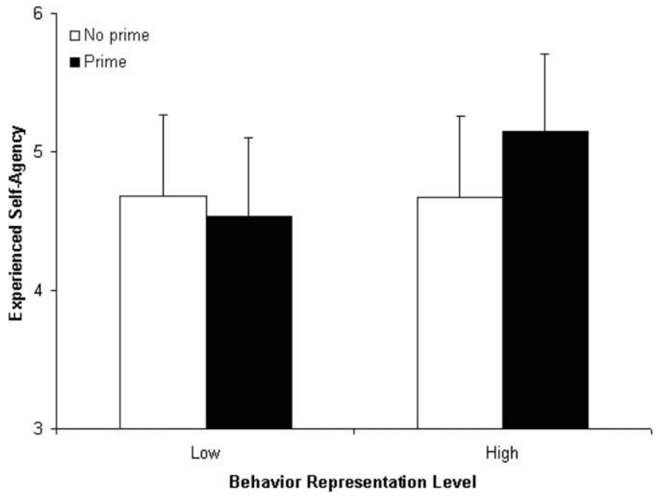

Fig. 1. Experienced self-agency as a function of priming (no prime vs. prime) for participants with a low behavior representation level (one standard deviation below the mean) and for participants with a high behavior representation level (one standard deviation above the mean). Error bars represent standard errors of the means.

between two successive strings there was a 30-ms interval. As a default, a row of neutral Xs was presented during this interval. In the prime trials a product name was presented on every 30-ms interval for seven times in a row. Thus, the letter strings served as pre- and post-masks for the primes, and the time between primes was 170 ms. The time between the last prime and the STOP-cue was 200 ms.

2.1.4. Measuring the level of behavior representation

At the end of the task, participants responded to two 9-point scale items that measured the level of behavior representation (cf. Vallacher, Wegner, McMahan, Cotter, & Larsen, 1992). One item probed participants to identify their behavior either in terms of pressing the stop-key or in terms of stopping a specific product. The other item asked them to indicate the extent to which they had tried to determine on which product the sequence would stop. The two ratings were averaged into an index of level of behavior representation ($\alpha = .54$), with lower scores reflecting a lower representation level, and higher scores reflecting a higher representation level.

2.1.5. Debriefing

As in earlier work on subliminal priming effects on self-agency experiences using the sequence task (Aarts et al., 2009), debriefing showed that none of the participants were aware of the presentation of the primes (product words). Furthermore, none of them realized the true nature of this study. Two (nonnative speaking) participants indicated to have misunderstood the task instructions. These two participants were omitted from the analyses.

3. Results

Average ratings of agency were computed for the no-prime trials and the prime trials. These ratings were subjected to the General Linear Model, with priming condition (no prime vs. prime) as a within subject variable and behavior representation level as a (between subjects) continuous variable. This analysis revealed a significant interaction between prime and behaviour representation level, $F(1, 40) = 5.87$, $p = .02$.

In order to examine this interaction and to test our specific hypothesis, the effect of priming on self-agency experiences was assessed for participants with a low level behavior representation (one standard deviation below the mean) and for participants with a high level behavior representation (one standard deviation above the mean) separately (see Aiken & West, 1991). These analyses showed that participants with a high level behavior representation experienced stronger self-agency over stopping the product when product words were primed, compared to when product words were not primed, $F(1, 40) = 6.78$, $p = .02$). Product word priming did not influence experienced self-agency for participants who represented their behavior at a lower level, $F < 1$. Fig. 1 presents the mean experienced self-agency for each cell in the design.[1]

[1] Across the three studies, there were no consistent and reliable effects of priming on participants' speed of pressing the key in response to the stop signal. Thus, primes did not affect participants' stopping behavior.

4. Discussion

The findings of Experiment 1 confirmed our predictions: for participants who represented their behavior as "stopping on a product", subliminally priming the name of a product before participants stopped the sequence and perceived the corresponding product enhanced their experienced self-agency, whereas no such priming effect occurred for participants who did not represent their behavior as "stopping on a product". Thus, when the subliminal primes corresponded with participants' behavior representation, participants' self-agency experiences over behavior increased compared to when no subliminal primes appeared. However, when participants' behavior representation did *not* correspond with the subliminal primes, no priming effect on experienced self-agency occurred. Given that the behavior of "stopping on a product" reflects a high level representation within the present task context, it seems likely that participants who did not represent their behavior at this high level, represented their behavior at a lower level, for example in terms of "pressing a stop-key". Accordingly, these findings support our hypothesis that the level of behavior representation moderates subliminal priming effects on self-agency experiences.

In the light of the robustness of previous subliminal priming effects on experienced self-agency (e.g., Aarts et al., 2005, 2009; Sato, 2009), it is noteworthy that self-agency experiences of participants who did not represent their behavior as "stopping on a product" were unaffected by subliminally priming the name of the product that was about to be selected from the vending machine. As such, the absence of a priming effect in the present experiment suggests that the level of behavior representation is a crucial determinant in the experience of self-agency over behavior. To further substantiate this claim, in Experiment 2 we assessed participants' behavior representation level in another way, by measuring participant's dispositional behavior representation level with the Behavioral Identification Form (BIF; Vallacher & Wegner, 1989). The BIF is designed to assess individual differences in the level at which people generally represent their behavior (i.e., in terms of how an action is done – low level – or in terms of why the action is done – high level) across an array of actions. The measure has been shown to meet convergent, divergent and predictive validity. Important for the present purpose, we expected this general disposition of behavior representation level to modulate priming effects on self-agency experiences over producing high level outcomes.

5. Experiment 2

In the second experiment, we used a different paradigm for assessing self-agency experiences to extend our findings to another task setting. Specifically, participants performed an adapted version of the stopping of the rotating square paradigm (see Aarts et al., 2005). In this task, participants and the computer each moved a single gray square in opposite directions on a rectangular path consisting of eight white tiles. Pressing a stop-key turned one of the eight tiles black, representing the location of either the participants' square or the computer's square. Importantly, the participant or computer could have caused the square to stop at the position, rendering the exclusivity of causes of outcomes ambiguous (cf. Wegner & Wheatley, 1999). To measure experiences of self-agency, participants rated the extent to which they felt to have caused the square to stop.

In this task, participants were either subliminally primed or not with a location before they stopped the moving square and were subsequently presented with the squares' stop location. Also, each participant's dispositional behavior representation level was measured with the Behavioral Identification Form (BIF; Vallacher & Wegner, 1989). We reasoned that a high representation level in the task corresponds with the behavior of stopping the traversing square on a location because this represents the goal of the action (why the action is done), whereas a low representation level in this task corresponds with the action's execution of pressing the stop-key (how the action is done). Based on previous findings (Aarts et al., 2005) and the results of Experiment 1, we expected that priming the stop location augments experiences of self-agency for participants with a tendency to represent their behavior at a high level, thus in terms of stopping the square on a location in the task at hand.

5.1. Method

5.1.1. Participants and design

Sixty undergraduates participated, receiving course credits or a small fee in return. All participants were primed with high level outcome information (the stop location of a moving square) or not, and this factor thus constituted a within-participants variable. Additionally, participants' general disposition toward behavioral representation level was measured with the BIF (Vallacher & Wegner, 1989) and served as a between-participant factor.

5.1.2. Experimental task and procedure

Participants worked individually on the task. They learned that the study was designed to examine people's experiences of behavior and how these experiences come and go. For this purpose, participants would move a gray square rapidly traversing a rectangular path in a counter-clockwise direction by pressing and holding the S-key. This path consisted of eight white tiles. The computer independently moved another gray square along the path at the same speed, but in the opposite direction (clockwise). At a certain point in time, participants had to stop the movement immediately by pressing the

Enter-key (see also Aarts et al., 2005). This action turned one of the eight white tiles black, representing the location of either their square or the computer's at the time they pressed stop. Thus, the black square could be represented as the consequence of their action. Note, however, that the stop location was always determined by the computer and hence, actual control was absent. Cues for responding were displayed in the middle of the rectangular path. It was stressed that participants should keep focused on the screen during the task. After each stop, participants indicated how much they felt they had stopped the square at the presented position. This agency feeling was measured on a 10-point answer scale [*not at all me* (0) – *absolutely me* (9)]. The stopped location was presented twice on each of the 8 tiles of the path. The experimental task thus consisted of 16 trials. Trials were randomly presented.

5.1.3. Events in a trial

Each trial started with a warning signal. Next, the message "start" was presented until participants pressed the S-key. One second after they pressed (and held) the S-key, their and the computer's square started to move along the path in alternating motion (that is, the squares were displayed one after the other). Squares were displayed for 60 ms on each position. Thus, the speed of one lap was 960 ms [60 ms $\times$ 8 positions $\times$ 2 (participant's and computer's square)]. The number of laps in a trial that was completed before the message "stop" appeared could vary between 8 and 10, and was randomly determined by the computer. From the moment that the message "stop" appeared, only the eight empty white tiles were visible until the participant pressed "Enter". On that response, a black square was presented after 100 ms, for 1 s. The placement of this square was always 4 positions farther than the last position of the participant's square before the message "stop" had appeared. So, for example, the black square was presented in the right lower corner position after the participant's last square was presented in the left upper corner position; the black square was presented in the right middle position after the participant's last square was presented in the left middle position, etc. Thus, participants did not have actual control, as the position of the black square did not depend on their action.

5.1.4. Outcome-priming

In 8 trials, a black square was flashed on the position on which the square would stop, just before the message "stop" appeared on the screen. Thus, the primed location corresponded with the presented location of the black square. The location-prime (e.g., lower corner right) occurred 40 ms after the last presentation of the participant's square (e.g., upper corner left). Location-primes were presented for 34 ms, and were 46 ms later followed by the message "stop" (the total time for the priming event thus was 120 ms). In the no-high level outcome priming condition the position of the black square was not flashed (the position appeared in white for 34 ms). The priming event was employed for every possible location, resulting in 8 replications of the high level outcome priming condition and the no-high level outcome priming condition.

5.1.5. Measurement of behavior representation level (BIF)

A few days before the experimental task participants filled out a questionnaire as part of another unrelated study. This questionnaire included the Behavioral Identification Form (BIF; Vallacher & Wegner, 1989). The scale consists of 25-items (forced choice options), and each item of the BIF consists of an action followed by two alternatives or 'identities', one of which is lower and one of which is higher in level. For example, "the act of reading", followed by "(a) following lines of print" (lower level behavior representation) and "(b) gaining knowledge" (higher level behavior representation). For each action, participants had to choose the alternative that best describes the action they would carry out. All items were combined into an overall BIF-score. A higher score reflects a higher level of behavior representation.

5.1.6. Debriefing

As in earlier work (Aarts et al., 2005), debriefing showed that none of the participants had seen the position-primes. Furthermore, none of the participants realized the true nature of the study.

6. Results and discussion

The average ratings of experienced self-agency across the eight no-high level outcome priming trials and eight high level outcome priming trials were subjected to a General Linear Model with priming condition (no-prime vs. prime) as a within subjects variable and the BIF-score as a (between subjects) continuous variable. This analysis yielded a significant interaction effect of priming and BIF, $F(1, 58) = 3.98$, $p = .05$.

In order to examine this interaction in more detail and to test our specific hypothesis, we assessed the effect of priming on self-agency experiences for participants with a low BIF-score (one standard deviation below the mean) and for participants with a high BIF-score (one standard deviation above the mean) separately (see Aiken & West, 1991). These analyses revealed a substantial priming effect within the group of participants with a high BIF-score (i.e., high general tendency to represent their behavior in terms of why an action is done). Priming strongly augmented these participants' experiences of self-agency, $F(1, 58) = 19.80$, $p < .001$. Priming enhanced the experienced self-agency in participants with a low BIF-score (i.e., general tendency to represent their behavior in terms of how an action is done), but this effect did not reach the conventional level of significance, $F(1, 58) = 2.62$, $p = .11$. Fig. 2 displays the mean agency feelings as function of priming and BIF.

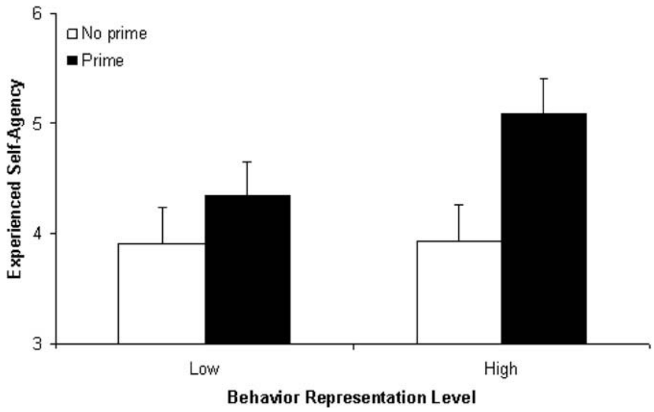

Fig. 2. Experienced self-agency as a function of priming (no prime vs. prime) for participants with a low behavior representation level (one standard deviation below the mean) and for participants with a high behavior representation level (one standard deviation above the mean), as measured by the Behavioral Identification Form (BIF; Vallacher and Wegner, 1989). Error bars represent standard errors of the means.

Consistent with findings of Experiment 1, we found that participants with a dispositional tendency to represent their behavior on a high level experienced increased self-agency as a function of priming the stop location. Participants with a dispositional tendency to represent their behavior on a low level did not show increased self-agency experiences as a function of priming the stop location. Thus, subliminally priming a high level outcome representation (i.e., the square's stop location) more strongly affected experienced self-agency of participants with high level behavior representations than of participants with low level behavior representations.

The results of the first two experiments show that the level of behavior representation is associated with participants' susceptibility to subliminal priming effects of high level behavior outcomes on experienced self-agency over behavior. Participants with a high level behavior representation were more strongly affected by high level outcome primes than participants holding a low level behavior representation. In our final experiment we wanted to take the evidence for our hypothesis one step further by determining the causal influence of behavior representation level on experienced self-agency as function of high level outcome priming. Therefore, we manipulated the level of behavior representation.

7. Experiment 3

The instructions and procedure in Experiment 3 were the same as in Experiment 2. However, here we manipulated, instead of measured, participants' behavior representation level. In the low level representation manipulation, participants were induced to represent their behavior in terms of producing a low level behavior outcome (moving the right finger to push the stop-key). In the high level representation manipulation, participants were induced to represent their behavior in terms of producing a high level behavior outcome (pushing the stop-key to stop the square on a position). Based on the findings of Experiments 1 and 2, we expected priming of the stopped position to enhance self-agency experiences, but mainly in the condition where participants represented their behavior in terms of the higher level outcome.

7.1. Method

7.1.1. Participants and design

Seventy-four undergraduates completed this experiment in return for course credit or a small payment. All participants were primed with high level outcome information (the stop location of a rotating square) or not, and this factor thus constituted a within-participants variable. Furthermore, half of the participants were induced with a low level representation, and half of them with a high level representation. Thus, behavior representation level was a between-participants variable. Participants were randomly assigned to the representation level conditions.

7.1.2. Experimental task and procedure

The task and procedure were similar to those of Experiment 2, with one major modification. In this experiment, half of the participants were induced to represent their behavior at a low level (in terms of how the action is done), whereas the other half were encouraged to represent their behavior at a high level (in terms of why the action is done). For this purpose, participants learned that they would receive a brief message on the computer screen before the start of each trial telling them what to do when the message "stop" appeared on the screen. Specifically, in the low level representation condition, the message cued them to move the right finger to press the key. Thus, the participants in this condition represented the task in terms of action execution upon the message stop. In the high level representation condition the message probed them to

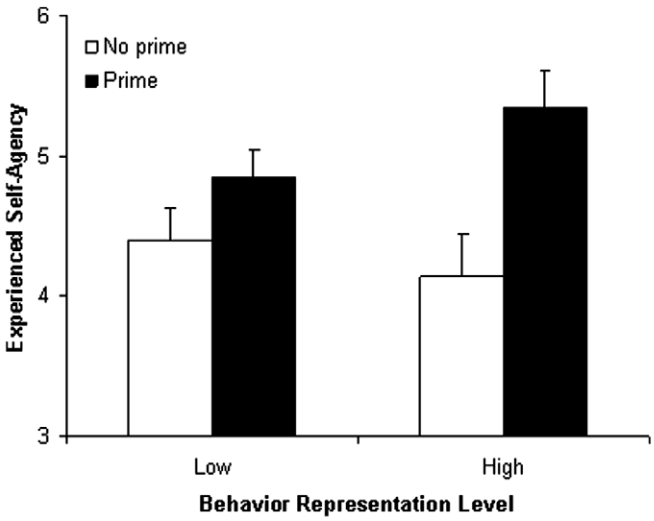

Fig. 3. Experienced self-agency as a function of priming (no prime vs. prime) and manipulated level of behavior representation (low vs. high). Error bars represent standard errors of the means.

determine the stopped position of the square when pressing the key. Accordingly, participants in this condition represented the task in terms of the higher level outcome of their action upon the stop message.

In both conditions the instruction appeared for 3 s at the beginning of a trial. Then, the trial proceeded as described in Experiment 2. That is, participants pressed (and held) the S-key upon the message "start", their and the computer's square started to move along the path in alternating motion, the STOP-cue appeared, and participants pressed the designated stop-key. Also similar to Experiment 2, after each stop participants indicated how much they felt they had stopped the square at the presented position (measured on a 10-point answer scale). Each of the 8 tiles of the path was selected twice as the stop location. The experimental task thus consisted of 16 trials and trials were randomly presented.

7.1.3. Debriefing

As in our previous experiments, debriefing showed that none of the participants had seen the position-primes, even though they all indicated to have focused on the screen during the task. Furthermore, none of the participants realized the true nature of the study.

8. Results and discussion

Average experienced self-agency was computed for the no-prime trials and the prime trials, and subjected to a 2 (priming: no-prime vs. prime) within-participants × 2 (behavior representation level: low vs. high) between-participants ANOVA. This analysis revealed the expected significant interaction effect between priming and behavior representation level, $F(1, 72) = 4.85$, $p = .03$.

To gain further insight in the two-way interaction effect and to test our specific prediction, we conducted planned comparison tests. These tests showed that in the high level representation condition, the prime led to higher agency ratings than the no-prime condition, $F(1, 72) = 22.84$, $p < .001$. However, this priming effect was much weaker and only marginally significant in the low level representation condition, $F(1, 72) = 3.75$, $p = .06$. The mean self-agency scores across conditions are presented in Fig. 3.

Replicating the results of Experiment 1 and 2, the results of Experiment 3 showed that subliminally priming high level outcome representations before the execution of an action enhances experiences of self-agency when behavior is represented at a high, compared to a low level. Additionally, these results indicate that the experience of self-agency is affected not only by general dispositions toward behavior representation levels, but is also susceptible to contextual cues that induce different levels of behavior representation.

9. General discussion

The present study examined whether the level at which a behavior is represented affects the experience of self-agency over the behavior. Together, three experiments showed the crucial role of behavior representation level in priming effects on the experience of self-agency as a function of both context and individual differences. Specifically, in the first experiment we manipulated participants' experience of self-agency by priming high level outcome information in a task where self-causation was ambiguous and we measured individual differences in the extent to which behavior was represented in terms of a goal outcome accomplished by the action in the task at hand. In the second experiment we measured participants' general tendencies to represent their behavior at a high or a low level. Finally, in the third experiment we *manipulated* participants' behavior representation level. Results showed that priming high level outcome representations enhanced experiences of self-agency when participants represented their behavior at a high level (i.e., in terms of why the action is done; e.g., stopping the square on a specific location) rather than a lower level (i.e., in terms of how the action is done; e.g., pushing a button). Thus, a match between primed outcomes and actual behavioral outcomes is not sufficient to affect experiences of self-agency. Primed outcomes should also correspond with the level at which the observer represents his or her behavior in terms of the outcomes.

Consistent with previous research examining priming effects on self-agency experiences we showed that experiences of self-agency can emerge even in the absence of a conscious intention to act. That is, experiences of self-agency emerge when nonconsciously activated behavior outcome representations match the observed behavior. This enables people to experience a sense of self-agency not only over behavior resulting from conscious intention (e.g., Haggard, 2005), but also over behavior that, in fact, is influenced by cues in our environment outside our conscious awareness (Aarts et al., 2009; Wegner, 2002). Whereas the finding that nonconscious activation of behavior representations increases experiences of self-agency is intriguing and important, the exact mechanism underlying these priming effects requires further examination. Based on the idea that overt behavior and resulting experiences of self-agency originate from the activation of relevant behavior representations the mechanism may unfold in two different ways. One possibility is that priming and conscious intentions enhance self-agency in a similar way by the mere activation of the same behavior representation, thereby rendering the conscious intentional source of self-agency more or less a by-product (Aarts et al., 2005). Another possibility is that priming of behavior representations causes people to consciously form intentions to produce the primed behavior, and thus self-agency results from intentional processes. Whereas both mechanisms may account for our daily experiences of self-agency, it would be interesting to sort out when one of these two different mechanisms is more likely to operate.

The present research discerns previous findings showing priming effects on self-agency experiences by demonstrating that people do not always experience enhanced self-agency when accessible outcome representations match the actual behavior outcome. Importantly, accessible behavior representations should also correspond with the level at which behavior is represented (cf. Pacherie, 2008). This implies that people's sense of self-agency is not influenced by the sheer priming of information that renders the representation of an outcome active when they do not represent their behavior in terms of producing that outcome.

Interestingly, our research on the effects of outcome priming on self-agency experiences as a function of the level of behavior representation does not only increase our understanding of when people experience self-agency in the absence of a prior intention to act. It also contributes to the question of why sometimes people do not experience self-agency over a behavioral outcome in the presence of a prior intention to obtain that outcome. Indeed, recent research shows there can be situations in which people do not experience self-agency despite the presence of an intention to act (e.g., Frith, 2005; Wegner, 2002). Even though one has an intention to produce a particular outcome, one may lose track of this intention along the way. This can occur if one does not maintain a high level behavior representation in mind while monitoring the action at a lower level (see also Pacherie, 2008), for example when a task is relatively difficult. In that case, people will re-identify their behavior at a lower level to remind oneself of how the action is done (Vallacher & Wegner, 1987). As a consequence, they may no longer experience self-agency over the high level outcomes of their own behavior.

In addition to the fact that context (such as task difficulty) can influence the level at which behavior is represented, there also seem to be individual differences in behavior representation level that can affect our experiences of self-agency. Here, we used the BIF measure to assess such individual differences, and this measure has been shown to correlate with self-understanding and action effectiveness (Vallacher & Wegner, 1989). That is, the more people are generally inclined to represent their behavior at a high level, the more they think of their behavior as indicative of their personality, being planned instead of impulsive, and the more effective they are in the execution of actions. This suggests that people who represent their behavior at a high level may be more successful in monitoring their goals, keeping a representation of their goals active. As a consequence, they may more often experience a sense of self-agency over their intentional behavior when attaining their goals than people who represent their behavior at a lower level. As the present findings suggest, however, people who generally represent their behavior at a high level may also be more prone to experience enhanced self-agency when the high level outcome (the goal that their action may serve) is primed outside of awareness just before action execution and outcome observation. Consequently, representing behavior at a higher level may more easily lead to illusory perceptions of self-causation and control.

The observation that behavior representation levels play a crucial role in the establishment of self-agency experiences may have important implications for our understanding and examination of the role of action–outcome contingency in the perception of control and self-causation. First, a growing literature shows that people's sense of control (a crucial contributor to one's sense of agency over actions; Pacherie, 2008) increases as a function of contingency between actions and outcomes (Alloy & Abramson, 1979; Gollwitzer & Kinney, 1989; Jenkins & Ward, 1965; Shanks & Dickinson, 1991). That is, the higher the probability that outcome *B* results from action *A* (i.e., high action–outcome contingency), the more we will feel to have caused outcome *B* after executing action *A*. Also, when an action is consistently followed by a high level outcome, people are more inclined to plan and represent their behavior in terms of that outcome (e.g., Aarts & Custers, 2009; Nattkemper & Ziessler, 2004; Prinz, 1997; Vallacher & Wegner, 1987). Thus, behavior representation levels could play a role in contingency effects on self-agency, because people may be more likely to represent behavior in terms of its higher level outcome when the behavior produces the outcome with higher probability. In other words, differences in contingency between actions and high level outcomes induce different levels of behavior representation.

Other research examining contingency effects on self-agency experiences proposes that the representation of behavior in terms of outcomes leads to the perception that action and outcome occur closer together in time (Engbert & Wohlschläger, 2007; Haggard, Clark, & Kalogeras, 2002). This temporal binding effect as a result of intentional action is associated with increased experiences of self-agency (Engbert, Wohlschläger, & Haggard, 2008) and has been shown to increase as a function of higher action–outcome contingencies (Moore & Haggard, 2008; Moore, Lagnado, Deal, & Haggard, 2009). This finding offers suggestive evidence that action–outcome contingency influences both the level of behavior representation and the extent of experienced self-agency. Building on the assumption that people represent their behavior in terms of high level outcomes when these outcomes follow their actions with higher probability, priming high level outcome representations should augment experiences of self-agency in a context where contingency between actions and high level outcomes is high.

Indeed, research examining the role of outcome predictability in priming effects on self-agency experiences supports this hypothesis (Sato, 2009; Experiment 3). In this experiment, participants had to press a left or right key in the service of producing two different (high level) outcomes (a blue or red circle presented on the computer screen). The outcomes could also be produced by the computer, rendering the cause of the outcomes ambiguous. To examine priming effects on self-agency experiences, the high level outcomes (the colors) were, or were not, subliminally primed. The role of high level outcome predictability was also investigated. Each of the two responses was followed by one particular color in 50% (low predictability) or 75% (high predictability) of trials. Results showed a substantial effect of high level outcome priming on experienced self-agency when predictability was high (75%) and no priming effect when predictability was low (50%). Assuming that people are more likely to represent their behavior in terms of high level outcomes when predictability is high rather than low, these findings support our hypothesis that the level of behavior representation moderates high level outcome priming effects on self-agency experiences. Importantly, whereas both statistical contingencies and levels of behavior representation can underlie the experience of self-agency, future research could examine when the predictive or the representational aspect of behavior contributes to the establishment of self-agency, and whether their contribution may differ as function of conscious (intentional) and nonconscious priming of outcome information.

It is important to note that the present experiments used paradigms designed to prime high level outcomes and to measure self-agency experiences over high level behavior outcomes. We therefore provided a partial test of the moderating role of the level of behavior representation in priming effects on self-agency. Yet, we do not know whether priming low level outcome information also enhances self-agency experiences, in particular when behavior is represented at a low level and the cause of one's own action is unclear. For example, when representing behavior in terms of how an action is done rather than why the action is performed, priming representations with respect to sensorimotor feedback before actual movement may increase experienced self-agency over action execution. This enhanced self-agency over action execution perhaps in turn also enhances self-agency experiences over producing high level behavior outcomes. Future research needs to address this issue.

To conclude, the present results replicate and extend recent research on the emergence of self-agency experiences in the absence of a prior intention to act (Aarts, 2007; Aarts et al., 2005; Sato, 2009; Wegner & Wheatley, 1999). Building on earlier work we presented novel findings for the crucial role of behavior representation levels in subliminal priming effects of high level outcome representations on the experience of self-agency as a function of both context and individual differences. In doing so, we hope that the present research may offer new directions in the study of self-agency to further our understanding why we believe that we can and do have an influence on our own behavior and, as such, feel responsibility for what we do.

Acknowledgment

The work in this paper was supported by VICI-Grant 453-06-002 from the Dutch Organization for Scientific Research.

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