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Abstract

Simple, self-posed questions may modulate behavioral repetition of choices in situations that are neither fully habitual nor fully intentional. In six experiments, participants were trained to repeatedly choose their preferred door out of an array of three doors. Questions generally increased speed in the upcoming task, supporting past findings that even exposure to question-like syntax can enhance performance. More importantly, affirmatively phrased questions like *Which one should I choose?*, framed either as an instruction to make the choice or as material unrelated to the study, produced more choice repetition than presenting either no question at all or a control question. In contrast, negatively phrased questions like *Which one should I not choose?* decreased behavior repetition. These effects allowed efficient and fast responding and thus showed features of automaticity. These findings imply that self-talk questions can affect choices in various domains of interest to social, clinical, educational, and health psychology.

Keywords: self-talk; inner speech; decision making; social cognition; motivation

The Modulating Role of Self-Posed Questions in Repeated Choice:
Integral and Incidental Questions Can Increase or Decrease Behavioral Rigidity

How often do you go grocery shopping? A significant portion of the choices we make are choices we have made before. Whether we are choosing which products or which brands to buy at the supermarket, placing our order at a coffee shop, selecting a mode of transport to get us to our destination, or choosing which shoes to wear, many choices are recurring. In fact, studies estimate that between 30 and 50% of our daily behavior is *repeated behavior.* For example, the average household spends 48% of their annual expenditures within a given product category (e.g., breakfast cereal) on just a single product, implying consistent choices of brand, flavor, and size over a one-year period (Hansen & Singh, 2015; Wood, Quinn, & Kashy, 2002). Such repeated behavior is often referred to as *habitual*, but a closer examination suggests that many assumed to be habitual situations still involve an element of conscious choice. For instance, while standing in the aisle of the supermarket, you might briefly ask yourself a question such as "What should I buy?", even when you know what you chose during the last three shopping excursions. Rather than automatically reaching for the same products without conscious awareness, the repeated choice may emerge from the *internal conversations* you hold with yourself – still leading you to choose the same products, but mediated through a more conscious, verbal mechanism. The aim of this paper was to examine these verbal conversations as a theoretical mechanism that can drives behavior for repeated choices.

Many of the behaviors we repeat are neither habits nor fully intentional actions, but rather a mix of efficiency and conscious verbal processes. These verbal processes may entail both explicit goals to repeat prior behavior and subtle inner conversations in response to *internal verbal prompts.* If these internal prompts occur again and again, they themselves are likely to

become repetitive and thus drive behavior repetition across similar situations. For example, the question “What should I buy?” might come up every time I pass the supermarket aisle. In turn, the same question may prompt me to give similar answers every time, leading me to choose the same product even when the context itself does not (yet) have enough power to lead to rigid behavior repetition.

Prior research has shown that when choices are influenced by language, questions appear to play a particularly important role. Instead of telling yourself “I will do this task”, you may ask yourself “Will I do this task?”. Formulating this query as a question instead of a statement has been associated with a higher likelihood of enacting the behavior (Godin, Bélanger-Gravel, Vézina-Im, Amireault, & Bilodeau, 2012). In addition, when the behavior is enacted, questions (vs. statements) have been associated with increased performance, both in self-talk and in externally presented messages (Müller et al., 2016; Senay, Albarracín, & Noguchi, 2010; Suri, Sheppes, Leslie, & Gross, 2014). Drawing on this literature, self-directed questions are likely to play a more critical role in choice repetition than are self-directed statements.

In particular, self-talk questions about one’s preferences is likely to facilitate or disrupt behavior repetition, depending on which questions are asked. This mechanism should lead people to make efficient decisions, meaning that they can select their responses quickly and without needing many cognitive resources (Bargh, 1994; Moors, 2016).Therefore, far from contesting automaticity in behavior repetition (Bargh, 1994; Moors & De Houwer, 2006; Shiffrin & Schneider, 1977; Wood & Neal, 2007), we assumed that in situations like selecting a product or placing a coffee order involve a choice that may often be prompted by others posing the question *What would you like?*, or by querying oneself with a similar question. Therefore, the question may later become a self-cue to the behavioral choice, with the same question leading to

the same behavior (Experiments 1-3 test this basic effect of self-talk questions across different stimuli, questions, and instructions). Once people have generated an answer to a self-posed question, the question may continue to function efficiently: Supplying a practiced answer to a familiar question likely does not require many attentional resources (Experiment 5 tests this hypothesis by examining the effects of cognitive load to assess response efficiency.) Therefore, in situations that are not stable or frequent enough to produce habits or in which people retain cognitive control for some other reason, recurring questions may be the stable element that enables repeated behavior. Experiment 6 then provides additional data to further test our proposed model of default modulation.

Proposed Model

This default perspective suggests that a default option exists, which represents the most accessible response and is then used to answer self-talk questions. These questions then modulate the default response. This perspective is informed by the situated inference model (Loersch & Payne, 2011), in which a given situation is assumed to afford a certain question that is then answered using accessible information. For example, meeting a new person could afford the question *What kind of person is this?* If a previous prime has made the concept of kindness accessible, the answer to the question is likely to be *kind*. In our analysis, previously repeated behavior can similarly serve as accessible information in answering self-posed questions. In that case, asking a question such as *Which one should I choose?* would most likely be answered by the previously chosen option, leading to the same choice again and again. In this way, such an affirmatively phrased question may lead to increased choice repetition. We propose that when self-talk is used in decision-making, repeated choices are produced by a combination of two processes: First, a pattern of previous choices will have created a default tendency to choose the

same option that was often chosen before. Second, the self-talk question is processed semantically and then modulates the default tendency. Depending on the content of the question, the semantic meaning may either reinforce or oppose the default. Although this process involves verbally mediated thinking, it may show features of automaticity.

To illustrate, assume that among a set of dessert choices, brownies are the default response for a particular person. At the most general level, when a question is posed, this default option (e.g., brownies) is "plugged in" as an answer because it is the most accessible option. When a negatively phrased question is combined with the default option, for example, "Which one should I not choose? - Brownies", the semantic meaning suggests avoiding brownies. The default response would be to repeat previous choices by choosing brownies again, but the question-implied response opposes this tendency and the resulting response conflict prevents the choice from being made more rapidly. When, instead, the default option is combined with an affirmative question, for example, "Which one should I choose? – Brownies", the semantic meaning suggests choosing the brownies. In that case, the default response and the question-implied response reinforce each other and the choice becomes more efficient (i.e., faster). In addition to this increased efficiency, the affirmative question may have an effect on the probability of choosing the trained option (e.g., brownies), depending on how strong the default tendency is: If there is already a strong default to choose brownies, the effect of the affirmative question will not have much additional impact beyond the default but will nonetheless increase efficiency. If, however, the default tendency is only of medium strength, the affirmative question should increase both efficiency and choice repetition.

Crucially, this default modulation perspective assumes that the questions affect the default response option in particular. If the dessert menu lists brownies (the previously chosen

default option) and cupcakes as options, then our model implies that self-posed questions are answered with “Brownies”, not with “Cupcakes”. As a result, the questions should influence the response pattern (i.e., efficiency and likelihood of choice) for brownies, but not necessarily the response pattern for cupcakes. In the common scenario where people have to choose one among several options, this distinction does not matter and cannot be tested, because a higher likelihood of choosing brownies necessarily corresponds to a lower likelihood of choosing cupcakes. Experiment 6 instead examines the scenario where a single option is either chosen or not chosen without contrast effects of alternative options, which allows us to test whether the questions affect only default responses (e.g., brownies) or also non-default responses (e.g., cupcakes).

Present Research

In six experiments, participants first practiced choosing one of several options, and then were given the opportunity to either repeat these practiced choices or change them when faced with different first-person questions. If affirmatively phrased questions can indeed drive behavior repetition, presenting a question like *Which one should I choose?* could facilitate the performance of repeated behaviors, as evidenced by professional musicians and athletes who report using verbal self-instructions to improve their performance of even highly learned behaviors (Geeves, McIlwain, Sutton, & Christensen, 2014; Jenkins, 2007; Toner & Moran, 2014). If a response tendency has been established via repetition, the prior choice is the most likely answer to *Which one should I choose?* In contrast, a negatively phrased question like *Which one should I not choose?* might lead people to consider other options and disrupt choice repetition, similar to how self-talk can be used strategically to break existing habits (e.g., by thinking *don’t do it*; as observed in Quinn, Pascoe, Wood, & Neal, 2010). In our experiments, we examined if and how these different questions modulated the performance of repeated responses

(Experiments 1-2). We tested how these effects replicate across different stimuli, different questions, and different instructions (Experiment 3), and whether the self-talk needs to be phrased as a question or if simple statements work just as well (Experiment 4). If responses to self-talk questions truly exhibit some features of automaticity, the effects of the questions should be efficient and observable even under reduced cognitive load (Experiment 5). Finally, we tested crucial parts of our proposed model by showing that the questions indeed selectively affect only stimuli that have been often chosen in the past, and by examining how questions combine with accessible preferred choices in more detail and excluded increased confidence as an alternative explanatory mechanism(Experiment 6). In sum, we analyzed self-talk as a potential mechanism that drives behavior repetition in situations that are located between the extreme endpoints of the habit-intentionality spectrum (e.g., Lally, van Jaarsveld, Potts, & Wardle, 2010) where response tendencies exist but are not environmentally controlled.

Experiment 1: Effects of Self-Posed Questions

The goal of this study was to provide evidence for the effect of externally cued questions on repeated choice. We chose a one-factor within-subjects design and compared an affirmative question, which was assumed to be naturally self-posed in a choice situation, with a corresponding negative question, and with a no-question condition.

Method

Forty-three participants were recruited from the paid community participant pool of a large private university and received $5 in compensation. This study was approved by the university's institutional review board. In the absence of prior knowledge about which magnitude of effect sizes to expect, we had aimed to collect about fifty participants. A simulation-based observed power analysis (based on 1000 simulations and using the *simr* R

package; Green & Macleod, 2016) estimated 100% power, 95% CI [99.63, 100.00], to detect the effect of question in our analyses, suggesting that this sample size is appropriate for this design. In the remaining studies, we aimed for comparable or higher sample sizes per cell.

The sample included 27 women (63%) and 16 men (37%) and participants were between 18 and 65 years old, $M = 25.49$, $SD = 11.44$. Participants reported their ethnicity/race as follows: 33% Caucasian, 30% Asian, 26% African American, 9% Hispanic/Latino, and 2% selected *Other*. Most participants (86%) reported that English was their first language. We further asked participants how long they had studied English (if it was not their native language), if any problems might have affected participation quality and whether they had ever participated in a similar experiment. To reduce the effect of trials in which participants did not consider their response at all, considered it in too much detail, or took too long because they were momentarily not paying attention, trials with reaction times under 200 ms or over 3500 ms were excluded (7% of all trials). In all experiments, results did not change when all trials were included.

We developed a four-step choice task to train repeated choices (see Figure 1): First, participants saw pictures of three identical doors labeled ‘left’, ‘center’, and ‘right’. Pressing the ‘l’, ‘c’, or ‘r’ keys selected the corresponding door, revealing the picture of an animal. Four sets of doors were distinguished by background color (blue, orange, purple, yellow), resulting in a total of 12 animal pictures. In the first phase, participants saw each set of doors 10 times in random order with the task of learning the locations of the pictures. For example, for the doors with the orange background, there was a picture of a dog behind the left door, a picture of a cat in the middle, and a picture of a hamster on the right. These pictures were shown for 2000 ms after the corresponding door was selected.

In the second phase, participants were asked to "indicate which of the three animals you like best by pressing the appropriate key" once for each set of doors (4 trials). For example, someone might select the orange door with the hamster picture behind the right door. In the third step (training phase), for each set of doors, participants were instructed to choose the location of their favorite picture over and over again. For example, whenever they saw the orange set of doors, the study would not continue until they had chosen the right-hand door leading to the hamster. Each set of doors appeared 30 times, resulting in 120 trials. In the fourth step (test phase), participants read that they were now free to choose any picture they wanted. Another screen appeared for 2000 ms before each set of doors: (a) a blank screen that served as a no-question baseline, (b) the affirmative question "Which one should I choose?", or (c) the negative question "Which one should I not choose?" (within-subjects). Participants were asked to incorporate the questions in their decision making: "If you see a question, please ask it to yourself to make your choice. It is of the **utmost** importance that you read these questions as if talking to yourself as they appear." These instructions were designed to make participants pay attention and to ensure that they would parallel the experience of self-talk. Each combination of question type and set of doors was presented 10 times, resulting in 120 trials appearing in random order.

Finally, participants answered demographic questions (see sample description). The experiment was programmed in MediaLab and DirectRT (Jarvis, 2010a, 2010b). We recorded how often participants continued to choose their favorite pictures in the test phase to obtain the proportion of repeated choices for each condition and how quickly they responded (measured from the door onset). For all studies in this manuscript, we report all data exclusions, all manipulations, and all measures (Simmons, Nelson, & Simonsohn, 2012). Data collection for

each study was complete prior to data analysis. Means, standard deviations, and correlation matrices for all experiments can be found in Table S1 in the Supplemental Materials.

Results

Response times. The training phase was successful in establishing high learning across participants: On average, participants' responses were $M = 2935$ ms ($SD = 2294.05$) faster in the last 10 versus the first 10 trials of the training phase. For the test phase constituting our primary focus, both questions were compared with the no-question condition using a multi-level regression of log-transformed reaction times (with random intercepts for participants) and contrasts (in this and all future analyses, contrasts were adjusted for multiple testing through single-step adjustment based on the joint normal distribution; Hothorn, Bretz, & Westfall, 2008). Both contrasts were significant ($L = -0.13$, 95% CI [-.0.16, -0.09] for affirmative vs. none, $L = -0.09$, 95% CI [-0.12, -0.05] for negative vs. none). Introducing questions thus sped up responses regardless of what question was asked (Table 1), which is consistent with the findings of Senay and colleagues (2010).

Repeated Action. Our main hypothesis concerned choice repetition as a function of question. The proportion of repeated action in the no-question condition was 49% (see Table 2), which is above the chance mark of 33% but well below 100%, thus suggesting a response tendency that is pronounced enough to guide choice but still flexible. A multi-level logit regression with repeated choice (0: other picture than the previously chosen favorite, 1: favorite picture) as the outcome and random intercepts for participants showed a main effect of question, $\chi^2(2) = 684.65$, $p < .001$. The model coefficients (corrected for multiple testing as for the RT analyses) showed participants repeated their choices more under the affirmative question "Which one should I choose?" than under the no-question baseline, $OR = 1.72$, 95% CI [1.46, 2.03], $p <$

.001, see Table 2[1]. We calculated the difference between how often each participant repeated their actions in the affirmative versus the no-question condition and found that 79% of participants showed this predicted pattern (difference greater than 0). In contrast, the negative question "Which one should I not choose?" was associated with lower levels of repeating the practiced choice than the baseline, $OR = 0.23$, 95% CI [0.19, 0.28], $p < .001$. Analyzing the difference score between the negative versus no-question conditions, we found that all but four participants showed this effect (91%).

Discussion

The results indicated that different questions can influence the degree of continuity in repeated action: Reading the affirmative question "Which one should I choose?" made participants more likely to repeat their past choices. This finding is in line with the hypothesis that when repetition is not absolute, the question facilitates choice repetition compared to the absence of any question. As expected, the negative question "Which one should I not choose?" disrupted the repetition of previous choices to below-chance levels. Additionally, both questions sped up responses compared to the baseline. This experiment compared just two questions and thus allowed only limited conclusions about what kinds of questions influence choices. Experiment 2 addressed this issue.[2]

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[1] Throughout all studies reported in this paper, the effects remain the same (OR +– 0.01) or become slightly stronger when including only native speakers of English. The only exception is Experiment 1, where the effect of the affirmative question was slightly weaker but still substantial in the native speaker sample, $OR = 1.59$ instead of $OR = 1.72$.

[2] We conducted two further studies based on Experiment 1 testing different additional manipulations ($N = 44$ and $N = 50$). Both studies replicate the results of the experiments reported in the main text.

Experiment 2: Replication and Irrelevant Questions as a Control Condition

Method

In Experiment 2, we wanted to replicate the effect obtained in Experiment 1 and rule out that irrelevant questions would not have similar effects on choice. The irrelevant question was similar to the other questions in modality (verbal) and visually (sentence on a screen) but different in content, allowing us to rule out the possibility that any verbal content would influence choices or that the questions merely looked more interesting than the blank baseline slide. This study had a one-factor within-subjects design (no question, affirmative question, negative question, irrelevant question) and was based on the same experimental procedure as Experiment 1. The newly introduced irrelevant question was "What should I have for dinner?". We recruited 55 participants from the paid community participant pool of a large private university who participated in exchange for $5. We excluded 8 participants because they indicated having participated in one of the previous studies, leaving $N = 47$ (including the excluded participants did not change the pattern of results). This study was approved by the university's institutional review board. Twenty-nine participants were female (62%) and 18 male (38%); 40% were Asian, 23% Caucasian, 21% African American, 11% Hispanic/Latino, and 4% selected *Other*. Participants' ages ranged from 18 to 49 ($M = 22.66$, $SD = 5.39$). Seventy-nine percent of participants said English was their first language. Trials with reaction times below 200 ms or above 3500 ms were excluded (7% of all trials).

To ensure that all participants gained a small degree of automaticity in responding, we increased the number of trials in the training phase from 30 to 50 trials per set of doors and included a short breather break in the middle. To keep the sessions short nonetheless, we used only three sets of doors instead of four. Further, we added a fixation prompt after each question

to ensure that our previous results could not just be explained by the questions drawing more visual attention to the doors than the blank screen in the no-question condition. Otherwise, the design was identical to Experiment 1.

Results

Response Times. A first observation is that average response times in Experiment 2 were faster than in Experiment 1 (M_1 = 1383.51, M_2 = 1038.88, t(81.34) = 4.60, $p < .001$). This result is consistent with the greater amount of practice provided to participants by introducing more training trials.

As in Experiment 1, response times were analyzed to verify that questions can increase attention to the situation irrespective of the type of question. The affirmative (L = -0.08 95% CI [-0.12, -0.05]) and irrelevant (L = -0.07 95% CI [-0.11, -0.03]) question conditions led to faster response times than the no question condition, even though both conditions included a fixation point designed to increase attentional focus. The negative question did not differ from the no question condition (L = -0.01 95% CI [-0.04, 0.03]), suggesting that perhaps the fixation point decreased the attention-drawing effect of the question manipulation.

Repeated Choice. Even though questions generally sped up performance, actual choice depended on the meaning of the question, main effect of question $\chi^2(3) = 484.94$, $p < .001$. Our previous findings were replicated: People repeated their choices more often under the affirmative question than under the no-question baseline, OR = 1.64, 95% CI [1.33, 2.03], $p < .001$, and 62% of individual participants showed this effect. Under the negative question, people repeated their choices less often than under the no-question baseline, OR = 0.25, 95% CI [0.20, 0.31], $p < .001$, and 72% of individual participants showed this effect. The irrelevant question was also associated with below-baseline but above-chance levels of repeated action, OR = 0.62, 95% CI

[0.50, 0.77], $p < .001$ (68% of participants showed the effect), but this effect was comparatively small and not nearly as pronounced as that of the negative question – the irrelevant and negative questions were statistically different, $OR = 2.48$, 95% CI [1.99, 3.10], $p < .001$.

Discussion

As in Experiment 1, the affirmative question was associated with more and the negative question with less repeated action than the absence of a question. Responses to the irrelevant question did not mimic the responses to either affirmative or negative question, suggesting that the questions need to be thematically related to the choice to have the identified effects. Verbally or visually similar material that is different in content does not affect choice repetition in the same way. Nevertheless, the irrelevant question also partially interrupted repeated action. It is unlikely, however, that this interruption occurred merely because the question confused participants. Such confusion would have been apparent in a corresponding increase in response time, but instead, the irrelevant question was associated with faster responses).

Experiments 1 and 2 provided evidence about the effects of integral questions because participants were asked to use the questions as a basis for their responses. Of course, *Which one should I choose*? is far from being a direct instruction, because participants can make their own decision in response to what is clearly a nondirectional question. However, it seemed desirable to replicate our findings about the roles of questions when participants are not asked to use the question as a basis for their response. In Experiment 3, we explained that questions were unrelated to the study and were not to be used as directions and replicated the prior experiments using different stimuli, different questions, and more subtle instructions.

Experiment 3: Variations in Stimuli, Questions, and Instructions

Method

First, we changed the animal pictures to pictures of desserts. Choosing between dessert options is a situation that is more applicable to participants' everyday lives than choosing between different animals. Second, our hypotheses referred to self-talk about preferences, but the previous questions included the word "should" and may also have carried connotations of obligation or experimenter demand. We therefore changed the questions to "Which one do I [not] like?" to see whether the same effects would occur. The irrelevant question was replaced with "What will I do tomorrow?" Finally, in the previous studies we chose a strong manipulation that involved directly instructing participants to incorporate the questions in their decision-making process. Of course, *Which one should I choose*? is far from being a direct instruction, because participants can make their own decision in response to what is clearly a nondirectional question. After we had established that this procedure worked, however, it seemed desirable to replicate our findings about the roles of questions using a subtler approach: We wanted to test if the effects we observed in the first two studies were truly effects of simply reading the questions, and not just of being instructed to say them to oneself or of task demand effects. In Experiment 3, we thus explained that questions were unrelated to the study and were not to be used as directions.

> Please use these questions as a fixation point (i.e., look at them). Typically, researchers just use an "x" as a fixation point, but we want to test a theory saying that different stimuli may improve attention. We vary the formats and trials to sample different conditions under which learning occurs. The questions are taken from another study and

are not related to your task in this study. (...) Remember, the questions are just there to focus your visual attention, they are not directions.

To make the task clearer for participants, in this and all future studies the key assignment was changed from *l*, *c*, and *r* for left, center, and right doors to *1*, *2*, and *3* to reflect the order of the doors on the keyboard. In addition, this study did not include a fixation cross. Further, we added items to the study: Participants were asked to indicate their second-favorite pictures in addition to their favorites, and at the end of the study they were asked to recall which favorites they had chosen previously. On average, participants correctly remembered $M = 3.65$ out of their 4 favorites, $SD = 0.86$, and 82% of participants correctly remembered all four of their favorite pictures. At the end, they were also asked whether their favorites had changed throughout the study. Of all participants, 53% chose at least one favorite picture that was different from what they had chosen before; on average, participants changed their preferences for $M = 1.28$ out of 4 pictures, $SD = 1.50$. We also added a series of questions to assess subjective perceptions of the response process (see Supplement for a full list).

Finally, to speed up the experiment and reduce participant reports of boredom, the chosen picture was shown for only 1000 ms instead of 2000 ms. A suspicion check and items on how difficult and confusing the study was and the language that participants usually rely on for self-talk were added, and we included all four sets of doors again. The no-question condition was no longer a blank slide, but instead included a fixation circle to focus participants' visual attention and to corroborate the cover story that we were presenting the questions to test the effects of different fixation prompts. Trials with reaction times below 200 ms or above 3500 ms were excluded (10% of all trials). This study was preregistered on Open Science Framework (osf.io/tsm6g).

Participants were recruited from the psychology subject pool of a large public research university. Seven participants were excluded for missing data from at least one full block of the experiment, and the final sample size was $N = 60$. On average, participants were $M = 18.80$ years old, $SD = 1.13$. Nineteen participants (32%) were male; 53% were Asian, 35% were White, 3% Latino, Latina, or Hispanic, 3% Middle Eastern, North African, or Arab American, and 5% indicated being another race. The majority of participants (52%) reported being native speakers of English.

Results

Response times. Overall, participants responded faster than in previous studies, perhaps because students working for course credit were less motivated to respond carefully than community participants who were paid for their participation. Another possibility is that the new response mapping on the '1', '2', and '3' keys was more intuitive than the previous one, allowing participants to respond faster. We again found that reaction times differed across questions, $\chi^2(3) = 12.82$, $p = .006$. The irrelevant question condition led to faster response times than the no question condition, $L = -0.06$ 95% CI [-0.09, -0.02]. Based on previous studies, we expected the affirmative and negative questions to also speed up responding, but they did not quite differ from the no-question condition, affirmative question $L = -0.04$ 95% CI [-0.07, 0.00], and negative question $L = -0.03$ 95% CI [-0.64, 0.01].

Repeated action. Questions again influenced choice, $\chi^2(3) = 255.66$, $p < .001$, and our previous findings were replicated. We expected the affirmative question to lead to more repeated choice, and indeed people repeated their choices more often under the affirmative question than under the no-question baseline, $OR = 1.27$, 95% CI [1.09, 1.48], $p < .001$, and 53% of individual participants showed this effect. Also as expected, under the negative question, people repeated

their choices less often than under the no-question baseline, *OR* = 0.47, 95% CI [0.40, 0.56], $p < .001$, and 68% of individual participants showed this effect. As in the previous study, the irrelevant question fell in between the negative question and the no-question condition. The irrelevant question was also associated with below-baseline but above-chance levels of repeated action, *OR* = 0.69, 95% CI [0.59, 0.81], $p < .001$, but this effect was comparatively small and not nearly as pronounced as that of the negative question: The irrelevant and negative questions were statistically different, *OR* = 1.46, 95% CI [1.23, 1.72], $p < .001$.

As a moderator analysis, we further tested whether the effects of questions were larger for individuals who reported usually self-talking in English (either exclusively English, or English and another language about equally often; $n = 49$) than for those who reported usually self-talking in a different language ($n = 11$). Comparing the effect sizes for all three questions (adjusting for multiple testing), this difference reached significance only for the irrelevant question, *OR* of the difference = 1.49, $p = .049$: For participants with English self-talk, the irrelevant question reduced repeated choice, *OR* = 0.74, but this effect was stronger for those without English self-talk, *OR* = 0.40. We also tested differences between participants who correctly remembered all 4 favorites they had previously chosen ($n = 49$) and those who misremembered at least one ($n = 11$). The effects of the irrelevant and negative questions did not differ by group, but the effect of the affirmative question was stronger for participants with better memory performance: The effect of the affirmative question was significant in the good memory group, *OR* = 1.45, 95% CI [1.20, 2.75], but not in the bad memory group, *OR* = 0.75, 95% [0.51, 1.08], *OR* of the difference = 1.94, $p < .001$. Finally, we analyzed preference change as a continuous predictor ranging from 0 (complete stability) to 4 (all favorites changed). There was a main effect of preference change such that more change was associated with less repetition of

previous favorites, $\chi 2(1) = 5.51$, $p = .019$. This finding was qualified by an interaction with question type, $\chi 2(3) = 271.01$, $p < .001$ such that the effects of all questions were weaker the more preferences changed. Clearly, the questions did not operate merely through modifying preferences. Rather, the effects of the questions became smaller when preferences changed.

Discussion

Experiment 3 showed that the previously identified effects of affirmative, negative, and irrelevant questions hold across different phrasings of these questions. We were also able to replicate the previous effects with a new, perhaps more personally relevant set of stimuli. Even a less direct manipulation of decision-making (presenting the self-talk phrases as incidental instead of instructing participants to use them) was still associated with the same effects, although they were reduced in size as expected for a more subtle manipulation (affirmative question: OR = 1.27, compared to 1.72 and 1.64 in the previous studies; negative question: $OR = 0.69$, compared to 0.23 and 0.25). The effects on response times were similarly smaller with this subtler manipulation, although the trend for faster responses under the affirmative and irrelevant questions remained even after we changed the baseline condition from a blank slide to a fixation point. This suggests that the observed effects are not merely due to attention-drawing visual properties of the questions as opposed to a blank slide.

Based on prior literature (Godin et al., 2012; Müller et al., 2016; Senay et al., 2010; Suri et al., 2014), we had assumed that an interrogative form of self-talk would be of particular relevance in decision making. With the next study, we aimed to verify that this assumption held true in our choice paradigm as well, by comparing the effect of questions with the effect of statements.

Experiment 4: Questions Versus Statements

Method

The paradigm was adapted from Experiment 3 and included the same pictures of desserts. In Experiment 4, however, participants were once more explicitly asked to read the phrases as if they were talking to themselves and to incorporate them in their decision making. In the test phase participants saw either a control slide with a fixation circle in the middle, an affirmative phrase ("Which one should I choose?" or "Choose this one:", depending on phrase style condition), or a negative phrase ("Which one should I not choose?" or "Don't choose this one:"). In parallel to Experiments 1 and 2, participants were asked to read the phrases as if they were talking to themselves. Trials with reaction times below 200 ms or above 3500 ms were excluded (7% of all trials).

We recruited $N = 121$ participants from a large public research university (plus one participant who was excluded because no data on their favorite pictures was available) who were randomly assigned to self-talk phrased as questions ($n = 65$) or as statements ($n = 56$). They were $M = 19.22$, $SD = 1.41$ years old, 41% male, 49% White, 31% Asian, 9% Black, 9% Latino, Latina, or Hispanic, and 2% other races. Seventy-five percent of participants reported being native speakers of English.

Results

Reaction times. Reaction times differed across self-talk content, $\chi^2(6) = 33.89$, $p < .001$, but not across whether it was phrased as questions versus statements, $\chi^2(7) = 1.21$, $p = .271$. The interaction did not quite reach the significance threshold, $\chi^2(6) = 5.81$, $p = .055$. For questions, the planned contrast comparing the baseline and the affirmative question was zero, $L = 0.00$, 95% CI [-0.04, 0.04], $p > .999$, although a $M_{Diff} = -21$ ms speedup of the affirmative question

was visible from the mean patterns (Table 1). Unexpectedly, the negative question led to slower rather than speedier responses in this study (compared to the no-question baseline), $L = 0.06$, 95% CI [0.02, 0.10], $p < .001$. For statements, both affirmative, $L = 0.05$, 95% CI [0.02, 0.09], $p = .006$, and negative phrases, $L = 0.07$, 95% CI [0.03, 0.11], $p < .001$, appeared to slow down participants' responses compared to the baseline condition.

Repeated action. Next, we examined the patterns of choice repetition. According to our prior studies, affirmative self-talk should lead to more and negative self-talk to less repetition and according to prior research on questions, questions should have stronger effects than statements. A 3 (none vs. affirmative vs. negative) x 2 (question vs. statement) multi-level logit regression of choice resulted in a main effect of self-talk content, $\chi^2(5) = 682.08$, $p < .001$, no main effect of question versus statement, $\chi^2(6) = 0.67$, $p = .413$, and a significant interaction, $\chi^2(5) = 104.06$, $p < .001$. Replicating our previous findings, participants repeated their choices more often under the affirmative phrase than under the no-phrase baseline. This pattern was present both for questions ("Which one should I choose?"), $OR = 2.25$, 95% CI [1.94, 2.62], $p < .001$, with 78% of individual participants showing this effect, and for statements ("Choose this one:"), $OR = 1.46$, 95% CI [1.25, 1.72], $p < .001$, with 63% of individual participants showing this effect. As can be seen from the different effect sizes, however, affirmative self-talk phrases had stronger effects when formulated as questions than as statements, $OR = 0.65$, 95% CI [0.53, 0.79], $p < .001$.

Again replicating our previous findings, people repeated their choices less often under the negative question ("Which one should I not choose?") than under the no-phrase baseline, $OR = 0.44$, 95% CI [0.37, 0.51], $p < .001$, 65% of individual participants showed this effect. The same effect was observed for negative statements ("Don't choose this one:"), $OR = 0.73$, 95% CI

[0.62, 0.86], $p < .001$, with 66% of individual participants showing this pattern, but once again the effect was stronger for questions than for statements, $OR = 1.68$, 95% CI [1.37, 2.07], $p < .001$.

Discussion

In conclusion, the effects of affirmative as well as negative queries are significantly stronger when phrased as questions rather than as statements. This result reaffirms the findings from previous literature that emphasizes the role of interrogative, as opposed to declarative, phrases in behavior change and decision-making (Godin et al., 2012; Senay et al., 2010).

The first four studies thus established that there is a robust effect of both affirmative and negative questions on choice repetition. With the next two studies, we sought to examine whether these questions influence choices through an effortful or an efficient process. If the questions are processed relatively efficiently, then they should speed up responses (see "Reaction times" sections of all studies, and Experiment 6) and they should still influence responses even when people are distracted (Experiment 5).

Experiment 5: Effect of Cognitive Load as Evidence for Efficiency

Method

To manipulate distraction, we used a within-subjects design where the test phase consisted of two blocks presented in counterbalanced order: A control block in which participants heard the sounds of an empty room (i.e., very quiet white noise) and a distraction block in which participants listened to a BBC fiction podcast. Participants were informed that they would have to answer questions about the podcast later. The podcast was all-dialogue and began without any introduction of the setting, characters, or plot, requiring participants to pay close attention to figure out what the story was about. On average, participants answered 85% of

the three comprehension check questions correctly, indicating that they were paying attention to the BBC podcast but also that following the podcast was hard enough to pose a challenge to participants. We expected that the effect of self-talk questions would be diminished by the distraction task. The rest of the paradigm was parallel to Experiment 3, meaning that participants saw pictures of desserts (rather than animals) and the questions "Which one do I like?", "Which one do I not like", "What will I do tomorrow?", or no question at all. As in Experiment 3, participants were again told that the questions were not related in content to the current study. Seven percent of trials were excluded for reaction times under 200 or over 3500 ms, and 4 trials were excluded because participants pressed an invalid key or made no response at all.

We recruited 111 undergraduate students from a large public research university, and excluded three participants who were missing data for entire sections of the experiment as well as one participant who self-reported being on their phone the entire time and who recommended that we do not use their data. Our final sample consisted of $N = 107$ students who were, on average, $M = 18.68$ years old, $SD = 0.95$. The modal participant was female (59%), White (54%; 25% Asian, 9% Latino, Latina, or Hispanic, 7% Black, 3% Middle Eastern, North African, or Arab American, 1% other), and a native speaker of English (81%).

Results

Reaction times. We found that reaction times depended on both question type, $\chi^2(3) = 73.80$, $p < .001$ and on cognitive load, $\chi^2(1) = 171.39$, $p < .001$ such that responses were overall slower in the distraction condition. There was no evidence for an interaction, $\chi^2(3) = 1.42$, $p = .702$. Pooling both blocks, the affirmative, $L = -.07$, 95% CI [-0.09, -0.04], and the irrelevant question, $L = -0.09$, 95% CI [-0.11, -0.06], led to significantly faster responses compared to the no-question condition, whereas the negative question did not, $L = -0.02$, 95% CI [-0.04, 0.01].

Repeated choice. Rates of choice repetition differed across question type, $\chi^2(3) = 361.50$, $p < .001$, but not between the distraction versus control blocks, $\chi^2(1) = 0.66$, $p = .42$. There was no evidence for an interaction, $\chi^2(3) = 6.41$, $p = .09$, and none of the three question effects were significantly different from each other across blocks, *OR*s < 1.14, *p*s > .459, suggesting that cognitive load did not affect the questions.

Across blocks, we replicated the previous effects: The affirmative question was associated with more repetition, $OR = 1.41$, 95% CI [1.26, 1.59], $p < .001$, 65% of participants showed this effect in the control block and 56% did so in the distraction block. In contrast, the negative question was associated with less repetition, $OR = 0.55$, 95% CI [0.49, 0.62], $p < .001$, and 62% and 64% of participants showed this effect in the control and distraction conditions, respectively. In this study, the irrelevant question did not have an effect, $OR = 0.92$, 95% CI [0.82, 1.04], $p = .259$.

Discussion

Experiments 1-4 showed consistent effects of affirmative and negative questions on patterns of choice, but the mechanism of these effects was unclear. Experiment 5 gave a first characterization of the underlying mechanism by showing that affirmative and negative questions influenced choice repetition regardless of whether or not participants were distracted by a secondary verbal task. Apparently changing one's decisions through self-talk does not require many cognitive resources – in other words, it is an *efficient* process, which is considered one feature of automaticity (Bargh, 1994; Moors, 2016; Moors & De Houwer, 2006). Thus, even though it is a verbal process, self-talk may still be easy to execute, potentially leading to consistent responses even when people have other things on their mind. To describe this efficient response process further, Experiment 6 was designed to test the default modulation perspective.

In this model, self-talk questions are answered with the default response (in our paradigm, the previously practiced response). An affirmatively phrased question would then semantically reinforce that default tendency, leading to more efficiency and potentially to a higher likelihood of choosing this response. In contrast, the semantic content implied by a negatively phrased question would counteract this default tendency, leading to a lower likelihood of choosing this response. This model implies that the self-talk questions modulate the responses to the default option, but not necessarily to the non-default options. In the previous experiments, targets were always presented in sets of three, making it difficult to test these ideas because we could not measure the responses to a single target without contrast effects of the others. To address this limitation and test the default modulation account, Experiment 6 included both joint presentations of three targets and separate presentations of a single target.

Experiment 6: Joint Versus Separate Presentation

Method

This experiment varied the way in which the stimuli were presented: In some trials, participants chose one out of three desserts (joint presentation, same as in the previous experiments). In other trials, they saw a single dessert and chose whether or not to choose it (separate presentation). One aim of this study was to validate the assumption that trained responses are more accessible by measuring the accessibility of each target in a way that was not possible in the joint format of the previous studies. Further, we wanted to test the default modulation perspective of question effects: We hypothesized that the self-talk questions would selectively affect the responses to trained stimuli, but not necessarily in response to non-trained stimuli. Specifically, we hypothesized that, in separate trials, both questions would decrease the response time for default choice options, and that affirmative [negative] questions would lead to

choosing the default choice options more [less] often. We expected the questions to increase the response time for non-default pictures and made no predictions about the direction of choices. For the joint presentation trials, we hypothesized a replication of the results from the previous studies (affirmative questions increasing and negative questions decreasing choice repetition and affirmative questions increasing response efficiency).

Participants were recruited from a psychology participant pool at a large public university and received course credit as compensation. This study was approved by the university's institutional review board. We attempted to recruit as many participants as we could within the last 1.5 weeks of the semester. Because of experimenter error, several participants were assigned the same ID so that we could not confidently match their data across different blocks, which forced us to exclude data from 21 participants (e.g., one experimenter assigned the ID "1" to 17 different participants). In addition, two other participants completed only 3 or fewer trials of the testing phase, rendering their data unusable and leading us to exclude them. The final sample size was $N = 65$. This sample included 55% women and 45% men with ages from 18 to 23 years ($M = 19.09$, $SD = 1.25$). The ethnicity/race composition was: 52% White, 23% Asian, 11% Black/African American, 11% Latinx/Hispanic, and 3% Other. Most respondents (80%) reported that English was their first language and out of the ones who indicated which language they usually self-talk in, 86% named English as their self-talk language.

To provide a context for participants' decisions, the instructions stated:

> Imagine that you are hosting a party for around 30 people. You are almost done with preparations, you just need to order dessert for everybody. By selecting a door, or by clicking "Order" on a picture, you are placing an order for 1 serving of that dessert. If

you already ordered brownies and then choose brownies again on a later trial, that means you will get two servings of brownies, and so on.

The presentation format was systematically varied such that 40% of all trials (42 of 120) were joint presentation trials as those used in our previous studies: Participants saw a set of three doors with a colorful background and had to choose which one to order. The remaining 60% of trials were separate presentation trials: Participants saw a picture of only one dessert against the appropriate background color and had to decide whether or not to order it. In addition, on 50% of all trials, participants saw the question "How confident are you in that selection?" after they had indicated their response. Participants were asked to place their right hand on the keys 1-3 of the number pad, which they used to choose doors in the joint-presentation trials and to indicate their confidence on select trials. They placed their left hand on the keys Z (Yes) and C (No) to respond to the separate-presentation trials, and participants practiced responding with those keys before starting the real trials. This training was a static image that did not respond to participants' button presses and included instructions for which button meant "Yes" and which one meant "No". This short training therefore gave participants the opportunity to familiarize themselves with the buttons without familiarizing them with the stimuli they were going to encounter in the next phase. This study followed a 2 (joint presentation, separate presentation; within-subjects) x 3 (no question, affirmative question, negative question; within-subjects) design.

Again, participants were told that the questions were taken from a different study and were simply included as visual fixation points. Participants saw dessert pictures, preceded by either a blank screen or one of the questions "Which one should I choose?" and "Which one should I not choose?". The irrelevant question was omitted to reduce the study length and thus participant fatigue. Dessert choices on which participants took less than 200 ms or longer than

3500 ms to respond and confidence choices on which they took longer than 5000 ms were excluded (8% of all trials).

Results

People chose the trained dessert more often in the separate than in the joint presentation format, main effect of presentation format $\chi2(2) = 249.82$, $p < .001$, their choices differed by question type, $\chi2(2) = 219.55$, $p < .001$, and both effects were qualified by an interaction between question and presentation type, $\chi2(4) = 110.40$, $p < .001$. Similarly, response times were faster when making a separate decision about a trained stimulus, $\chi2(2) = 28.24$, $p < .001$, response times differed by question type $\chi2(2) = 8.38$, $p < .001$, and both effects were qualified by an interaction, $\chi2(4) = 18.81$, $p < .001$. To decompose the interactions, we present the results separated by presentation type.

Joint presentation. For joint presentation trials, we observed the same pattern as in previous experiments: The affirmative question increased repeated choice – although this effect narrowly missed significance in this study, the effect size is in line with our prior effects, *OR* = 1.31, 95% CI [0.9995, 1.71], $p = .051$. The negative question again decreased repeated choice, *OR* = 0.31, 95% CI [0.24, 0.41], and the affirmative question again decreased response times, *L* = -0.06, 95% CI [-0.11, -0.01]. There was additionally a tendency for the negative question to slow responses down, although this effect narrowly missed significance, *L* = 0.05, 95% CI [-0.004, 0.11].

Separate presentation. Overall, participants were inclined to order the desserts they viewed (order frequency >50% in all conditions). Once again confirming that our paradigm successfully induces response tendencies, the likelihood of ordering a trained dessert was much higher than the likelihood of ordering a non-favorite dessert.

Default responses. The pictures participants chose as their favorite during the training phase were labeled default choices. The effect of the affirmative question was absent in the separate presentation trials, *OR* = 0.95, 95% CI [0.61, 1.48], but the negative question still made participants selectively less likely to choose their default (but not their non-default) option, *OR* = 0.48, 95% CI [0.32, 0.74], 56% of individual participants showed this effect. Response times for separately presented default trials also mirrored those of the joint-presentation trials: The affirmative question appeared to speed up responses as predicted (M_{Diff} = 50 ms), although this effect was non-significant, *L* = -0.03, 95% CI [-0.10, 0.05], and the negative question slowed responses down, *L* = 0.11, 95% CI [0.04, 0.19].

Non-default responses. We did not predict any specific influence of self-talk questions on non-default picture choices and did not observe any effects, affirmative question *OR* = 0.96, 95% CI [0.74, 1.25], negative question *OR* = 0.96, 95% CI [0.74, 1.25]. In line with the idea that questions affect only the default option, both questions showed a tendency to slow rather than speed up responses to non-favorite pictures when they were presented separately, albeit nonsignificantly, *L* = 0.02, 95% CI [-0.03, 0.07] for the affirmative and *L* = 0.04, 95% CI [-0.02, 0.09] for the negative question.

Confidence. Participants were overall highly confident that they had made the right choice, *M* = 2.56 on a 1-3 scale, *SD* = 0.32. There was no evidence for differing confidence across self-talk questions, main effect $\chi2(2) = 2.76$, $p = .252$, interaction $\chi2(4) = 2.09$, $p = .719$. Instead, the only significant effect was a main effect across type of presentation, $\chi2(2) = 50.79$, $p < .001$: Participants were less confident in their choices in joint presentation trials compared to separate presentation trials with both default and non-default stimuli, *L* = -0.13, 95% CI [-0.20, -0.06], likely because there were no foregone options that could elicit post-decisional regret.

Participants also reported slightly more confidence in separate presentation trials when the dessert was a default choice than it was a non-default one, $L = 0.10$, 95% CI [0.01, 0.20] reflecting the lasting influence of the training phase in creating a default response tendency.

Discussion

In our model, we hypothesized that the questions, in particular the affirmative question, could activate people's memory of the training phase, making the default choice more salient. In a first step, we expected this default to be reflected in faster reaction times. In a second step, we expected that the default would interact with the semantic content of the question to lead to more (affirmative) or fewer (negative) choices of the favorite option, respectively. Overall, the pattern of responses supported this prediction, though with exceptions: The affirmative question increased the accessibility for default choices as operationalized by faster response times, but increased behavioral choices only in joint presentation trials ($p = .051$, but with an effect size in line with the previous studies, $OR = 1.31$), not in separate presentation trials. It seems likely that the default option was already accessible enough that the additional reinforcement through the affirmative question did not additionally increase choices in the separate-presentation trials, as indicated by the overall faster responses in separate default (but not non-default trials). Conversely, the negative question decreased choices in joint as well as separate trials, but was associated with slower (rather than faster) response times. Finally, the data did not support the alternative explanation that the negative question reduces perceived confidence or that the affirmative question increases confidence, but instead supported a model in which self-talk questions combine with the default responses to produce the new response.

General Discussion

Across variations in stimuli, instructions, and questions, six experiments demonstrated that affirmative and negative questions respectively increase and decrease choice repetition and that self-directed questions are more effective than self-directed statements. Further, the process underlying these effects poses small demands on cognitive resources (a related finding across our experiments is that questions whose propositional content reinforces the default choice tendency lead to more efficient choices) and affects both the accessibility of default responses and the pattern of choices. Equally importantly, our door choice paradigm illustrates situations in which people respond neither fully habitually nor fully intentionally (Lally et al., 2010). In accordance with previous research on the role of self-talk in decision making (Alderson-Day & Fernyhough, 2015; Senay et al., 2010), our data suggest an important place for self-talk in influencing choices that are neither fully intentional nor fully habitual. In particular, the current research affirms the importance of questions, which are associated with increased rates of behavior (current studies; Godin et al., 2012) and increased performance (Senay et al., 2010; Suri et al., 2014). According to our default modulation perspective, self-posed questions likely matter because people answer them with information that is accessible at the time (cf. situated inference model, Loersch & Payne, 2011). If this accessible information includes an existing default response, choice repetition is the most probably outcome. In that case, an affirmative question would make that default response even more accessible and lead to faster responses and, if the existing default response tendency is not too rigid yet, also lead to a higher probability of choosing the default response. In contrast, a negative question would suggest the opposite of the default tendency, leading to a response conflict and a lower probability of choosing the default. Ultimately, the response process we observed may suggest that seemingly habitual behavior (consistently

repeated choices characterized by relative response efficiency) can in fact be the product of a partially deliberate process that is mediated through self-directed language.

Natural Self-Talk Questions

Our findings suggest that participants adopted the questions as self-talk, and then these self-posed questions influenced choices. Further, our data suggest that participants made their choices through self-talk even when not explicitly prompted. Even in the absence of externally cued questions (the no-question condition), participants in our studies may have naturally asked themselves affirmative questions that elicit repetition, such as "Which one should I choose?" or "Which one do I want?" (as suggested by Loersch & Payne, 2011; e.g., *Which one should I choose?* in an approach situation). Three aspects support this possibility. First, explicitly thinking about a natural question may reinforce this natural decision-making process, which the affirmative question appeared to do: Requiring participants to self-pose an affirmative question resulted in more repeated choice than the control, whereas the negative question had opposite effects on repeated choice. Second, if the questions interrupted an ongoing natural decision-making process, this should be reflected in longer response times. On the contrary, however, questions led to faster responses, suggesting that the questions reinforced instead of disrupted naturally occurring processes. Third, if the irrelevant questions were neither facilitating nor disrupting spontaneous choice processes, introducing them should have no effect. Throughout our studies, however, the irrelevant question decreased choice repetition, suggesting that the irrelevant question served as a verbal distractor that disrupted naturally occurring self-talk questions and the repetition that went with it.

Future Directions

Repeated choice happens on a continuum ranging from the most flexible choices that are guided by deliberate decisions to the most rigid habits that are guided by context cues (Lally et al., 2010). In the current paradigm, participants likely did not form strong habits, and future research should ascertain the effects of self-posed questions at different levels of habituation. Truly habitual responses should be relatively less affected by self-talk questions unless habituation was done in association with questions. Further, we would expect the same decision-making processes to work in other, more personally relevant choice situations as well. Future work should thus also replicate these effects for questions on self-chosen, personally relevant goals, different domains, and different samples.

If self-posed questions indeed underlie repeated choices in the supermarket aisle, our findings have important implications for understanding consumer purchase behaviors and may underlie the high rates of brand choice concentration observed in the literature (Hansen & Singh, 2015). Further, other daily choices may function in the same way, and self-talk questions may be involved in dietary, financial, and environmental choices. Future work should extend the current findings by examining how self-posed questions affect choices in situations that are more natural and more complex than the paradigm we employed here. Ultimately, people may be able to strategically use specific self-talk questions to change their behavior patterns in ways they find desirable. If affirmative questions increase choice repetition as shown by our experiments, these questions could be used to deliberately increase the ease of such healthy behaviors like fruit and vegetable intake or exercise. Conversely, negative questions may be used to deliberately reduce such problematic behaviors as eating sugary food or excessive reliance on cars as opposed to more sustainable modes of transportation. Our results inspire confidence that these self-guided

interventions may work even in busy, distracting situations that are common to demanding contemporary life.

References

Alderson-Day, B., & Fernyhough, C. (2015). Inner speech: Development, cognitive functions, phenomenology, and neurobiology. *Psychological Bulletin*, *141*(5), 931–965. https://doi.org/10.1037/bul0000021

Bargh, J. A. (1994). The four horsemen of automaticity: Awareness, intention, efficiency, and control in social cognition. In R. S. Wyer & T. K. Srull (Eds.), *Handbook of social cognition* (2nd ed., pp. 1–40). Hillsdale, NJ: Erlbaum.

Geeves, A., McIlwain, D. J. F., Sutton, J., & Christensen, W. (2014). To think or not to think: The apparent paradox of expert skill in music performance. *Educational Philosophy and Theory*, *46*(6), 674–691. https://doi.org/10.1080/00131857.2013.779214

Godin, G., Bélanger-Gravel, A., Vézina-Im, L.-A., Amireault, S., & Bilodeau, A. (2012). Question-behaviour effect: A randomised controlled trial of asking intention in the interrogative or declarative form. *Psychology & Health*, *27*(9), 1086–1099. https://doi.org/10.1080/08870446.2012.671617

Green, P., & Macleod, C. J. (2016). SIMR: An R package for power analysis of generalized linear mixed models by simulation. *Methods in Ecology and Evolution*, *7*(4), 493–498. https://doi.org/10.1111/2041-210X.12504

Hansen, K. T., & Singh, V. (2015). *Choice concentration [Working paper]*. Retrieved from http://faculty.chicagobooth.edu/workshops/marketing/pdf/Concentration - Hansen.pdf

Hothorn, T., Bretz, F., & Westfall, P. (2008). Simultaneous inference in general parametric models. *Biometrical Journal*, *50*(3), 346–363. https://doi.org/10.1002/bimj.200810425

Jarvis, B. G. (2010a). DirectRT [Computer software]. New York, NY: Empirisoft Corporation.

Jarvis, B. G. (2010b). MediaLab [Computer software]. New York, NY: Empirisoft Corporation.

Jenkins, S. (2007). The use of swing keys by elite tournament professional golfers. *International Journal of Sports Science and Coaching*, *2*(Supplement 1), 199–229. https://doi.org/10.1260/174795407789705460

Lally, P., van Jaarsveld, C. H. M., Potts, H. W. W., & Wardle, J. (2010). How are habits formed: Modelling habit formation in the real world. *European Journal of Social Psychology*, *40*(6), 998–1009. https://doi.org/10.1002/ejsp.674

Loersch, C., & Payne, B. K. (2011). The situated inference model: An integrative account of the effects of primes on perception, behavior, and motivation. *Perspectives on Psychological Science*, *6*(3), 234–252. https://doi.org/10.1177/1745691611406921

Moors, A. (2016). Automaticity: Componential, Causal, and Mechanistic Explanations. *Annual Review of Psychology*, *67*(1), 263–287. https://doi.org/10.1146/annurev-psych-122414-033550

Moors, A., & De Houwer, J. (2006). Automaticity: A theoretical and conceptual analysis. *Psychological Bulletin*, *132*(2), 297–326. https://doi.org/10.1037/0033-2909.132.2.297

Müller, B. C. N., Ritter, S. M., Glock, S., Dijksterhuis, A., Engels, R. C. M. E., & van Baaren, R. B. (2016). Smoking-related warning messages formulated as questions positively influence short-term smoking behaviour. *Journal of Health Psychology*, *21*(1), 60–68. https://doi.org/10.1177/1359105314522083

Quinn, J. M., Pascoe, A., Wood, W., & Neal, D. T. (2010). Can't control yourself? Monitor those bad habits. *Personality and Social Psychology Bulletin*, *36*(4), 499–511. https://doi.org/10.1177/0146167209360665

Senay, I., Albarracín, D., & Noguchi, K. (2010). Motivating goal-directed behavior through introspective self-talk: The role of the interrogative form of simple future tense.

Psychological Science, *21*(4), 499–504. https://doi.org/10.1177/0956797610364751

Shiffrin, R. M., & Schneider, W. (1977). Controlled and automatic human information processing: II. Perceptual learning, automatic attending and a general theory. *Psychological Review*, *84*(2), 127–190. https://doi.org/10.1037/0033-295X.84.2.127

Simmons, J. P., Nelson, L. D., & Simonsohn, U. (2012). A 21 word solution. *SPSP Dialogue*, 1–4. https://doi.org/10.2139/ssrn.2160588

Suri, G., Sheppes, G., Leslie, S., & Gross, J. J. (2014). Stairs or Escalator? Using Theories of Persuasion and Motivation to Facilitate Healthy Decision Making. *Journal of Experimental Psychology: Applied*, *20*(4), 295–302. https://doi.org/10.1037/xap0000026

Toner, J., & Moran, A. (2014). In praise of conscious awareness: A new framework for the investigation of "continuous improvement" in expert athletes. *Frontiers in Psychology*, *5*. https://doi.org/10.3389/fpsyg.2014.00769

Wood, W., & Neal, D. T. (2007). A new look at habits and the habit-goal interface. *Psychological Review*, *114*(4), 843–863. https://doi.org/10.1037/0033-295X.114.4.843

Wood, W., Quinn, J. M., & Kashy, D. A. (2002). Habits in everyday life: Thought, emotion, and action. *Journal of Personality and Social Psychology*, *83*(6), 1281–1297. https://doi.org/10.1037//0022-3514.83.6.1281

Table 1

Average Response Times (in ms) in All Studies, with Standard Deviations in Parentheses.

Question	Experiment 1	Experiment 2	Experiment 3	Experiment 4		Experiment 5	
				Questions	Statements	Control	Distraction
None	1459.33 (393.64)	1057.59 (307.29)	732.76 (272.99)	844.04 (316.33)	761.62 (326.88)	816.18 (318.07)	929.00 (373.39)
Affirmative	1312.30 (390.88)	994.52 (340.18)	720.87 (292.73)	822.91 (287.71)	796.96 (333.80)	780.28 (328.74)	852.51 (338.16)
Negative	1384.41 (443.07)	1086.02 (391.54)	737.04 (346.44)	891.65 (372.45)	824.71 (341.93)	836.92 (359.03)	907.40 (369.04)
Irrelevant	–	1010.98 (321.69)	712.83 (311.09)	–	–	773.92 (316.93)	850.33 (334.69)
N	43	47	60	65	56	107[a]	107[a]

Question	Experiment 6		
	Joint	Separate: Trained	Separate: Non-trained
None	1391.60 (348.02)	1254.01 (330.15)	1301.66 (295.96)
Affirmative	1311.70 (351.57)	1203.94 (297.62)	1337.48 (276.85)
Negative	1482.81 (439.88)	1403.42 (311.74)	1364.35 (290.73)
Irrelevant	–	–	–
N	65[b]	65[b]	65[b]

Same subscripts denote same samples (within-subjects conditions).

Table 2

Average Proportions of Repeated Choice in All Studies, with Standard Deviations in Parentheses.

Question	Experiment 1	Experiment 2	Experiment 3	Experiment 4		Experiment 5		Experiment 6		
				Questions	Statements	Control	Distraction	Joint	Separate: Trained	Separate: Non-trained
None	.49 (.17)	.57 (.27)	.47 (.21)	.41 (.22)	.43 (.20)	.52 (.26)	.53 (.27)	.60 (.25)	.81 (.21)	.61 (.24)
Affirmative	.62 (.26)	.68 (.26)	.52 (.23)	.61 (.27)	.51 (.21)	.61 (.24)	.58 (.25)	.65 (.27)	.80 (.23)	.61 (.23)
Negative	.19 (.14)	.31 (.27)	.32 (.20)	.25 (.18)	.36 (.20)	.39 (.26)	.42 (.26)	.35 (.27)	.68 (.25)	.61 (.23)
Irrelevant	–	.49 (.28)	.39 (.22)	–	–	.49 (.27)	.51 (.27)	–	–	–
N	43	47	60	65	56	107[a]	107[a]	65[b]	65[b]	65[b]

Same subscripts denote same samples (within-subjects conditions).

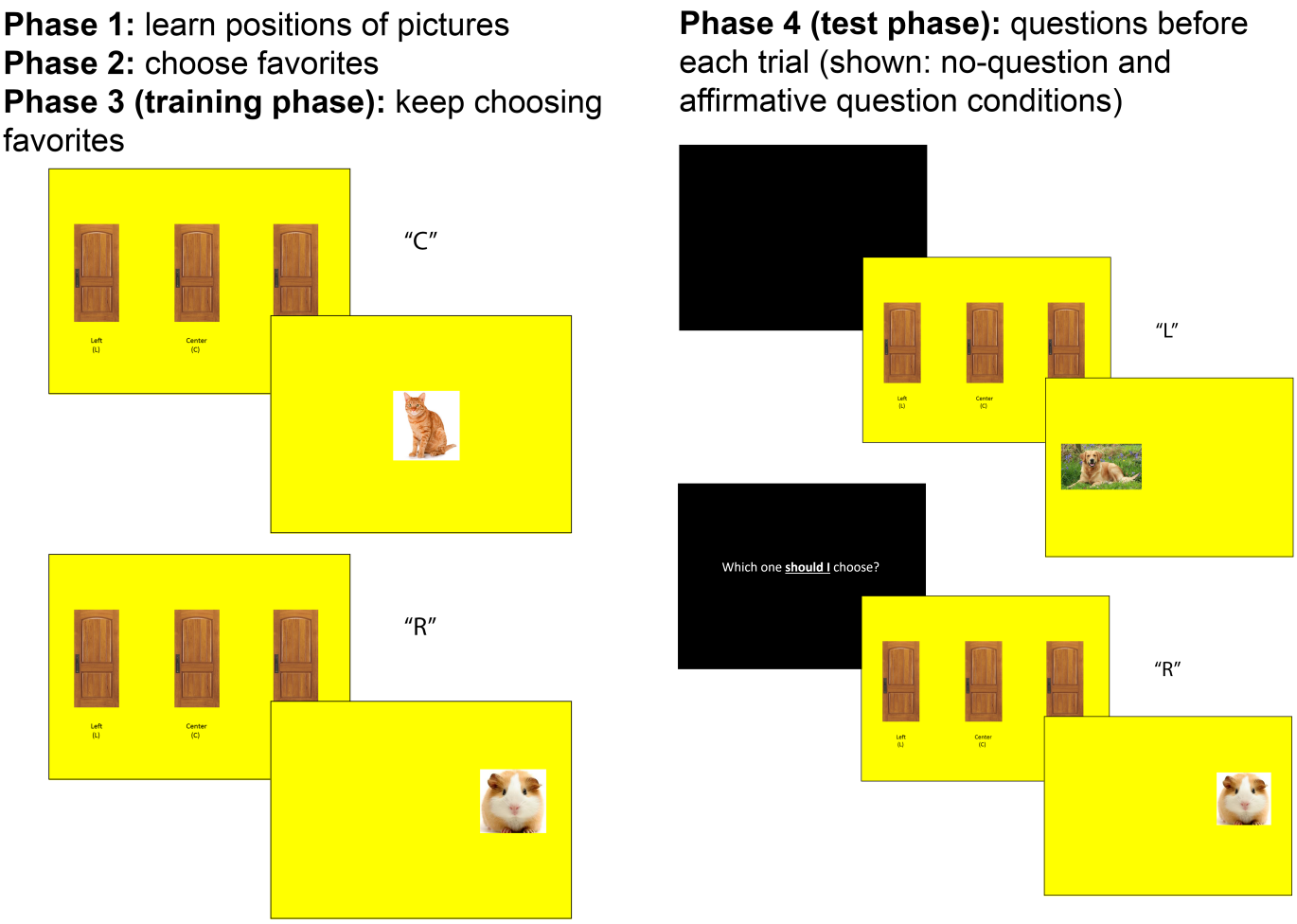

Fig. 1. Schematic representation of the door choice paradigm. The key assignment for choosing pictures was *L* for the left door, *C* for the center door, and *R* for the right door in Experiments 1 and 2, and 1, 2, 3 for the later experiments. The text of the affirmative question has been increased slightly in this figure for better visibility.

Supplemental Measures

In Experiments 3-5, we added two bipolar items to assess choice clarity (clarity1: 1 = *I knew exactly which door I was going to choose before the doors were shown* to 7 = *I decided which door I was going to choose in the spur of the moment*, and clarity2: 1 = *It was unclear to me which door I was going to choose* to 7 = *It was very clear to me which door I was going to choose*). Next, we asked six questions on scales from 1 (*almost never*) to 7 (*almost always*) (think1: *Choosing a door came naturally to me,* think2: *Choosing a door required a lot of thinking,* think3: *Choosing a door was an effortless decision,* intowords: *I put my decision into words in my mind, e.g., by thinking "I'll pick the left one",* vaguefeeling: *My decision was just a vague feeling,* keepchoosingfaves: *I tried to keep choosing the pictures that I had previously picked as my favorites*).

Experiment 4 further contained a series of open-ended questions: “How would you describe your decision-making process in the last phase of this study?”, “How did you make your choices?”, and “When you read the [question/statement] [e.g., "Which one should I choose?"], what did you think? How did you interpret this phrase?”. We also asked participants about their enjoyment of the task, interest1: *I found the pictures interesting.* and interest2: *I liked seeing the pictures.* (1 = *not at all*, 5 = *very much*). Finally, we added the following items about their decision-making experience: options1: *The [question/statement] ["..."] made me consider all possible options*., option2: *... immediately made me think of one particular door.*, trainingphase: *... made me think back to the training phase.*, and goalreminder: *... made me remember my goals.* (1 = *not at all*, 5 = *very much*).