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THE SPONTANEOUS THOUGHTS OF THE NIGHT: HOW FUTURE TASKS BREED INTRUSIVE COGNITIONS

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Everyone has had the experience of trying to clear one's mind before going to sleep, only to have *intrusive cognitions* about future tasks (e.g., giving a speech, solving a financial conundrum) perturb consciousness. Similar cognitions can interfere with other goals (e.g., to concentrate while driving). We propose that intrusive cognitions are far from indeterminate and reflect the 'prospective' nature of the brain. We hypothesize that they are triggered automatically by future tasks that may benefit from forethought. Accordingly, during a meditation-like exercise requiring one to clear the mind of excess thought and focus on just one thing (breathing), participants reported more intrusive cognitions about a future task that could benefit from forethought than when they anticipated no future task or anticipated a task that, though of comparable difficulty and content, could not benefit from forethought. This finding illuminates conditions such as rumination and the prospective nature of the brain.

Life is what happens to you while you're busy making other plans.

—John Lennon

Everyone has had the experience of trying to clear one's mind before going to sleep, only to have thoughts about future tasks and obligations perturb consciousness. These *intrusive cognitions* could be about paying the bills, giving a speech, or editing the introduction of a manuscript.[1] As aptly illustrated by Lennon, intru-

1. There is substantial evidence that, under certain conditions, people cannot clear their minds (e.g., to fall asleep) because of intrusive cognitions about future tasks and obligations (Fichten et al., 2001; Lichstein & Fanning, 1990; Mitchell, 1979). Such cognitions may also be of counterfactual thinking or of re-evaluations of past behavior, cognitions which are also believed to be in the service of future action (Epstude & Roese, 2008; Schacter & Addis, 2007).

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sive cognitions disregard the value of "living in the present" and can interfere with the task at hand, such as enjoying a film or concentrating while driving. Similar unintentional cognitive phenomena play a debilitating role in disorders such as rumination and obsessive-compulsive disorder (Clark, 2005; Nolen-Hoeksema, 1996; Reynolds & Brewin, 1998).

We propose that, despite their seemingly "out of the blue" character, these cognitions are far from indeterminate and reflect basic properties of the cognitive apparatus. Specifically, we hypothesize that future tasks that could benefit from forethought are a major cause of intrusive cognitions, consistent with theoretical developments regarding the prospective, forward-looking tendency of the mind/brain (Bargh & Morsella, 2008; Barsalou, 2003, 2008; Berthoz, 2002; Buzsaki, 2006; Glenberg, 1997; Hawkins & Blakeslee, 2005; Klinger, Barta, Maxeiner, 1980). The anticipatory nature of the cognitive apparatus has already been illuminated in research on perception (Summerfield & Mangels, 2006), memory (Glenberg, 1997), "mind wandering" (Bernsten & Jacobsen, 2007; Smallwood & Schooler, 2006), action/motor control (Berthoz, 2002), cognitive control (Zanto & Gazzaley, 2008), language production (Morsella & Miozzo, 2002; Slevc & Ferreira, 2006), language perception (Pickering & Garrod, in press), basic cortical processing (Buzsaki, 2006; Hawkins & Blakeslee, 2005), memory (Glenberg, 1997), and mental simulation (Barsalou, 2003, 2008; Schacter & Addis, 2007). For example, based on neuropsychological evidence that simulating possible future events depends on neural machinery that is also used for remembering past events, it has been proposed that the function of episodic memory—a cognitive capacity traditionally associated with past experiences—is actually to simulate potential future actions (Schacter & Addis, 2007). In addition, the hypothesis is consistent with substantial research in social cognition demonstrating that, through unconscious mechanisms, goals about future tasks remain activated and can influence both behavior and cognition, even when such an influence is undesired (see Discussion and Review in Förster, Liberman, & Friedman, 2007).

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Although the evidence and theoretical support for our hypothesis is more than suggestive, it has yet to be demonstrated that future tasks capable of benefiting from forethought systematically trigger cognitions that counter one's current goals. How can one evaluate this hypothesis experimentally?

RATIONALE

To evaluate this hypothesis, we re-created in an experimental setting the bedtime scenario mentioned above, in which one is trying to clear the mind of all excess thoughts but nonetheless experiences intrusive cognitions about a future task that may benefit from forethought. The rationale of our approach is that, if future tasks that may benefit from forethought automatically trigger intrusive cognitions, then participants should experience intrusive cognitions when anticipating such a task, even when they are trying to clear their minds. Specifically, we tested the prediction that participants would experience more intrusive cognitions about a future task that could benefit from forethought (a kind of geography quiz) than when they anticipated no future task or a task that, though of comparable difficulty and content, could not benefit substantially from forethought. Such a finding would be

a demonstration of an experimentally manipulable link between spontaneously experienced conscious thoughts and future tasks.

OVERVIEW OF EXPERIMENT

In our experimental condition, participants were under the false belief that at some future point in the session they would be quizzed about geographical knowledge. Participants were told the cover story that, at some point during the session, they would have to recall the names of the states of the U.S.A. to the best of their ability—the kind of task that, like any quiz, would benefit from mental preparation (i.e., searching for the items in long-term memory beforehand; Anderson, 1974; Jones & Anderson, 1987; King & Anderson, 1976). In actuality, in this experimental, *state-generation* condition, there was no future test. Instead, participants only performed a *concentration exercise* that was putatively unrelated to the state generation task and that, resembling the bedtime scenario, required them to focus on their breathing and clear the mind of all excess thoughts. During this exercise, participants were instructed to jot down all intrusive cognitions (a kind of "thought listing" technique; Siebert, & Ellis, 1991). We predicted that this condition would be capable of triggering intrusive "geographically related" thoughts, that is, thoughts that would help performance on the future quiz.

CONTROL CONDITIONS

Controls were given the same exact instructions and information, presumably leading to comparable effects from *knowledge activation* or "priming" (Bargh & Chartrand, 2000; Higgins, 1996), but they were also told after hearing the information that they would *not* have to perform the state generation task. Thus, they were presented with the same instructions, but, as a function of additional information, were not anticipating any future task. We predicted that the state-generation condition would yield a greater proportion of intrusive cognitions about geography than the control condition. Faced with such a finding, however, one could argue that the increased proportion of intrusive cognitions was actually caused, not because the state-generation task would benefit from forethought, but by the simple fact that, while participants in the experimental condition anticipated a challenging task involving geography, participants in the control condition anticipated no future task whatsoever, let alone one that was challenging and about geography. We needed to find a control future task that, though possessing the same stimuli, topic of content, and level of difficulty of the experimental task, would not benefit from forethought in any obvious and substantial way.

To remedy this concern, we had a second control condition in which participants were told the cover story that, following the concentration exercise, they would have to speed count the letters of names of the states (e.g., WISCONSIN = 9). This carefully chosen task is comparable to the experimental task with respect to topic content and anticipated difficulty, but is different from it in that it does not require retrieval from long-term memory and is unlikely to benefit substantially from any mental preparation: Much in the same way that motor operations toward objects are computed on the fly when one is in the presence of those objects (rendering

limited value to intentional motor preparation; Rosenbaum, Vaughan, Meulenbroek, Jax, & Cohen, 2009), object counting (including subitizing) is a skill that is usually performed "online," that is, when one is in the presence of the objects to be counted (Watson, Maylor, & Bruce, 2007). We strove to have the experimental condition differ from the control conditions only in that it involved a future task that could benefit from foresight. We predicted that both control conditions would lead to comparable effects, and that the state-generation condition would yield the greatest proportion of intrusive cognitions about geography.

METHOD

PARTICIPANTS

Undergraduate San Francisco State University participants (n = 150) were run in a large group and participated for class credit.

PROCEDURES

Each participant received written instructions about the concentration exercise and the putative subsequent task in a three-page packet that included a blank page for jotting down intrusive cognitions during the concentration exercise. The experimental group (n = 52) was informed that they would hear audio-taped instructions about how to concentrate on one's breathing. The following instructions were presented in the packet.

> "You will be presented with a naming task, in which you will be asked to name all the states of the U.S.A., to the best of your abilities. During the concentration exercise, it is common for people to be distracted by thoughts, feelings, and bodily sensations. We ask that every time you catch yourself being distracted by an intruding thought, to jot that thought down in the space provided (even a repeating, intruding thought), and to then bring back your attention to the exercise. Please jot down only thoughts that you feel comfortable sharing with strangers."

Participants then performed the 7 min 51 sec concentration exercise, which involved listening to audio-taped instructions about meditation and breathing (from Kabat-Zinn, 2005). The narrative explained how to focus on breathing. It was emphasized to participants that they should follow instructions and focus on their breathing. Although this exercise requires one to focus only on breathing and demands that one clear the mind of all excessive thoughts, the narrative contained no instructions to the effect of "clear your mind" or "ignore distracting thoughts," instructions that could potentially lead to an *ironic processing* effect, a kind of rebound effect in which one is more likely to think about something as a function of trying not to think about it (cf., Wegner, 1994). Importantly, the narrative contained no terms/phrases related to geography. It is important to note that, if participants could perform this task as instructed and without difficulty, no intrusive cognitions should arise during the short concentration exercise.

Controls (n = 51) received the same instructions, except that the description of the task was followed by a sentence stating that, "you will NOT perform this second task and will perform only the concentration exercise." The procedures in the letter counting condition (n = 46) were identical to those of the experimental condition, except that participants were informed, "After completing the concentration exercise, you will be presented with a challenging 'speed counting' task, in which you will be presented with the names of all the states of the U.S.A. and you will be asked to count the letters in each of the names as quickly as possible and to the best of your abilities." Using an 8-point rating scale, in which 1 signifies "EASY" and 8 signifies "DIFFICULT," independent judges (n = 8) deemed both tasks to be comparable with respect to anticipated difficulty ($M_{\text{State-Generation}}$ = 3.5, $SEM_{\text{State-Generation}}$ = 1.05, and M_{Counting} = 5.0, SEM_{Counting} = .76), $t(7) = 1.09$, $p > .30$.

After the exercise, each participant was asked a handful of questions about personal information (geography education, whether they inferred the true nature and purpose of the study) that could potentially identify him or her as ineligible for our study. On the basis of this information, the data from no participant were excluded from analysis. However, the data from one participant were excluded because the participant failed to follow instructions. The entire set of all of the participants' intrusive cognitions were transcribed, coded, and counted blindly by two raters, one of whom tallied 1,326 cognitions and the other 1,307 (98.57% agreement). Our dependent measure was the proportion of geographically related intrusive cognitions, defined as the proportion of thoughts falling under the categories of geography, states, and travel. Raters were in 100% agreement with respect to the categorization of the cognitions.

RESULTS

As predicted and illustrated in Figure 1, the state-generation condition yielded a significantly greater proportion (M = .068, SEM = .03) of intrusive cognitions about geography than the letter counting and control conditions, $F(2, 146) = 4.974$, $p < .0081$ ($\eta_p^2 = .07$), which led to comparable effects (M = .005, SEM = .003 and M = .008, SEM = .004, respectively). Consistent with what is illustrated in Figure 1, *Fisher's PLSD* revealed that all differences between conditions were significant (ps < .01), except for that between the letter counting and control conditions (p = .890). The same pattern of results is obtained when evaluating the absolute number, rather than the proportion, of geographically related thoughts. Condition did not have an effect on the overall number of intrusive cognitions, $F(2, 146) = .126$, p = .8821 ($\eta_p^2 = .002$).

If the mechanism underlying our effect is unconscious and unintentional, then one would expect that, through a "diffuse" and non-strategic form of knowledge activation, there should be increased activation of many kinds of geographically related thoughts, not just of state names. (Deliberate rehearsal would be more likely to activate just state names.) Accordingly, the same general pattern of results is still obtained when the state names are excluded from geographically related thoughts, $F(2, 146) = 2.732$, p = .068, though regarding statistical significance the effect is now a trend. Moreover, the way in which state names were generated resembled the nature of intrusive cognitions more than that of deliberate rehearsal: Participants tended to generate a small number of state names, a quantity that is

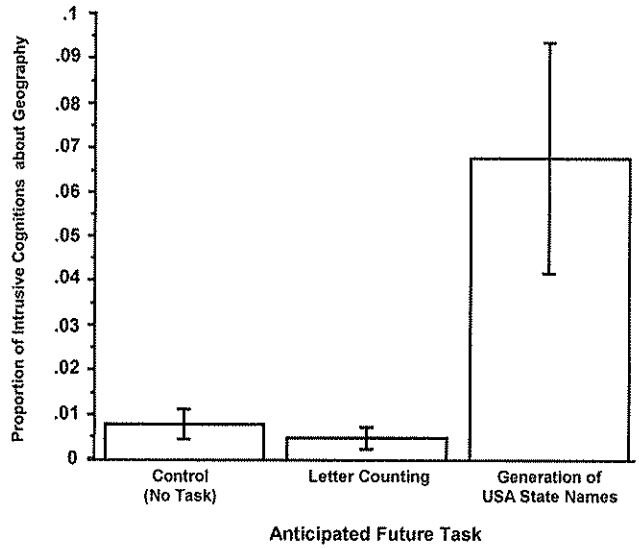

FIGURE 1. Mean proportion of intrusive cognitions about geography as a function of anticipated task. Error bars indicate SEMs.

unlikely to arise in deliberate rehearsal. To corroborate this, we had an independent group of judges (n = 14) estimate how many state names they would generate if they intended to rehearse for a subsequent quiz about the names of the U.S.A. state names. The mean number of estimate state names was 34.29 (SEM = 4.05), a number well above half-a-dozen. Importantly, the same pattern of results from the three conditions was obtained when removing the data from the two participants who produced more than half-a-dozen state names, $F(2, 144) = 4.54$, $p = .0133$.

DISCUSSION

At this stage of understanding one can appreciate that, though the occurrence of a single intrusive cognition is a seemingly haphazard event, the nature of these cognitions is far from indeterminate and reflects the prospective nature of the mind/brain (Bargh & Morsella, 2008; Barsalou, 2003, 2008; Berthoz, 2002; Buzsaki, 2006; Glenberg, 1997; Hawkins & Blakeslee, 2005; Klinger et al., 1980; Summerfield & Mangels, 2006; Zanto & Gazzaley, 2008). We hypothesized that future tasks that may benefit from forethought are a major cause of intrusive cognitions. Accordingly, we found that, during a mock meditation-like exercise that requires one to focus on one thing (breathing) and to clear the mind of all other thoughts, participants reported substantially more intrusive cognitions about a future task when the task could benefit from forethought than when they anticipated no future task or a task that, though of comparable difficulty and content, could not benefit substantially from forethought. The state-generation and letter-counting tasks were matched for anticipated difficulty; hence, the experimental condition differed from the control conditions, not with respect to content, anticipated difficulty, or how challenging it could be perceived to be, but only with respect to it having a future task that could benefit from mental preparation. Hence, data from

both control conditions rule out that the effect from the experimental condition was due to mere knowledge activation (priming) or to the anticipated difficulty of the future task. In addition, the manner in which participants experienced the geographically related thoughts—with state names intermixed with other intrusive thoughts and usually being fewer than half-a-dozen in number—resembled intrusive cognitions more than the kind of thoughts one would experience during deliberate, conscious rehearsal.

We do not propose that future tasks requiring forethought are the only source of intrusive cognitions (see Footnote 1). (For research on intrusive cognitions about the past events, see Smallwood, Nind, & O'Connor, 2009.) Negative events or the evaluation of past events may also give rise to these cognition (Klinger et al., 1980; Nolen-Hoeksema, 1996; Smallwood et al., 2009). Consistent with prior research (Smallwood et al., 2009), we are just proposing that this kind of future task is one major determinant of such processes, furnishing a substantial proportion of the spontaneous thoughts of the night that perturb restfulness, and, in our laboratory setting, triggering intrusive conditions about a future task that does not at all possess the gravity of real-world challenges. It is quite remarkable that, while performing a relatively short (roughly 8-minute) concentration exercise in which one is continually reminded through vivid auditory instructions to focus on breathing and clear one's mind, participants experienced any intrusive cognitions whatsoever, let alone those that were predicted to intrude into consciousness. This particular vulnerability reveals how the contents of consciousness are often determined by concerns and sophisticated calculations that are themselves unconscious (Bargh & Morsella, 2008).

Our finding supports a strong literature demonstrating that such goal-related effects are mediated unconsciously. It is well-established that goals, once activated, can influence behavior unconsciously (Bargh, 1990) and can in the same implicit manner determine that which enters consciousness (Morsella, Hoover, & Bargh, in press). In addition, goals can unconsciously suppress competing goals (Kruglanski & Kopetz, 2009). In several important ways, these goal-related effects are distinct from those involving the priming of knowledge (see review in Förster et al., 2007). For instance, unlike semantic priming, goal-related activation is inhibited after a goal is obtained (Förster, Liberman, & Higgins 2005).

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OBSERVATIONS FOR FUTURE RESEARCH

In the *motivational inference model* (MIMO; Förster & Liberman, 2004), one uses the effort involved in suppressing intrusive cognitions as information—information regarding how much one would like to perform the activity associated with the intrusive cognition. For example, if one finds it difficult to stop thinking about unhealthy foods such as cake, candy, and soda, then one may conclude that one really wants to consume the foods. According to MIMO, it is this inference that is critical for the increased activation and accessibility of thoughts about unhealthy foods, thoughts which remain highly activated until the motivation is fulfilled. This framework is unique in explaining why, absent such an inference, no ironic or rebound effects arise (Förster & Liberman, 2001). From this standpoint, it could be hypothesized that in our paradigm, because of the activation of the goal to generate state names, experimental participants not only experienced intrusive cogni-

tions about geography but may have also inferred that they felt the desire or "itch" (Förster & Liberman, 2004, p. 8) to perform the state generation task. Moreover, because no such effects were found for the letter counting condition, it seems that ironic effects are modulated, not only by the perceived difficulty of the future event (or of suppressing cognitions), but by the ability to prepare for the future event. In other words, the effect is found with tasks that prime goals requiring planful striving (e.g., the state generation task) and not with tasks that do not require such striving (e.g., the letter counting task). In this vein, our finding is consistent with the everyday observation that the spontaneous thoughts of the night are usually about unresolved issues and matters requiring cognitive resources (Klinger et al., 1980) and are seldom about future tasks not requiring much mental preparation, such as driving to work or carrying out other routinized tasks, though the latter account for the largest proportion of the human behavioral repertoire (cf., Wood, Quinn, & Kashy, 2002). (See Bernsten & Jacobsen, 2007, for a diary study about intrusive cognitions that are future-looking and past-looking.)

Apart from providing additional, basic evidence in favor of the notion of the prospective brain (Schacter & Addis, 2007) and illuminating rudimentary aspects of the relationship between thought and action, this finding may have implications for our understanding of the basic mechanisms in psychopathological states/conditions such as rumination, self-regulation failure (Wegner, 1994), and obsessive-compulsive disorder, where intrusive cognitions play a prominent and debilitating role (Clark, 2005; Nolen-Hoeksema, 1996; Reynolds & Brewin, 1998).

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